

TECHNOLOGY VISION 2020

# WE, THE POST-DIGITAL PEOPLE

Can your enterprise survive the tech-clash?

# Foreword

## From tech-clash to trust: organizations need to focus on value and values

In a world where digital is everywhere, people's interactions across society are changing. They are reevaluating their relationships with businesses and governments. They are rethinking their actions in a globally interconnected economy and seeking more sustainable products and services. And they are reexamining whether the value that enterprises deliver is fully aligned with their core values.

Technology is an intrinsic part of this process, to the point where it has become deeply embedded in how people work and live. Enterprises have furthered this reliance by weaving technologies into their product and service offerings and how they are delivered to customers.

But the existing business and technology models that organizations have used for years are under increasing scrutiny. Despite broadly using and benefitting from technology, people are expressing concerns about how it is used and what it is used for. And they are advocating for change.

The message? **In the future, people don't just want more technology in our products and services; we want technology that is more human.**

Enterprises that ignore this message will face an existential tech-clash, in which today's models are incongruous with people's needs and expectations. To avoid this impending crisis, companies must reexamine their fundamental business and technology models in a responsible way—to create a new basis for competition and growth.

Trust and accountability are the new litmus tests for businesses in a world where digital is everywhere. Creating a more inclusive future that is better for all people is the new mindset. Success will require an innovative approach to innovation itself.

The theme of our Accenture Technology Vision this year—We, the Post-Digital People—describes what is happening now and outlines new ways for enterprises to build a better, human-centered future. Once again, technology is the catalyst to steer the realignment. Companies that take the lead with a shared-success mindset—and invite collaboration with customers, employees, ecosystem partners, governments and the public—will create new opportunities for growth in a way that benefits all.

This year marks the 20th anniversary of our Tech Vision, and we are proud to share it as part of Accenture's deep commitment to your organization's ongoing success. We look forward to helping you think about what comes next, using these tech trend insights and pragmatic steps to drive tangible business value and widespread societal trust.



**Julie Sweet**  
Chief Executive Officer



**Paul Daugherty**  
Chief Technology &  
Innovation Officer

# Contents

4

## Introduction

- 4 We, the Post-Digital people
- 8 People are changing. Why aren't you?
- 12 Leaving the roadmap behind
- 15 Building a foundation of trust
- 17 2020 Tech Trends
- 19 Completing the picture

22

## Trend 1: The I in Experience

Helping people choose their own adventure

44

## Trend 2: AI and Me

Reimagine the business through human and AI collaboration

64

## Trend 3: The Dilemma of Smart Things

Overcome the “beta burden”

86

## Trend 4: Robots in the Wild

Growing the enterprise’s reach — and responsibility

108

## Trend 5: Innovation DNA

Create an engine for continuous innovation

128

## About the Technology Vision

132

## References



## **We, the Post-Digital people**

**People's love for technology has let businesses weave it—and themselves—into our lives, transforming the way we work, live and interact with the world. But that unconditional love is starting to fray, and it's increasingly clear that the approaches companies took to reach this point won't take them any further.**



Even as people’s expectations for their future with technology continue to grow, many enterprises’ attempts to deliver on those expectations are being rejected. Companies need to build a new path forward, developing new models that bring a human focus.

Imagine a world with seamless, secure and personalized healthcare. Wearables give doctors instant access to patients’ real-time and past vital signs. Digital healthcare records automatically incorporate results and notes from different providers, with no delayed requests for records or decisions made on incomplete information. All the while, artificial intelligence (AI)-powered machines use these records to make preventative recommendations.

Companies already aspire to this type of human-centered experience. But even though the technology exists to build it, implementation remains out of reach. Models that companies have been relying on for decades are becoming roadblocks. Closed ecosystem models mean different levels of technology access and different standards, creating obstacles to smooth experiences. Application-centered data models create fragmented, even conflicting, data about patients, while innumerable go-betweens, regulators and gatekeepers can often add friction—not value—to the experience. Meanwhile, concerns about security, privacy and ethical issues keep patients and providers alike wary of new technological solutions.





## This is a conundrum playing out across all industries

The promise of a world made better and easier by technology is being trapped behind models, architectures and governing structures that have not realized their full potential nor created adequate value—leaving companies out of sync with people’s needs and expectations.

Despite this tension, businesses aren’t slowing down with their agendas; in fact, many are unknowingly speeding toward technological deadlock. They’re poised to flood the world with purportedly smarter products and services like intelligent assistants and immersive experiences—offerings that hold deeply transformative potential for both people and the enterprise. But enterprises are embedding digital everywhere just as customers and governments are bringing more scrutiny to the role technology plays in their lives. With technology as the foundation of the enterprise, leaders need to update their models and bring business value in line with people’s values, or future innovations stand to be rejected and fail.

Enterprises are facing their next big challenge. Up until now, businesses have largely benefited from following the technology roadmap laid out by digital pioneers. Now, digital technology is evolving from an advantage to a basic expectation—and yesterday’s best practices are turning into today’s shortcomings. To grow and compete, enterprises will need to revisit their fundamental models of business and technology, rebuilding them to align better with people today.

**Enterprises are facing their next big challenge. Up until now, businesses have largely benefited from following the technology roadmap laid out by digital pioneers.**



Every business assumption and entrenched approach is up for review and reinvention toward people-centric models. Companies must reengineer the experiences that bring people and technology together; they must raise questions about the democratization of data and technology, and they must reevaluate the application and value of intelligence—what technology is providing for people, and the ways it's changing people in the process.

This reimagining of the enterprise offers tremendous opportunity to those that take the lead. In every industry, companies' current successes are happening in spite of their foundations, not because of them. When leaders successfully rebuild their technology models to deliver the human focus they've lost, they will be poised to do far more than meet expectations. They'll set the new standard that every competitor—in every industry—will be forced to try to meet.

Getting there is the greatest challenge the C-suite will face during the next decade. The success of the next generation of products and services will rest on companies' ability to elevate the human experience. None of the steps on the journey are incremental changes, nor are they as simple as finding the next technological tool to do what you're already doing today. Leading in the future will demand rethinking core assumptions about how an enterprise works and redefining the intersection between people and technology.

**Leading in the future  
will demand rethinking  
core assumptions about  
how an enterprise  
works and redefining  
the intersection  
between people  
and technology.**



# People are changing. Why aren't you?

**To move forward, enterprises must first acknowledge the essential role technology plays in people's lives today, and how that relationship is changing.**

The reason that the increasingly strong and symbiotic connection between people and technology is meeting resistance is not because technology has ceased to be valuable. It's because enterprises have not yet re-oriented to just how meaningfully people treat technology today.





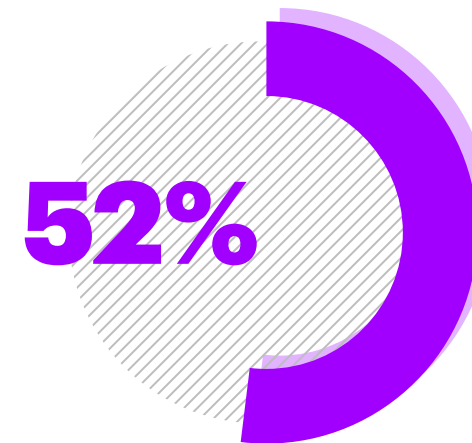
## In retrospect, this isn't surprising

Just 20 years ago, digital access was limited by dial-up connections and desktop PCs, and individuals remained predominantly anonymous online. Tools like e-mail, forums and e-commerce were more efficient or far-reaching than analog counterparts, but hardly vital to people's existence. Companies didn't need to closely consider the impact of technology in their customers' lives; our digital lives were distinctly separate from our "real" ones.

It's hard to find that kind of separation today as technology has become an inextricable part of the human experience. More than half the world's population—a whopping 4.5 billion people—have access to the internet.<sup>1</sup> People are ever-connected on every type of device, globally spending an average of 6.4 hours online daily.<sup>2</sup> Even distinctions about "screen-time" are becoming an obsolete way to look at reality as technology permeates the physical world. Daimler is integrating intelligent voice control into its Mercedes-Benz vehicles, letting drivers ask their car questions about traffic, weather and more.<sup>3</sup> Samsung's digital assistant Bixby is interacting with people in their homes via the company's FamilyHub line of refrigerators.<sup>4</sup> And the last mile is becoming a thing of the past as companies like FedEx, Amazon and Postmates use robots and drones for delivery right to customers' doorsteps.<sup>5</sup>

Not only is technology a symbiotic part of people's lives, it's also being embedded in the building blocks of society. Take the evolution underway in education: China is investing \$30 billion in edtech by 2020 to ensure its 230 million K-12 students have access to individualized learning platforms.<sup>6,7</sup> In Indonesia, non-profit group Room to Read is closing the country's illiteracy gap by building an open-source platform that provides access to children's stories, literacy education videos and training videos for teachers.<sup>8,9</sup> And technology isn't just transforming how people learn, but also what they learn: bootcamps that teach coding and web development skills have grown 11x in the last six years.<sup>10</sup>

Given the starring role technology has in people's lives, it makes sense that we take technology personally—and why we expect so much more from it going forward. Just as many current models fail to account for the growing impact of technology, our unconditional love for unlimited technology is fading. Some are labelling today's environment a "tech-lash," or backlash against technology. But that description fails to account for the fact that we're using technology more than ever. Rather, it's a tech-*clash*—a collision between old models that are incongruous with people's current expectations.



**of consumers say that technology plays a prominent role or is ingrained into almost all aspects of their day-to-day lives. An additional 19% report that technology is so intertwined with all aspects of their day-to-day lives that they view it as an extension of themselves.**



**Some are labelling today's environment a "tech-lash," or backlash against technology. But that description fails to account for the fact that we're using technology more than ever. Rather, it's a *tech-clash*—a collision between old models that are incongruous with people's current expectations.**



Smart products are appearing everywhere, but businesses create walled gardens around them, turning a world of unprecedented choice and customization into one of ecosystem lock-in. Privacy and security concerns around the troves of valuable data people produce lead to hesitation and distrust. AI is being applied to bigger challenges, but is still largely focused on automation, leading people to worry about losing their livelihoods.

And the issues leading to tech-clash are changing constantly as technology becomes ever more prominent in people's lives. AI systems today are being used to decide whether a job candidate should proceed to an interview or recommend whether criminal defendants should be allowed to post bail.<sup>11</sup> As the capabilities of AI-driven systems have grown beyond automating boring or repetitive tasks, to making decisions that directly impact people's lives, the fact that many of these systems are still "black-box" leaves people skeptical about the fairness and effectiveness of the algorithms.<sup>12</sup>

This deadlock must be broken, or the progress of the last 20 years will grind to a halt. Governments from the European Union, United States, Brazil and other countries are attempting to ease the burden by creating new rules, guidelines and practices.<sup>13, 14, 15</sup> But lawmakers are limited to addressing or changing existing models—not building new ones. The true path to solving the tech-clash rests in the domain of the enterprise, driven through what products and services companies build and how they offer them to customers, employees and ecosystem partners.

For people to accept the flurry of new product and service innovations that companies are eager to introduce, a major reckoning must take place. Companies must synchronize the business and technology models that drive enterprise value with people's evolving expectations.





# Leaving the roadmap behind

**With the roadmaps of the past two decades, companies successfully wove technology throughout the business, but tech-clash makes these blueprints irrelevant going forward.**

What does that mean for enterprises? There's no defined path left to follow. Everyone is working from the same blank slate, but that doesn't mean they're working with nothing. There's a larger guiding light: companies should look to people's core values to see how success could take shape.

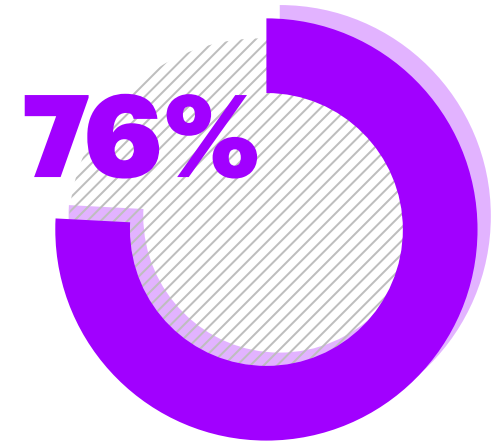


Businesses must challenge existing models to create something wholly new. Inventing a better, human-centered future for people requires a virtuous circle of trust, data and deeper experiences.

Consider just one of the challenges today's models create. People's information—whether medical, shopping or other data—is generated, stored, shared, accessed and controlled by the companies and ecosystems with which they do business, and sometimes even by businesses with whom they have no direct relationship. As these ecosystems grew to provide expansive personalization and valuable services, companies were relied on to steward more data and manage increasingly complex relationships. But now customers are growing hungry for more input on how their data is used, and many businesses lack the mechanisms needed to provide that engagement. In this absence, customers can grow wary of businesses and potentially distrust them too. Governments, sensing that distrust, are looking to impose consumer access and control requirements on personal data.

But where people's expectations are outgrowing today's standards, disruptors see the beacon of opportunity. One company introducing a new model for this relationship is Inrupt, a startup founded by Tim Berners-Lee (the originator of the world wide web) and a business partner to scale a data-linking architecture called Solid.<sup>16</sup>

The Solid movement emphasizes trust. Individuals' data is stored and used across the web through "pods," which can contain personally identifiable information, financial records, contact lists, content subscriptions and more—but people can decide where their personal data is hosted and determine which companies or machines can access their pods. They can also revoke that access at any time and even delete all their information with a click of a button. It's the beginning of a new kind of platform that gives people more agency and builds clear lines of sight for companies about how to best engage with customers.



**of executives agree that organizations need to dramatically reengineer the experiences that bring technology and people together in a more human-centric manner.**



## Opportunities are knocking

These new models represent new ways to unlock value for both customers and enterprises alike. For instance, the Known Traveller Digital Identity (KTDI) program, a World Economic Forum initiative to deliver a better travel experience by shifting the paradigm on how data is shared through the ecosystem.<sup>17</sup> The blockchain-based solution encrypts an individual traveler's critical identity data, like passport information, and stores it on the traveler's own personal mobile device. With the old model, a traveler's personal data is taken and stored by a different entity every time the person goes through passport control, buys an airline ticket or books a hotel room. With KTDI, the traveler alone can determine who gets what access and when—fundamentally placing the human at the center of the ecosystem. With data access being revoked when the transaction is completed, the system maximizes efficiency and mitigates security risks for all parties.

There are opportunities to reimagine models across all dimensions of technology. Microsoft is redesigning experiences and rethinking interoperability models to meet customers' new expectations. The company announced its Xbox One entertainment system would start supporting Amazon's Alexa and Google Assistant—a departure from the ecosystem playbook of the past, where technology and standards were used to push customer choice in a particular direction.<sup>18</sup> Rather, Microsoft is respecting individual consumer's preferences and ecosystem choices, setting themselves on a new path for success.

And with technologies increasingly able to have a physical impact in our lives, trust is among the important guiding lights in developing new models of operation. Look at autonomous vehicles. These cars use a wide array of sensors and AI to "see" the world around them, but people are already aware of close calls during test situations and, in one case, a pedestrian fatality, giving rise to serious concerns and

distrust around autonomous technology. Volvo and Perceptive Automata are working together to build safer autonomous vehicles by pairing computer vision with behavioral science and neuroscience to understand the intention and awareness of pedestrians.<sup>19, 20, 21</sup> By teaching autonomous vehicles about human intuition and why people might act the way they do, the companies are making it safer for these vehicles to operate on busy streets.

As a variety of technology models hit their breaking point, they herald a bigger shift that enterprises in every industry must note: people will no longer be bystanders when it comes to technology. Whether it's security standards misaligned with today's interconnected ecosystems, bad actors leveraging the content neutrality of social platforms to amplify misinformation, or government regulations that are years behind the technology itself, expectations are not being met—and the resulting tech-clash demands action.



# Building a foundation of trust

**Diffusing tech-clash begins with new models, but it's imperative for companies to adopt a broader perspective.**

Disruptive technology opened the door for enterprises to take a deeper and more influential position in shaping the world. With impact that now resonates beyond customers and employees alone, every business must hold itself accountable for its role across society. Failure to acknowledge this growing impact will push people to reject even the best of intentions as trust becomes currency in an era where digital is everywhere.



Microsoft is embracing a model of accountability that goes far beyond its products or customers. Responding to the impact the tech boom is having on Seattle's housing prices, the company pledged \$500 million to build affordable housing in the city.<sup>22</sup> Similarly, as Microsoft has researched and developed more advanced technology, it has strived for responsible innovation. Most notably, the company built an ethical framework to guide its development of AI and backed state legislation around proper use of facial recognition technology.<sup>23,24</sup>

Businesses across all industries are also beginning to acknowledge that they have a responsibility to a larger range of stakeholders. In 2019, chief executives of nearly 200 major companies, including Accenture, signed a letter indicating this shift: that shareholder value should not be the only metric of success. The signatories took a more holistic approach, pledging to expand investments in employees, protect the environment and work ethically with supply chain providers.<sup>25</sup>

Business leaders must adapt for the world they've created. Sticking with yesterday's models isn't just a risk around annoyed customers or disengaged employees; it's a permanently limited potential for future innovation and growth. But it doesn't have to be this way. Tech-clash is a challenge waiting to be solved: people still love technology. The enterprises that find a way to deliver it in line with people's expectations will blaze the trail for everyone else.

Is your company ready to deliver human-centered experiences?  
The world is ready for you.

**The enterprises that find a way to deliver it in line with people's expectations will blaze the trail for everyone else.**





## 2020 Tech Trends

**To truly bring a human touch to the next decade, the new models that enterprises build must be rooted in collaboration. As technology's level of impact grows ever higher throughout society, successful businesses will be those that use new models to invite people—customers, employees, partners or the public—to co-create their new course for the future.**



## Our five tech trends this year:



### The I in Experience

#### Helping people choose their own adventure

Redesign digital experiences with new models that amplify personal agency. Turn passive audiences into active participants by transforming one-way experiences into true collaborations.



### AI and Me

#### Reimagine the business through human and AI collaboration

Take a new approach that uses artificial intelligence to bring out the full power of people. Move beyond deploying AI for automation alone and push into the new frontier of co-creation between people and machines.



### The Dilemma of Smart Things

#### Overcome the “beta burden”

Address the new reality of product ownership in the era of “forever beta.” Transform pain points into an opportunity to create an unprecedented level of business-customer partnership.



### Robots in the Wild

#### Growing the enterprise’s reach—and responsibility

Build new models of interaction and impact as robotics move beyond the walls of the enterprise. Companies in every industry will unlock new opportunities by introducing robots to the next frontier: the open world.



### Innovation DNA

#### Create an engine for continuous innovation

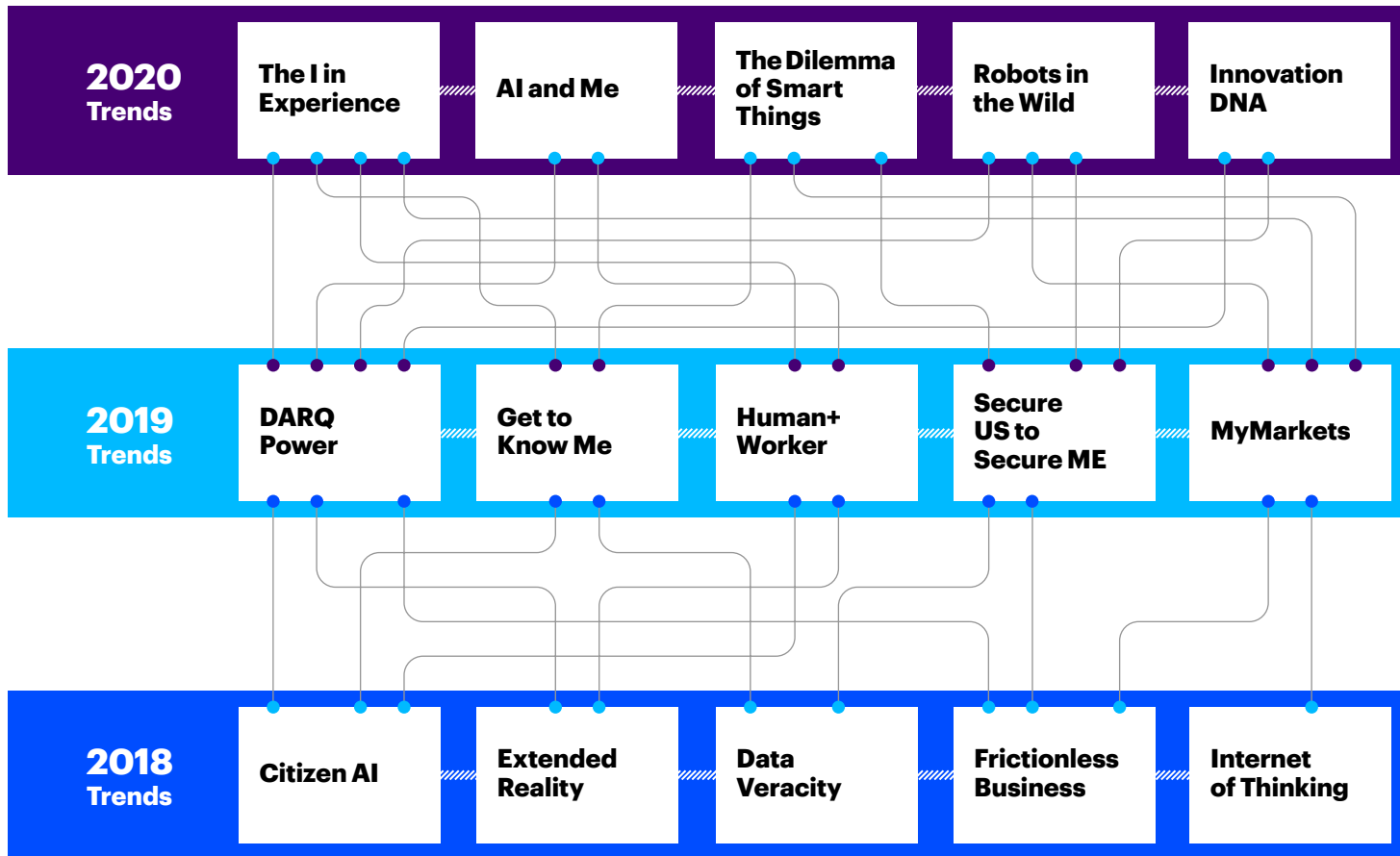
Tap into the unprecedented scale of disruptive technology available today. Build the capabilities and ecosystem partnerships necessary to assemble the organization’s unique innovation DNA.



# Completing the picture

Accenture's Technology Vision report comprises a three-year set of technology trends, currently including trends from 2019 and 2018.

It's important to recognize that each year's trends are part of a bigger picture. Tracking how they evolve over time offers a glimpse into how they may continue to grow in the future.





# 2019 Trends

## DARQ POWER

### Understanding the DNA of DARQ

New technologies are catalysts for change, offering businesses extraordinary new capabilities. Distributed ledger technology, artificial intelligence, extended reality, and quantum computing will be the next set of new technologies to spark a step change, letting businesses reimagine entire industries.

## GET TO KNOW ME

### Unlock unique customers and unique opportunities

Technology-driven interactions are creating an expanding technology identity for every consumer. This living foundation of knowledge will be key to not only understanding the next generation of consumers, but also to delivering rich, individualized, experience-based relationships in the post-digital age.

## HUMAN+ WORKER

### Change the workplace or hinder the workforce

Workforces are becoming human+: each individual is empowered by their skillsets and knowledge plus a new, constantly growing set of capabilities made possible through technology. Now, companies must adapt the technology strategies that successfully created this next generation workforce to support a new way of working in the post-digital age.

## SECURE US TO SECURE ME

### Enterprises are not victims, they're vectors

While ecosystem-driven business depends on interconnectedness, those connections increase companies' exposures to risks. Leading businesses are recognizing that just as they already collaborate with entire ecosystems to deliver best-in-class products, services and experiences, it's time security joins that effort as well.

## MYMARKETS

### Meet consumers' needs at the speed of now

Technology is creating a world of intensely customized and on-demand experiences, and companies must reinvent their organizations to find and capture those opportunities as they come. That means viewing each opportunity as if it's an individual market—a momentary market.



# 2018 Trends

## CITIZEN AI

### Raising AI to Benefit Business and Society

As artificial intelligence grows in its capabilities—and its impact on people’s lives—businesses must move to “raise” their AIs to act as responsible, productive members of society.

## EXTENDED REALITY

### The End of Distance

Virtual and augmented reality technologies are removing the distance to people, information and experiences, transforming the ways people live and work.

## DATA VERACITY

### The Importance of Trust

By transforming themselves to run on data, businesses have created a new kind of vulnerability: inaccurate, manipulated and biased data that leads to corrupted business insights, and skewed decisions with a major impact on society.

## FRICTIONLESS BUSINESS

### Built to Partner at Scale

Businesses depend on technology-based partnerships for growth, but their own legacy systems aren’t designed to support partnerships at scale. To fully power the connected Intelligent Enterprise, companies must first rearchitect themselves.

## INTERNET OF THINKING

### Creating Intelligent Distributed Systems

Businesses are making big bets on intelligent environments via robotics, AI and immersive experiences. But to bring these intelligent environments to life, they must extend their infrastructures into the dynamic, real-world environments they want to reach.

Trend 1: The I in Experience

# Helping people choose their own adventure



**1**

The I in Experience

2

3

4

5

**Redesign digital experiences with new models that amplify personal agency. Turn passive audiences into active participants by transforming one-way experiences into true collaborations.**

**1**

The I in Experience

2

3

4

5

**In Netflix's *Black Mirror: Bandersnatch*, viewers make decisions for the main character—listen to this song, throw that cup of tea, bury the body. It's an interactive choose-your-own-adventure episode of the larger sci-fi series, with five possible endings and millions of ways to get there.<sup>1,2</sup>**

Audience feedback was so positive that Netflix announced it would develop two new interactive shows.<sup>3,4</sup> And it's not the only one. YouTube, which has experimented with interactive advertising, started developing a choose-your-own-adventure original series.<sup>5</sup> Audible released interactive audiobooks for kids, prompting them to participate via their Amazon Echo devices.<sup>6</sup> The BBC decided to celebrate the 1,000th episode of its technology news show "Click" with a branching narrative, personalized and localized for individual viewers.<sup>7</sup>

This may seem like an entertainment industry fad, but it reflects a growing opportunity for businesses of all kinds: building cooperative experiences. These cooperative experiences are the next generation of business offerings, where enterprises are becoming collaborative partners in experience creation, not just providers of it—ultimately transforming their relationships with customers.





**1****The I in Experience****2****3****4****5**

Take McDonald's, which is introducing a cooperative element by giving employees more control over their workplace experience. The company is rolling out digital ordering kiosks in its drive-thrus across the US, featuring personalized menus and recommendations based on weather, time of day, trending menu items and customers' past purchases.<sup>8,9,10</sup> But rather than prescribe the menu based on centralized data, employees are given the freedom to change menu displays based on local circumstances. They can use live traffic data and observational insights to identify peak times, and switch the menu recommendations to promote simpler items, easing the burden on employees and restaurant operations.

This might seem like typical customization at first glance. But what McDonald's does differently is make the individual—in this case the employee—an active and necessary contributor to the experience. It's a powerful shift from the norm. Throughout the digital age, companies have built customization

and technology services on top of their offerings, adding immense value to the customer experience. However, this has increasingly committed companies to the same limited path: inadvertently taking control away from people in the name of greater curation. Now, enterprises are dealing with a major side effect. While customization can create powerful and beneficial experiences, it can also frustrate people with unintended results.

For instance, researchers at Harvard's Berkman Klein Center found that the personalized recommendation system of a popular video streaming platform was leading viewers to increasingly radical content, contributing to the rise of conspiracy theories and spread of misinformation.<sup>11</sup> In response to this unintended consequence, the platform added new features explaining why viewers see certain recommendations and giving them more control over the experience.<sup>12</sup>





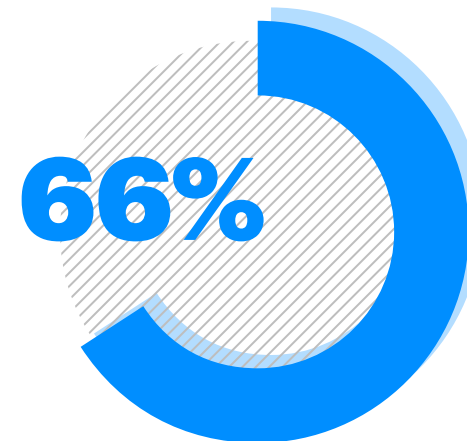
## Aging customization models are the root of the problem

Businesses have built robust data gathering and analytics practices, which largely operate behind the scenes to determine what customers want and deliver targeted personalization. But as businesses expand their experience delivery and customization capabilities, those behind-the-scenes techniques are inadvertently, but increasingly, pushing customers out of the equation, leading them to feel out of the feedback loop to choose their own experiences.

What's more, discomfort with the results of customization is only part of the issue. People are also growing concerned about some of the methods businesses use to get there. Recent security breaches and increased scrutiny have contributed to mistrust in data gathering practices and deteriorating attitudes toward black-box personalization. In RSA Security's Data Privacy & Security Survey for 2019,

only 17 percent of respondents said they thought personalized ads were ethical, and only 24 percent said personalizing newsfeeds is ethical.<sup>13</sup>

Demand is shifting. People want customized experiences, but they don't want their experiences overly determined for them without their knowledge. Customers are asking enterprises to be their partners: working with them to create experiences, helping them reach their goals and giving them the option to change the experience when companies get it wrong. For businesses, this is an exciting new opportunity. More than just creating a personalized touchpoint for their consumers, they can begin building long-term partnerships and fostering customer loyalty. But it means sharing control and power in the relationship. It's a new model—cooperative experiences—and it's based around customer agency.



**Two-thirds of consumers (66%) report they are just as concerned about the commercial use of their personal data and online identity for personalization purposes as they are about security threats and hackers.**

**1****The I in Experience**

2

3

4

5

Giving customers agency—the ability to make relevant choices that inform their experiences—will turn passive audiences into active participants, increase engagement and let businesses sidestep many of the hurdles that are holding back their customization initiatives. It will transform experience delivery from one-way streets to dynamic and responsive collaborations.

Consider how the dating app Tinder is increasing engagement and helping people connect with potential dates by introducing customized experiences into its platform. Rather than collecting more information and heightening behind-the-scenes customization efforts, the company released a choose-your-own-adventure series, called “Swipe Night,” that required participation.<sup>14,15,16</sup> Each five-minute episode was released at 6pm local time on a Sunday night and

was available for just six hours. People swiped to make choices and advance the plot, and could then display those choices on their profiles, which provided an opportunity to match with other participants. On top of delivering a new, engaging and non-invasive way to connect and start conversations, time-boxing the experience encouraged people to use the app at the same time, with the intention to help conversations and matches move faster.

**Giving customers agency—the ability to make relevant choices that inform their experiences—will turn passive audiences into active participants.**

**1**

The I in Experience

2

3

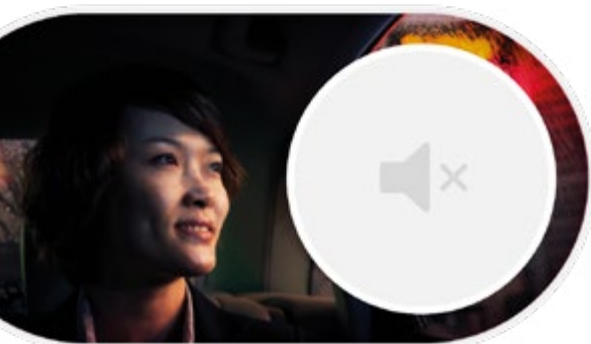
4

5

## Businesses are now at a pivotal point for their long-term strategy



Cooperative experiences promise incredible value to companies that can push them across customers' everyday lives. But to do so successfully, companies need to take on a new role—shifting the focus from simply making sales or providing entertainment, to how they can best utilize customer input, guidelines and choices. They're still providing experiences, but now customizing those experiences effectively means understanding when to make the process seamless and invisible for customers, and when to step back and give individuals control. The new imperative for enterprises is to reposition themselves from an administrator to an enabler and a guide.



For instance, Steam Labs, a section of video game developer Valve, is experimenting with a new kind of game recommendation system.<sup>17</sup> The company's interactive approach starts traditionally, basing recommendations on customers' playtime history, but also incorporates how players feel in the moment. Customers use sliders to help generate recommendations in line with their current interests—like more indie games or newer releases. Just one month after launch, Valve said the recommender was so far performing very well, with people adding nearly 10,000 different games to their wish lists from the Interactive Recommender page.<sup>18</sup>

Meanwhile, Uber is ramping up its effort to give riders more control over the in-car aspect of the Uber experience. In May 2019, the company added a "quiet preferred" option to its luxury Uber Black and Uber SUV rides, allowing passengers to avoid unwanted small talk.<sup>19</sup> Later in the year, the company expanded that strategy to more riders, launching Uber Comfort, a new option that features a slew of customer preference choices—including quiet mode and temperature controls.<sup>20</sup>

Companies like Tinder, Valve and Uber are not just gaining immediate value from their cooperative experiences, they're setting themselves up for future success. As emerging technologies like 5G and augmented reality (AR) become widespread, their impact on experience delivery will make balancing curation with customer agency even more critical. AR will let businesses customize people's visual environment, moving experience delivery outside of screens and into the world. And as 5G networks roll out globally, they will enable an explosion of new interactions and channels in the physical world, making experience delivery possible nearly everywhere.

**1**

The I in Experience

2

3

4

5

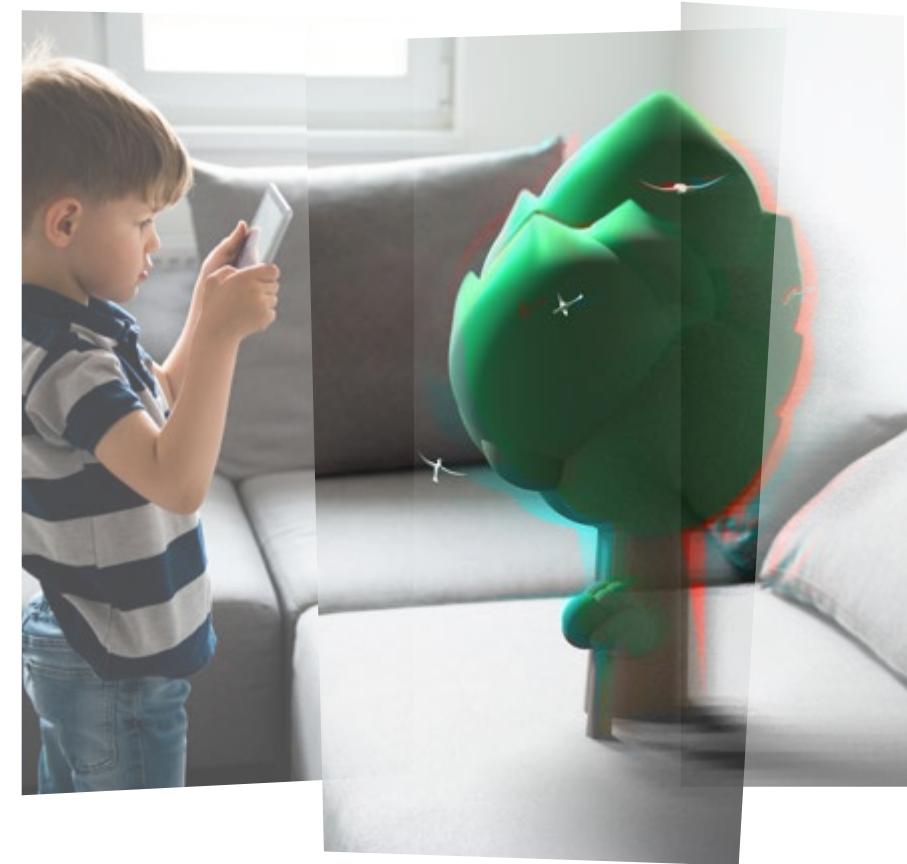
## But as businesses' reach grows, so does the risk of overstepping customers' boundaries

Consider how Huawei is using these technologies to change what people see as they navigate daily life. Its "Cyberverse" technology integrates AR with physical reality, using spatial computing, 3D and ultra-high definition maps, ultra-realistic immersive rendering and 5G to build AR map overlays that people can view through their mobile devices.<sup>21</sup> Apple is also exploring AR experience customization through art by offering a series called [AR]T in cities around the world. The experience includes a walking tour to view professional AR art around the city, as well as an in-store session to learn how to create AR art.<sup>22</sup>

The combined impact of AR and 5G will let businesses customize people's experiences throughout their lives, anywhere and anytime. But with today's growing wariness around overly

curated experiences, successfully doing so isn't just a matter of deploying new technologies. If enterprises jump on this opportunity without rethinking their customization model, the chasm between what they're delivering and what customers want will grow, and pushback will be fierce. If, instead, businesses shift their techniques—enabling cooperative experiences rather than black-box customization—the potential value is huge.

The enterprises exploring cooperative experiences today are launching a new generation of customization, fit for future capabilities and expectations. Those wanting to keep up, and stay competitive and relevant, will need to start building reputations as companies that amplify customers through curated experiences, rather than marginalizing them.





## Become a true partner to your customers

Although many of the technologies that will truly revolutionize experience delivery—like AR and 5G—are still in early stages, there are others that can help businesses get started. For instance, many are already investing in machine learning to build recommendation systems. These systems have traditionally left little room for customer input or to escape echo chambers; however, the technology can be repurposed to enable customer agency. THE.FIT, a menu personalization engine, uses artificial intelligence (AI) to help restaurants collaborate with customers to customize menus for their specific dietary restrictions, no matter how complex. Customers can scan a quick response (QR) code with their phones, choose all their dietary needs or preferences and receive a personally tailored mobile menu.<sup>23</sup>

No-code development platforms—drag-and-drop interfaces that anyone, technical or not, can use to create custom apps—can also be adapted to help deliver cooperative experiences. These platforms can boost productivity within organizations,

helping them create the large volumes of content needed to offer customers more experience customization options. Turned external, they can help customers design and personalize apps or experiences themselves.<sup>24</sup> Amazon Sumerian lets people build their own AR, virtual reality (VR) or 3D applications without any programming or 3D graphics expertise. Anyone with Sumerian can build immersive environments and experiences, like classrooms or building tours, and can populate them with 3D objects and animated characters.<sup>25</sup>

Choose-your-own-adventure stories, customization with live user input and tools that let people design their own experiences are all ways that businesses are embracing cooperative experiences. It's a major shift away from how enterprises have operated in the past, but a necessary one. While there is incredible value to be gained from curated experiences, businesses will only access it if they redesign their customization models to emphasize personal agency. Becoming a true partner to customers will be a defining aspect of enterprises' future.



**of executives agree that to compete in a post-digital world, organizations need to elevate their relationships with customers as partners.**

**1**

The I in Experience

**2****3****4****5**

# Big Takeaways

## Personalizing experiences

Providing immersive and meaningful digital experiences is how leading businesses are connecting with their customers. But as demand for customized experiences grows, people are becoming increasingly wary of the methods enterprises use to provide it.

## The need for agency

As customers demand more ownership over their digital experiences, enterprises must find ways to provide individuals with more agency and make them co-creators of their experiences. Those that do will find more active, engaged and loyal customers.

## Setting up future success

Emerging technologies like 5G and AR have the potential to make experience customization ubiquitous across people's lives. But that future will be unachievable if people continue to feel out of the loop. Leaders that explore new avenues to include customer agency today will be laying the foundation for long-term success.

**1**

The I in Experience

**2****3****4****5**

#TECHVISION2020

Deep Dive

# Keep up with regulations by giving customers choice

**In today's rapidly evolving data privacy landscape, leaders are using their new efforts in customer agency to help them remain compliant.**

The workplace communication tool, Slack, has traditionally stored all customers' data in the US, but in 2019 announced it would add data residency controls to its platform and let people choose where their data is stored. Slack adopted this change in light of emerging privacy laws that would complicate its existing practice. Under the European Union's General Data Protection

Regulation (GDPR), for example, companies based in the EU may only export data outside of the European economic area if the receiving country or organization maintains similar data privacy standards. While Slack is GDPR-compliant today, data residency will help the company—and organizations that use the Slack software—stay that way, even if regulations change.<sup>26</sup>





## This flexibility is increasingly critical

Any company with global ambitions risks being overwhelmed as new regulations emerge around the world. The implementation of GDPR alone sent businesses scrambling. After a two-year delay in enforcement, more than 60 percent of companies said they still didn't expect to be fully compliant by the May 2018 deadline.<sup>27</sup> One year later, the EU had fined organizations around the world millions for non-compliance.<sup>28</sup> A major airline was issued a £183,000,000 fine over an incident that compromised customer data; a hospital in the Netherlands was fined over lax controls regarding access to patient data; and a school in Sweden was fined after trialing a facial recognition system to take attendance.<sup>29,30</sup>

And new data privacy laws are expected to make things even tougher. The California Consumer Privacy Act, effective January 2020 and enforceable in July 2020, will bring another wave of stricter regulations. The law gives residents

of the state the right not only to access their data, but also to control and delete it.<sup>31</sup> And Brazil's privacy law, *Lei Geral de Proteção de Dados Pessoais* (LGPD), is slated to go into effect in August 2020. While similar to GDPR, the amount of time companies are given to respond to individuals' requests will be shorter, and the definition of "personal information" is broader.<sup>32</sup>

Organizations can't afford to be set back by each new regulation, especially at the speed these laws are going into effect. Like Slack, businesses will need to build flexibility and transparency into their data collection and storage practices, prioritizing their ability to make changes quickly and easily.

Google demonstrates another way that increasing customer agency can help businesses balance regulation compliance with business goals. The company is offering customers auto-delete controls: Google still uses location data and web

and app activity to make its products more useful to individual customers, but customers can set time limits on how long that data can be used after it is generated.<sup>33</sup> While it's already possible to delete data manually, the auto-delete settings go a step further. Google is giving customers the option to manage their data on a constant and rolling basis—increasing their agency, not just over their data, but also in their relationship with the company.

Businesses like Slack and Google are setting themselves up to navigate a new reality—something every enterprise needs to do. Businesses in every industry must tread a fine line between delivering the products, services and experiences their customers want versus non-compliance with ever-changing regulation. Incorporating customer agency will help organizations maintain that balance, setting them on a new path toward regulation resilience.



# Why Now?

**Consumer demand is moving in two clear directions: increased desire for personalization and demand for experiences. But as customers grow distrustful of the techniques used to provide these experiences, businesses are hurtling toward a breaking point.**

**Customer preferences are shifting. The desire for customization continues to grow, and demand for experiences is beginning to eclipse demand for things.**

- | Eventbrite's research showed that the last 30 years have seen a 70 percent increase in the share of consumer spending on live experiences and events.<sup>34</sup> Millennials continue to drive this forward, as 72 percent said they would like to increase their spending on experiences rather than physical things in the next year.
- | Demand for personalization is high. In a survey by Adobe, 67 percent of consumers said it's important for companies to customize content automatically based on a person's current context. What's more, 42 percent said that unpersonalized content annoys them.<sup>35</sup>



## Public sentiment around customization hinges on agency and trust.

People feel a lack of agency over their experiences, and they're holding companies responsible. In a McAfee survey, 43 percent of respondents felt they lacked control over their personal data, and 33 percent weren't sure if they could control how companies collect it.<sup>36</sup>

When an individual lacks agency, personalization can feel like an overstep. In a 2019 survey, 77 percent of consumers said that they were uncomfortable when they noticed targeted online ads.<sup>37</sup> And a global survey from RSA Security found that just 17 percent of respondents thought personalized ads were ethical.<sup>38</sup>

Increasing distrust and discomfort affects consumer behavior, which negatively impacts business. In an Accenture survey, 58 percent of consumers said they would switch half or more of their spending to a provider that excels at personalizing experiences without compromising trust.<sup>39</sup>

## Rapidly maturing technologies are expanding businesses' experience customization capabilities, making the balance between customization and consumer choice increasingly critical.

Immersive technologies like AR and VR are already being adopted by consumers today. An eMarketer report estimated that 68.7 million people in the US used AR at least monthly in 2019. By 2021, the report forecasts that number will go up to 85 million.<sup>40</sup>

Enterprise spending on extended reality (XR) also shows no signs of slowing down. According to IDC, worldwide spending on AR and VR is expected to pass \$18 billion in 2020—a 78.5% increase over 2019—and will reach \$160 billion by 2023.<sup>41,42</sup>

5G networks are expected to enable faster and more interconnected networks of people and devices, and the opportunities are growing quickly. The 5G infrastructure market is expected to rise at a compound annual growth rate (CAGR) of 76 percent between 2018-2026, according to Fortune Business Insights.<sup>43</sup>

# Survey Stories

## Striking a balance with personalization

# 70%

of consumers agree:

**I am concerned about data privacy and commercial tracking associated with my online activities, behaviors, location and interests.**

# 66%

of consumers agree:

**I am just as concerned about the commercial use of my personal data and online identity for personalization purposes as I am about security threats and hackers.**

### By Generation



■ Concerned about data privacy and commercial tracking  
■ Concerned about the commercial use of my personal data

N=2,000 Global Consumers

**1****The I in Experience**

2

3

4

5

Personalization is undeniably becoming a key differentiator for enterprises across industries. Accenture's Technology Vision 2020 survey finds that 90 percent of businesses believe delivering highly personalized services is a top strategic priority. Within the retail sector alone, 96 percent of consumer electronics executives, 97 percent of health & beauty executives and 92 percent of travel industry executives all report a strong focus on personalization.

But while customers may be hungry for the benefits of personalization, they are starting to weigh them against the risks of data privacy and security. Sixty-six percent of consumer respondents are just as concerned about the commercial use of their personal data and online identity for personalization purposes as they are about security threats and hackers. Seventy percent of consumer respondents are concerned about data privacy and commercial tracking associated with their online activity, behavior, location, and interests.

Beyond data privacy alone, there is emerging concern that personalization efforts are trapping people in bubbles—both group and individual echo chambers. Nearly half of consumers believe personalization has a major risk of cutting off people from new ideas and experiences. These concerns will only grow as enterprises continue along the same path of personalization without assuming additional responsibility and empathy with their customers.

As enterprises look to deliver personalized experiences in sync with the nuanced expectations of customers, new roles are emerging. Fifty-seven percent identify as a “guide” and 45 percent as a “coach,” indicating their ambition to push people outside of their comfort zones. Meanwhile 39 percent of companies identify as “order-takers,” demonstrating a more conservative approach to experience customization. What might your enterprise's role be in the future, and what are the implications and responsibility of that role?

**As enterprises look to deliver personalized experiences in sync with the nuanced expectations of customers, new roles are emerging.**

**1**

The I in Experience

**2****3****4****5**

Deep Dive

# How Epic Games is building a platform for cooperative experiences

**As enterprises begin to build cooperative experiences, where customer choice is abundant and expected, they don't have to start from scratch. Companies from every industry can apply the same technologies already used by leaders in the video game industry.**

Games have always relied on active participation to drive an experience. Early digital games had a starting point for a player and a finite set of endings, but the player chose how to get there. Modern gaming companies are moving into multiplayer open-ended experiences like Minecraft and Fortnite, where players build and create with one another. Games take the shape of an ongoing, ever-changing collaboration, and every session played is a unique, real-time social experience.

Epic Games' Fortnite is using Amazon Web Services' (AWS) cloud services to support experiences like these at an unprecedented scale. With more than 200 million players around the world, Fortnite is one of the world's most popular video games, and the experience is full of choices.<sup>44</sup>

**1****The I in Experience**

2

3

4

5

Games with 100 concurrent players take place across a dynamic map with ever-evolving features, where people can tailor their avatar's appearance and clothes. The game also hosts multiple different experiences, including one where a player competes with other players, another where players explore alongside their friends, and a version where the individual has command of the entire environment to create and construct maps.

Fortnite is able to support these experiences via Epic's strong technology base: the game was built through Epic's Unreal gaming engine and a wide variety of Amazon's cloud services, ultimately supporting a more than 100-fold growth of players in just one year.<sup>45</sup> Enterprises looking to co-create experiences at scale will need the elasticity and scalability benefits cloud provides to allow for massive spikes of concurrent customers. With its unique architecture, Epic can scale seamlessly to support, at times, more than eight million unique users.

With customers all having different experiences, it's critical for enterprises to bake in the capability to understand the quality of those experiences. Epic's robust analytics practice shows how to look beyond just what the experience is today, to how to transform constantly and improve over time.

The company's analytics pipeline streams gigabytes of data to the cloud, leveraging tools like Amazon Kinesis, Apache Spark and Tableau to capture (and make sense of) up to 40 GB of game data every minute. This data feeds into Epic's multi-terabyte databases, which developers can use to understand key insights like customer satisfaction, behaviors and engagement.<sup>46</sup>

Finally, companies will have to strategically on-board customers into these new experiences. With such a wide range of possibilities, people can be at a loss for where to get started. Epic is using AI to deliver sophisticated and tailored guidance to its customers. An October 2019 update to Fortnite included the introduction of AI-controlled bots to the game. The company discovered that new players were being eliminated too quickly

to enjoy the game and abandoning it altogether as their frustrations grew. By introducing AI companions of variable skill, the company gave new players a chance to learn, explore, train and ultimately fall in love with the experience.<sup>47</sup>

The path laid by gaming companies like Epic is not industry specific. Non-gaming enterprises are already starting to take the lessons learned, and the technology built, to drive new value for customers. The architecture firm HOK uses Epic's Unreal Engine, a gaming engine to showcase interactive designs to clients. The company uses the dynamic environment to give clients a more immersive look at proposals, aggregating content from multiple sources to introduce elements that make the world feel more real.<sup>48</sup> Finnish airline Finnair has also used the Unreal Engine to build a digital twin of the Helsinki Airport.<sup>49</sup> The company used this precise rendering to build VR experiences, such as situational awareness training for ground crews, and to familiarize airplane staff with cabin layouts and key functions.

**1**

The I in Experience

2

3

4

5

**As enterprises move to co-creating experiences with customers, they will be introduced to a new set of technology challenges. But forward-thinking leaders are already seeking out unexpected partnerships, like those in the gaming industry, and finding new ways to craft and guide their customers through dynamic, personalized experiences.**





# Decision Points

## To what extent does your business understand consumers' trust (perceived or lack thereof) in your business?

- | Consider the risks and benefits associated with the business growing its personalization strategy, and the methods used to generate those experiences.
- | Seek out opportunities to generate more customer feedback. Build a holistic understanding of how individuals experience your digital products or services today. Use these insights to inform your approach to designing future interactions.

## Does your current method for designing experiences lend itself to sharing control of experience design?

- | Find points within your customer journeys where individuals may want more control over their experiences. These points are opportunities to give people using your digital products and services the agency that will drive long-term partnerships.
- | Identify and invest in the technologies that will enable your next wave of cooperative experiences. Scalability, immersion and participation will be key to sharing control and co-creating unique customer engagements.

## How is your company preparing for data regulation that impacts customer experiences?

- | Prepare the enterprise to address an increasingly regulated digital landscape. Review your current data collection and management practices to identify potential points of risk.
- | Ensure that your policies for consumer management of data are fully documented and made available to consumers and regulators.
- | Revise your data collection and storage strategies to support cooperative experiences while complying with regulation that requires consumer privacy.



1

The I in Experience

2

3

4

5

#TECHVISION2020

# I make the experience

**1**

The I in Experience

**2****3****4****5**

# Bold Predictions

**5**

## In five years

The line between media entertainment and gaming companies will blur as real-time interactive experiences become a primary form of leisure.

**5**

## In five years

At least one country will pass legislation to regulate interactive advertising in the physical world.

**10**

## In ten years

All customer interactions will be multisensory, including haptics, vision, gestures or sound to drive cooperative experiences.

Trend 2: AI and Me

# Reimagine the business through human and AI collaboration





1

2

AI and Me

3

4

5

**Take a new approach that uses artificial intelligence to bring out the full power of people. Move beyond deploying AI for automation alone and push into the new frontier of co-creation between people and machines.**

## Don't just automate, collaborate

The Volkswagen Microbus is the definition of an iconic design. Just saying “VW Bus” conjures a mental image of the 1960s mainstay; even people who haven't seen one in person can immediately picture it. So, when VW decided to reconceptualize the 1962 Microbus, the company wanted to stay true to the vehicle's historic design—but update it to be lighter and greener in line with today's standards.

To solve this problem, VW partnered with engineering software services leader Autodesk to experiment with generative design tools.<sup>1</sup> Generative design enables iterative collaboration between human engineers and artificial intelligence: humans provide design goals and constraints to an AI system, which outputs a wide range of feasible—though sometimes unexpected—solutions. From there, the parties continue to iterate, with the machine generating ideas and human co-workers curating and refining them.

The VW and Autodesk collaboration ultimately created parts for the Microbus that were lighter and stronger than any prior designs. The AI, for example, inspired a tree-like design concept for the wheels that made them 18 percent lighter than a standard set. The generative approach also allowed VW to reduce the time spent getting from development to manufacturing—a 1.5-year cycle was reduced to just a few months. Those metrics were big wins. But what was more important was how VW got there. The designers credited generative design and their AI collaboration with creating structures they could never have created on their own.<sup>2</sup>





1

2

AI and Me

3

4

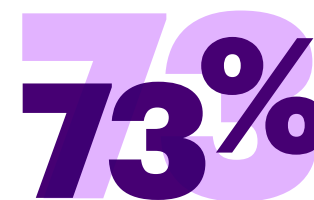
5

This and similar experiments from across industries reveal a stunning reality: businesses today are realizing only a fraction of their AI potential. Leaders got to a point of advantage by plugging AI and other tech tools into existing workflows, focusing on automation and execution. But simply using AI to make their organizations run faster and cheaper limits its impact. Now, leaders are leveraging the potential of AI systems to transform not just *how* businesses do work, but also *what* they actually do. AI is becoming an agent of change across the organization.

To capitalize on this, businesses need to reimagine AI's role in the organization. Artificial intelligence offers one of the key advantages that have let startups disrupt decades-old incumbents: the technology doesn't approach a problem based on years of experience or inherent human biases. It hasn't yet learned what not to try.

But AI can't reinvent the business on its own. To tap into the unique strengths of the technology, businesses will rely on people's ability to steward, direct and refine AI. Enterprises will need to engineer the opportunity for human employees to couple their unique talents and knowledge with the limitless capacity of machines to explore new possibilities. Those that do so successfully will build the next generation of intelligent businesses—where humans and AI systems work together to reimagine what's possible.

This trend isn't limited to generative design. Leaders are beginning to recognize the tremendous potential of enabling humans and machines to inspire one another. Take OpenAI's MuseNet, an AI that collaborates with humans to compose music, without people needing expertise in composition or technology. A human provides a starting sample, a target style and instrument preferences. MuseNet uses what it's learned from hundreds of thousands of musical files to make suggestions about the next segment of a composition.<sup>3</sup> The process repeats until a novel piece of music is created, the result of a true collaboration and division of labor between human and machine.

A large graphic of the number 73% in a bold, purple font. The 7 and 3 are solid purple, while the percent sign is a lighter shade of purple with a white outline. The graphic is positioned on the right side of the page, above the main text of the callout box.

**of organizations  
report piloting  
or adopting AI  
in one or more  
business units.**



1

2

AI and Me

3

4

5

## Untethering creativity and catalyzing change begin at the individual level of human-machine interaction

To start reimagining the organization, enterprises need to facilitate and enable true human-AI collaboration. They must think beyond a linear “command and response” relationship and engineer an interactive, exploratory and adaptable experience.

This requires an innovative set of capabilities that most enterprises aren’t actively building today. Automation required designing the skills to get a job done, but collaboration demands the ability to communicate and iterate with partners. To foster human and AI collaboration, businesses will need to explore and master the tools and advancements that enable humans and machines to better engage each other. Natural language processing (NLP), explainable AI and extended reality (XR) will all unlock new ways for humans to interact with machines and for machines to interact with us.

Meaningful collaboration always begins with communication, yet historically machines have struggled to understand the most common form of human communication: language. This is no surprise; machines typically are precise in their actions and operation, while language is anything but. Between slang, regional variations in dialect and single words that have multiple meanings, the challenges of language have defied straightforward communication with machines.

**To start reimagining the organization, enterprises need to facilitate and enable true human-AI collaboration.**





1

2

AI and Me

3

4

5

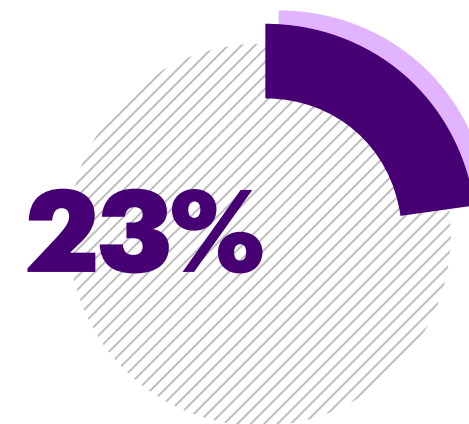
Now, these challenges are disappearing for both written and spoken text through advancements in NLP. By leveraging these advances, businesses can deepen human-AI collaboration. Google's BERT and Baidu's ERNIE—which are both open-source frameworks—enabled AI systems to move from understanding just one word, to understanding phrases in context.<sup>4,5</sup> The same way humans learn reading comprehension in school, NLP systems can now understand that there's a difference between "Joe is running at the gym," "the car engine is running" or "Maria's nose is running." This semantic understanding improves a machine's ability to understand a human's intent, letting them better inform outcomes without requiring constant direction.

Businesses are already seeing the benefits of increasing NLP sophistication. Casetext, a startup building an AI-powered research platform for lawyers—named CARA—has applied techniques similar to the BERT approach. In doing so, the company improved its citator filtering algorithm to better curate the passages sent on from the AI for human review. This helps lawyers build their cases by providing more relevant and actionable information. The collaborative approach has cut the percentage of potentially overruling passages that human co-workers need to read in new cases down to three percent.<sup>6,7</sup>



Language is just one element that machines will need to understand to better collaborate. For many employees, these technologies are most valuable when they can understand the physical context of humans. Companies must ensure the tech can sense—and make sense of—a person’s surroundings to enhance human-machine collaboration. Image recognition and machine learning allow Microsoft’s HoloLens 2 mixed reality headset to not only see, but also understand the wearer’s physical environment.<sup>8</sup> While previous XR devices might only know that *something* exists in the field of vision, the HoloLens 2 identifies an object and understands what that object is: for instance, a couch is not just a series of pixels, but something that can be sat on and belongs in a living room. This contextual understanding of the environment unlocks new capabilities for the device, like being able to identify dangerous equipment and warn the wearer if the equipment is operating hazardously.<sup>9</sup>

And collaboration can’t just be one-way; companies must complete the feedback loop and build the capabilities that allow humans to better understand machines. True iteration will require understanding the decision-making process of an AI system, so that people can correct or fine-tune it as needed. The growing field of explainable AI is letting humans de-mystify the output of previously “black-box” AI systems—making human-machine collaboration possible even if the AI wasn’t designed to explain its decision-making process, through approaches like counterfactual explanations.



**Only 23% of organizations report they are preparing their workforce for collaborative, interactive, and explainable AI-based systems.**



1

2

AI and Me

3

4

5

## AI reimaged

Work at Accenture Labs demonstrates this using data from loan applications. If an applicant is denied a loan, the system explains the reasons for the denial and offers the smallest number of changes the applicant would need to make to have the application approved, such as having more cash on hand or increasing annual income.<sup>10</sup> The process is also interactive: if an applicant can't increase income, for example, they can ask the system to make another suggestion that would lead to a successful approval. Making AI explainable turns a human-AI interaction into a relationship.

IBM built a system that put many of these new capabilities into action. "Project Debater" combines IBM Watson's natural language capabilities to listen to and parse human speech, with a system that mines through an array of newspaper and journal opinions to construct an argument. In 2019, the company pitted the system against European Debate Champion Harish Natarajan in a live, unscripted debate.<sup>11</sup>

Natarajan was declared the winner, but noted the system's potential, saying that if its ability to grasp and contextualize information were paired with a human colleague's skills in using that information more subtly, it would make for a powerful collaboration.<sup>12</sup>

Once enterprises enable the full scope of human-AI collaboration, they can jump on the new opportunity before them—employing AI as an agent of change. Competitive advantage is no longer about finding a faster way to do what's already being done. Leaders in the future will be the ones that can rapidly and continuously change, using AI to rethink and reimagine everything—from the way their organizations are structured, to the way they approach work, to the value their enterprise creates.

Look at Lemonade, a startup natively designed to use human-AI collaboration to disrupt the insurance industry. At Lemonade, AI is embedded in the organization and present in nearly

every workflow. Particularly, the company's claims payment process was designed to play to the strength of AI and humans working together.<sup>13</sup> Customers file claims with a chatbot that both logs the claim details and instantly compares the claim to others within the Lemonade database—a first wave of defense against fraud. If everything is okay, the claim can be paid out immediately to the customer. If a claim is too complex or problematic, the AI shares the information with a human agent, who steps in to manage the case.<sup>14</sup>

This unique division of labor is the root of why Lemonade can offer competitive pricing within the insurance industry. Fraud and the administrative costs of complex bureaucracies are two of the largest costs to insurance companies, and the company solves both by making AI a key part of the process. Meanwhile, it also provides the customer with a simplified, seamless insurance experience while making a human touchpoint available when it's needed most.<sup>15</sup>



Ultimately, the problem every company is trying to solve comes down to delivering the experience and outcomes that customers want. Today, an airline customer service chatbot may be able to answer the question, “Can I bring my crutches on board?” with a simple yes or no, and perhaps provide a link to the airline or regulatory authority’s policy about carry-on items. But there’s an opportunity to extrapolate far beyond the simple language of the inquiry.

An intelligent agent could recognize that the question about crutches may mean the traveler has a mobility issue. It could then pull up the person’s itinerary, note that a plane change would require a transfer between terminals, and ask if a wheelchair or cart transit would be helpful. An AI system could even suggest an alternate itinerary that would mean less distance to walk. Quickly answering a customer’s narrow question is one type of problem; however, delivering on the entire range of outcomes a customer might desire is a much more valuable one to address—and one that businesses *can* start solving today.

Going forward, companies will be limited only by what they can imagine, but they will be expected to grow and change more rapidly than ever. By consciously structuring their organizations with human and machine collaboration at the core, pioneers are already positioning AI to be a driver of that change. The next generation of intelligent enterprises will be led by those that are not just open to new ideas, but collaboratively building them.

**The next generation of intelligent enterprises will be led by those that are not just open to new ideas, but collaboratively building them.**

# Big Takeaways

## Collaborate, don't just automate

Enterprises are only realizing a fraction of the potential of AI—and ultimately their employees. By finding more collaborative use cases and building the capabilities needed for AI and people to work together seamlessly, they will amplify the best qualities of both.

## Context matters

To collaborate successfully, humans and machines need to better understand one another. Advances in natural language processing (NLP) and computer vision can help machines understand people and their surroundings. And prioritizing explainability will help organizations ensure that people understand AI.

## Reimagine what you do

Businesses that facilitate human-machine collaboration today will be able to reimagine every aspect of their organization, from the way they design products, to the way they hire and train employees. True pioneers will use these capabilities to reinvent the entire business from the ground up—tackling bigger challenges and building the next generation of the intelligent enterprise.

[1](#)[2](#)[AI and Me](#)[3](#)[4](#)[5](#)

Deep Dive

# A new way to learn

**When the workforce at Red Nucleus started asking for leadership training, the learning solutions company enlisted the services of an executive coach. But this was no ordinary coach. The company brought in Coach Amanda, an AI-powered virtual assistant for management training developed by LEADx, a leader in conversational learning and leadership enablement.<sup>16</sup>**

While traditional executive coaching is expensive and typically granted to very few employees, deploying a collaborative system like Coach Amanda can give far more employees access to an ongoing learning experience. Red Nucleus employees could talk to Coach Amanda at any time in natural language, asking

for advice concerning employee problems, suggestions to increase employee engagement or lessons on management fundamentals. The results are impressive: The company saw a 33 percent increase in productivity, a 35 percent decrease in workplace stress and a nine percent increase in managerial confidence.<sup>17</sup>



1

2

AI and Me

3

4

5

## Transform the business inside and out

Advances in AI are letting organizations build interactive, adaptable and intelligent systems that collaborate with human employees to help them reach their goals. While this collaboration is valuable across the organization, businesses are finding it's especially transformative for their learning and training initiatives. Far more than just streamlining existing methods, collaborative AI coaching has the potential to democratize and expand HR programming, while creating entirely new strategies for employee development.

Collaborative AI training can provide learning opportunities at unprecedented scale. Microsoft recently launched an AI-powered presentation coach for its web version of PowerPoint.<sup>18</sup> The tool assists presenters with pace, slide reading and wording. It can track how quickly or slowly someone is speaking, detect when a person

is merely reading off of the slides and provide feedback on how often filler words ("um" and "ah") are used or insensitive phrases like "best man for the job." Microsoft's presentation coach isn't just an automated system; it collaborates with individual employees, using live feedback to help them learn and improve their speaking. What's more, every employee with PowerPoint can use it.

Human-AI collaboration is also creating training opportunities that didn't exist before. Cogito, a behavioral science software company, is using voice-to-text and sentiment analysis to coach human call center agents in empathy during their phone calls with customers.<sup>19</sup> When a customer calls with a question, Cogito lets the agents know in real time if they are speaking too fast or interrupting the customer. The AI-driven tech can also recognize the emotion and inflection in people's voices,

offer live insights about how a customer is feeling and provide guidance to the call agent on how to improve the experience. This collaboration between human employees and AI not only offers the call agents real-time coaching, but also helps identify future coaching opportunities for them.

Sophisticated systems that interact and collaborate with humans are becoming an integral part of the work environment, generating ideas and solutions just like their human counterparts. It's a new kind of partnership that impacts every level of the business, and leaders will see that opportunities for collaborative AI are both external and internal. AI training is just the start. In the future, collaboration between humans and AI will transform the business inside and out.

# Why Now?

**Enterprises are moving beyond automation alone and beginning to reimagine how they use AI. Bringing together the creativity and critical thinking skills of humans with the scalability of AI is opening up new frontiers for the enterprise.**

**Businesses are increasingly leveraging AI, and it's quickly becoming a strategic imperative.**

- | The market for AI is expected to grow to \$14.7 billion by 2025, up 154 percent from 2018.<sup>20</sup>
- | The adoption of enterprise voice assistants and virtual digital assistants is expected to grow rapidly to one billion users by 2025.<sup>21</sup>
- | Two-thirds of enterprise leaders are expecting to deploy AI in the next year with successful implementations projected to boost revenues up to 30 percent.<sup>22</sup>
- | Eighty-four percent of executives believe they must leverage AI to achieve growth objectives.<sup>23</sup> Companies that have adopted AI and are strategically scaling it report 3x growth on the return of their AI investments.





1

2

AI and Me

3

4

5

## As enterprise use of AI grows, so are the capabilities of intelligent systems.

On a 2019 benchmark test, a best-in-class NLP model scored near the human baseline level of language processing tasks like semantics, argument structure and logic. A new benchmark had to be introduced to keep up with the unexpected pace of the technology's progress.<sup>24</sup>

Google developed a speech recognition model to be hosted on-device for its smartphones. The model transcribes speech almost instantly on a character-by-character basis and is compressed to only 80 megabytes.<sup>25</sup> Advances in NLP have improved translation offerings, too: Waverly Lab's "Pilot" headphones can translate 15 languages during a real-time conversation, and the company sold 35,000 devices in less than a year.<sup>26</sup>

These intuitive advances are driving big business. IHS Markit predicts that the global smart home market, which reached \$41 billion in 2018, will grow to \$192 billion in 2023.<sup>27</sup>

## With these new capabilities, AI is making a larger impact across companies.

In a 2019 survey, 62 percent of US consumers said they liked using chatbots to engage with businesses.<sup>28</sup> Now, 80 percent of businesses are expected to have some sort of chatbot automation by 2020.<sup>29</sup>

Companies are exploring the future role that AI will play in talent acquisition, with 36 percent saying they expect the usage of AI in recruitment to be high or very high in two years.<sup>30</sup>

AI is starting to reshape industries as well. In the pharmaceutical sector, revenue from AI-generated solutions is expected to grow to \$2.19 billion by 2022.<sup>31</sup> The market for generative design is expected to grow at a 16 percent compound annual growth rate (CAGR), reaching \$124.58 million by 2023.<sup>32</sup> AI is even taking over Wall Street, where algorithmic trading is accounting for a growing percent of total trade volume.<sup>33</sup>



1

2

AI and Me

3

4

5

Deep Dive

# How Adobe is building an intelligent experience

**Maximizing the impact and value of AI means looking beyond automating a given task to how human-AI collaboration can improve outcomes.**

But unlocking this potential requires more than building or buying a tool. It means reengineering the enterprise and the workflows AI systems are designed to support.

Adobe is completely transforming its suite of products with Adobe Sensei, an AI layer infused across the company's various cloud tools.<sup>34</sup> Using backend machine learning models, data streaming pipelines, microservices and more, Adobe's entire architecture is designed to allow Sensei to provide rich, intelligent collaborations as people use Adobe's products.



1

2

AI and Me

3

4

5

## Expand human capabilities

Adobe has leveraged advances in NLP to enable voice search with Sensei: customers can interactively search Adobe's large repository of images and videos by speaking to Sensei, further direct and refine results and even ask the application to move a selected image into Photoshop for final editing.<sup>35</sup> While the voice search itself makes for a more natural interaction with the software, it's also making the move from one stage of the workflow to the next a more seamless experience.

Sensei's systems are also continuously learning. The system is designed to capture user interaction data across the entire range of cloud products and use this information to understand the person's intent and context.<sup>36</sup> It also applies this understanding to augment the workflow, such as streamlining tasks

the system observes the person repeating. But Sensei learns from more than just the individual. The Adobe creative community is continuously sharing new layouts for creative campaigns. Sensei learns from these layouts and pairs that knowledge with design and communication best practices to assist customers throughout their campaign design process.<sup>37</sup> With Sensei's capabilities, Adobe Spark can collaboratively navigate a person through hundreds of layout options, iterate based on the individual's decisions and recommend alternative layouts, allowing people to draft a creative content campaign in a matter of minutes.

Sensei's capabilities also help support customer relationships after a campaign is launched. Data related to customers is gathered from across channels and

platforms, then used to provide automated personalization of offers, analyze digital channel traffic and behavior and suggest improvements for customers. This collaborative, AI-driven approach enables the use of intelligent cloud products inside of existing workflows, while simultaneously improving a campaign manager's ability to react to the fast pace of customer needs today.

AI holds immense potential to transform how enterprises bring value to their customers, but businesses will never reach that potential if they don't rethink where and how they apply the technology. Leaders must focus on building the capabilities for AI to interact with people in a collaborative, understandable way that expands, not replaces, human capabilities.



1

2

AI and Me

3

4

5

**Forcing people to navigate between discrete tools, devise workarounds for complicated workflows and figure out how to use data produced by intelligent systems will be a thing of the past. The future is in AI-driven systems that put people at the center, while being context aware, seamless and adaptable.**



1

2

AI and Me

3

4

5

# Decision Points

## Is your company thinking collaboratively?

- | Determine the role that AI is playing in your business alongside your existing workforce. Think beyond which tasks could be replaced and imagine how you can build a new kind of workforce with humans and AI collaborating side by side.
- | Determine what tools are available internally to introduce the AI solutions needed to move your organization in this direction. If none are available, evaluate if employees have the skills to build the solutions, or engage partners to generate the necessary capabilities.

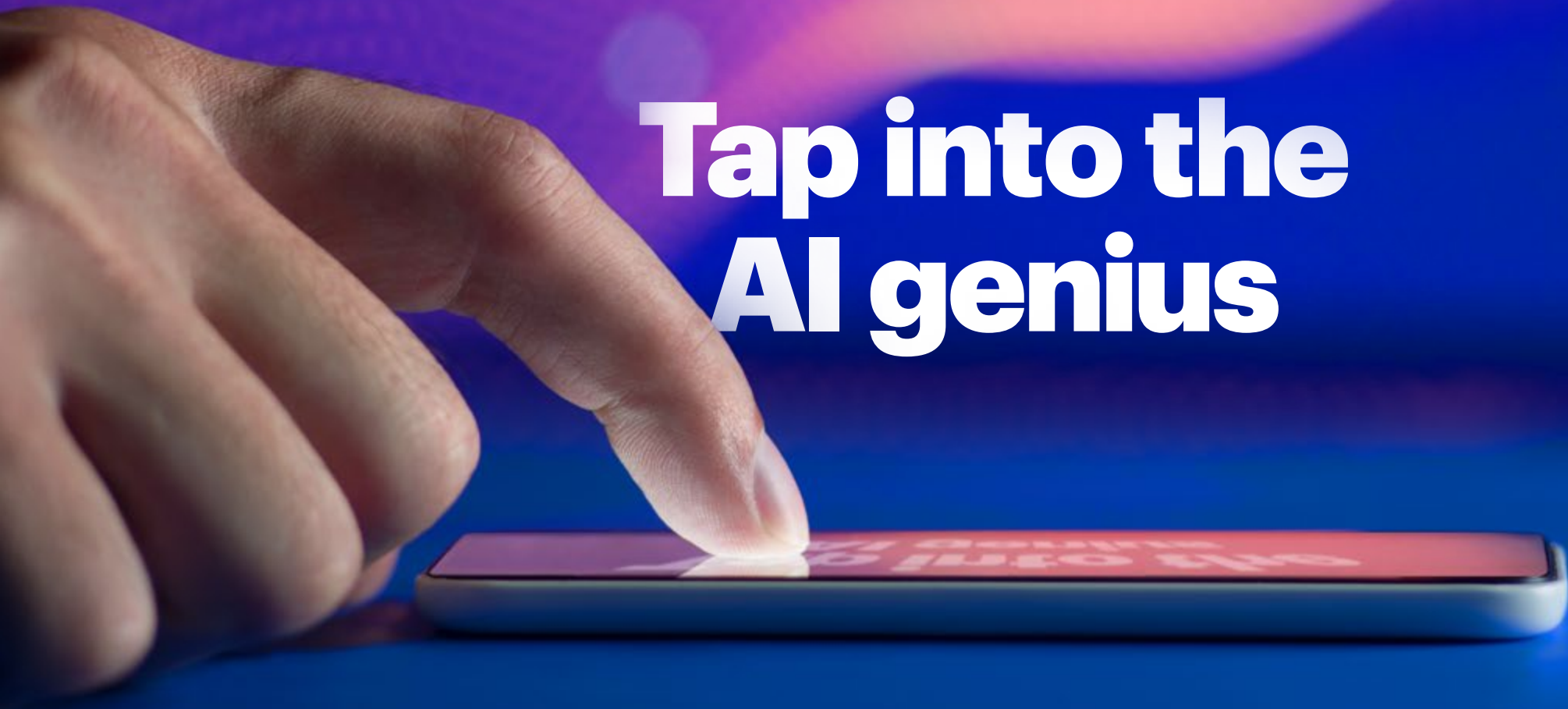
## How will you roll out collaborative AI initiatives across the organization?

- | Evaluate where your industry is headed. Where are partners or competitors finding success in deploying AI?
- | To ensure transparency and trust, gather workforce perspectives into the design and implementation of AI systems. Ultimately, these employees will be the ones who determine the success of your AI investments.
- | If you're not already using AI in the company, find an area to begin piloting the technology, such as co-designing a new product, coaching or training employees or reinventing customer engagement strategies.

## How will you address explainability?

- | Evaluate the scope of decision-making that AI is being given in your organization. Identify sensitive areas where additional oversight may be needed and prioritize post-implementation explainability solutions, such as counterfactual explanations, for those systems.
- | For all future AI projects, plan for explainability by design. Develop policies and principles that will guide the development, building and implementation of new AI systems.

# Tap into the AI genius



# Bold Predictions

## 3 In three years

**Seventy-five percent of Global 2000 companies will offer employees the opportunity to work with AI-powered career coaches that make personalized growth and training recommendations.**

## 5 In five years

**Every operational AI deployment will be legally required to have an explainable component.**

## 7 In seven years

**The majority of people's interactions with intelligent systems will happen in natural language and spatial interfaces.**

Trend 3: The Dilemma of Smart Things

# Overcome the “beta burden”







1

2

3

The Dilemma of Smart Things

4

5

**Address the new reality of product ownership in the era of “forever beta.” Transform pain points into an opportunity to create an unprecedented level of business-customer partnership.**

## When customers buy products today, do they completely own them?

In early 2019, the Jibo home robot surprised its owners with bad news: its control servers were shutting down. While people could still get the \$899 robot's attention by saying, "Hey, Jibo," it would no longer understand or respond to any other voice commands.<sup>1</sup>

Around the same time, in an effort to create a more unified and secure experience for its smart home ecosystem, Google announced that it would be shutting down the "Works with Nest" program in favor of the "Works with Google Assistant" solution. Works with Nest had allowed developers to connect Nest products like smart thermostats and doorbells with third-party smart devices to create experiences: turning lights on when the sun sets or cooling down the kitchen when the oven is on.<sup>2</sup> Migrating to Works with Google Assistant meant customers would need to re-register all of their

devices with Google, losing their apps and automated routines until the new setup was in place. Following pushback, the company announced that existing Works with Nest connections would stay online.<sup>3</sup>

Jibo isn't the only device to change functionality on customers, and Google won't be the last company to shake up its ecosystem. Enterprises are beginning to design updateable products with the ability to expand services and experiences in the future, making it possible to respond to changing customer demands and expectations at a moment's notice. This sets the stage for feedback loops that support true partnerships, where customers can see the value and utility of products grow over time rather than fade.



However, as companies introduce this state of “forever beta,” they are challenging traditional perspectives on ownership. As Jibo and Google demonstrated, products that consumers think of as “theirs” are being redefined at the drop of a code release. Without proper care, this living connection can quickly drift from a wellspring of opportunity, to products that feel completely beyond the control of the people using them. The risk is customers constantly having to play catch-up, not knowing if the next system update is bringing exciting new capabilities, a critical security refresh, a new user interface to learn or a dramatic change to functionality. It’s not surprising that customers are growing weary of what’s around the corner.

Call it the beta burden: the unintended consequences when products, and their contained experiences, are constantly in flux.

Enterprises across all industries are already making big bets on a connected future. The internet of things (IoT) market is expected to grow to 75.44 billion connected devices by 2025, with a projected market value of \$1.1 trillion by 2026.<sup>4,5</sup> For businesses that want to build a competitive position in this emerging market, addressing the beta burden will hold the key: those that ignore it will face attrition as mounting frustration leads customers to reject their biggest innovations.

**Call it the beta burden: the unintended consequences when products, and their contained experiences, are constantly in flux.**





The question of ownership and the challenges of the beta burden are two sides of the same coin. It might sound strange to claim that ownership of products is now being shared, but consider the wave of connected products emerging across industries. Caterpillar’s new generation of industrial equipment is being integrated with Cat Connect, a platform that allows the company to continuously explore and introduce new telematics-driven services to customers such as remote troubleshooting, performance optimization and more.<sup>6,7</sup> Likewise, Samsung is continuously expanding the capabilities of common items like TVs and refrigerators by integrating connected products from disparate companies with its SmartThings app. And Tesla customers have seen their cars transform without ever visiting a mechanic as new functions like autonomous driving, accommodations for pets and enhanced safety features are pushed through firmware updates.<sup>8,9</sup>

In these cases and others, the evolving digital experience is designed to be an intrinsic part of the usefulness and differentiation of a product. That’s possible because the enterprise can take control of a product to improve or expand the experience after a person has purchased it. But this is a huge departure from the past, where what you bought is what you got. Today, customers may own the physical piece, but the business administers the digital side—effectively retaining ownership over part of what makes the product valuable.

## These new realities of ownership are catalyzing deep change within the enterprise

This is allowing companies to reinvent themselves as collaborators with their customers. But companies are experiencing the beta burden because the strategies and operating models that support their products are misaligned with this new role. To deliver the wide-ranging experiences they hope to achieve through flexible, updateable products, companies must rethink the way the entire organization develops, delivers and supports its outputs.

Evolutions in the engineering space started businesses down this path. Agile and DevOps processes allowed the organization to move and respond to the demands of customers, while application programming interfaces (APIs)

opened the door for robust and ever-transforming ecosystems. But as adoption of this new generation of products continues to grow, the impact is being felt far beyond the technology organization alone.

Companies must expand the approach that began in the engineering space to permeate every aspect of their organization, whether it's sales, customer support, development, design or others. If leaders ignore this imperative, even the most successfully delivered product or service will look like a failure when the businesses can't keep up with its evolution.

79%

**of executives believe their industry is moving toward offering more variety in ownership models for their connected products and/or services.**



1

2

3

The Dilemma of Smart Things

4

5

Consider how enterprises now have a deeper stake in the long-term lifecycle of a product and must build the capabilities to support that. Apple recognized early on that the paradigm of product ownership was changing, and that they would need to be more deeply involved with a product's lifecycle. For instance, the company knew that iPhone owners would always want the latest and greatest software experiences, but also knew that older devices could struggle to support their newest innovations. Rather than risking overloaded batteries and disabled devices, the company proactively pushed an update designed to extend the lives of the iPhones by managing performance.<sup>10</sup> Without knowing why the company had taken this action, however, some customers were surprised by the sudden change in performance in devices they felt were "theirs." As part of its commitment to its customers, Apple took it one step further: it also began offering subsidized battery replacements for

affected phones.<sup>11</sup> Apple demonstrated what will soon become a basic function for companies from all industries: the need to support longer lifecycles and manage both the digital and physical lives of their devices. To do so effectively, they'll need to develop a strategy for continued clear communication and transparency with people.

**Consider how enterprises now have a deeper stake in the long-term lifecycle of a product and must build the capabilities to support that.**

## New models for the future

As more enterprises from all industries integrate digital technology into products, they will increasingly have to contend with the “digital deaths” of those products. Look at smart appliances: a refrigerator might last 20 years, but add a touchscreen to the door and some digital capabilities, and that life expectancy could drop fast. The fridge might still keep food cold, but the smart capabilities won’t be very useful if the screen gets too old to function. Not only will old devices limit the business in its ability to deliver the most cutting-edge experience, they will begin to generate risk for the whole ecosystem as aging technology is often rife with security vulnerabilities. Building a strategy to smoothly transition customers from one generation of product to the next will be a key component of customer retention and loyalty in the future.

Signify, the new company name of Philips Lighting, took an innovative approach to keeping the latest and greatest technology in its customers hands by introducing Signify Circular lighting. It’s an enterprise solution where Signify offers lighting based on the uptime and energy needs provided by its customers.<sup>12</sup> The company maintains the materials, lightbulbs and sensors required to deliver the experience, swapping out older pieces for new in order to deliver a consistent experience. This also allows Signify to reuse, refurbish and recycle as much as possible, helping both the company and their clients to meet sustainability goals with better energy efficiency and reduced digital waste.

Signify is essentially providing lighting-as-a-service, de-emphasizing the individual device and focusing on providing the best experience. Leaders like Signify realize that addressing the beta burden isn’t just about alleviating consumers’ burdens around smart products. It’s about finding opportunity in a new business model.





Shiseido, a large Japanese beauty brand, is giving one of its latest innovations away for free. The company wanted to bring a personalized skincare experience to its customers and developed Optune, a platform that creates uniquely tailored lotions for customers. People take pictures of their skin and upload them to the Optune app, which uses AI to analyze the photos and incorporate external data such as weather, humidity, environment and more.<sup>13</sup> The app then creates a customized “recipe”—Shiseido has identified more than 80,000 so far—and sends it to a connected device, which mixes and dispenses the lotion.<sup>14</sup> But rather than burdening customers with an expensive up-front device cost, the company is maximizing adoption by only charging a monthly subscription for lotion refills and access to the platform.<sup>15</sup>

Under today’s new models of ownership, products are more than just the object in someone’s hands. As Philips and Shiseido are demonstrating, they can be a channel for companies to deliver extraordinary experiences and value to customers. Thinking of the product as the end-all, be-all for the customer relationship exacerbates the beta burden and puts a hard limit on the company’s potential for future growth. But the beta burden doesn’t have to stay a burden—for customers or businesses.

Enterprises transitioning to experience-driven products are doing so because they see the potential of continuous interactions with their customers. Reimagining the organization to support these products’ new lifecycle is how leaders will bring that potential to life.



# Big Takeaways

## Understanding the “beta burden”

As products become conduits for experiences, their features and functionality are constantly in flux. While this state of “forever beta” opens up a wellspring of opportunity, if mishandled it risks leaving people overwhelmed, frustrated and wary of what’s around the corner.

## Ownership is changing

Experience-driven and updatable products are introducing a new model of ownership—one where businesses must retain some control and responsibility over a device, even after a customer purchases it. This shift has implications for the whole organization, and businesses must ensure their strategies and operating models are aligned with this new reality.

## Designing for the journey

Enterprises have to design products to evolve and transform over time, while simultaneously becoming more comfortable releasing products they might conventionally see as “unfinished.” Products will gain value from the ecosystem of experiences that form around them, if properly fostered and guided by the enterprise.



1

2

3

The Dilemma of Smart Things

4

5

#TECHVISION2020

Deep Dive

# Designing “unfinished” products

**Just as the advent of cloud computing upended the notion of a software “update,” leading businesses today recognize that IoT maturation means revisiting the idea of a “finished” product. Rather than striving for perfection before release, they are deliberately shipping unfinished products—and building potential for growth into their designs.**

Consider how Sony is using sensor-rich hardware to extend device value in new and exciting ways. The company’s robotic dog, Aibo, exists as a standalone device that consumers can purchase, but Sony has also introduced a cloud service that lets the robot companion remember subscribers’ faces, environments and interactions.<sup>16</sup> This lets Aibo evolve over time, becoming a unique product for each person. Sony’s design also lets the company create future value for owners by rolling out new tricks. The device’s connectivity and advanced hardware—including cameras, motion sensors and light sensors—all provide rich opportunity for developers to change the Aibo experience over time.

## Maximize the value

Companies like Sony are preparing for a future where they are expected to enhance device functionality long after a consumer makes the initial purchase—and they’re doing so in a way that guards against the beta burden. Leaders are rethinking their design processes and hardware to help make sure their products are equipped to evolve constantly.

Since the launch of Amazon’s Echo devices, for instance, the company’s Alexa assistant has changed the way many consumers obtain information and interact with their personal spaces. But moves from Amazon indicate the company has ambitions beyond stand-alone smart speakers. The Amazon Echo Flex is a smart outlet that not only contains a microphone for Alexa interactions, but also a USB port that can support plug-and-play accessories, such as motion sensor and nightlight accessories.<sup>17</sup> By opening up a developer API and technical specifications, the company is creating a modular ecosystem that will grow and change as developers create new accessories in the future.

General Motors (GM) is also adopting the unfinished product mindset, and it has created a “digital nervous system” platform for new GM cars.<sup>18</sup> This system will be able to process 4.5 terabytes of data an hour—a fivefold increase over what current GM cars can do—which will let the cars process camera footage, Light Detection and Ranging (LIDAR) data and real-time information on road conditions and traffic. Initially, this system will let GM deliver over-the-air software updates to customers, remotely improving vehicle functionality without requiring drivers to visit a dealership. In the future, it will be critical to delivering more autonomous driving capabilities.

But to be truly successful, enterprises must move past thinking about what is minimally viable and consider what will make a product maximally valuable over its entire lifecycle. Businesses will find that their ability to iterate and improve products over time will continue to grow exponentially as the data they use becomes more granular. Case in point: Siemens

acquired MultiMechanics, Inc., which develops finite element software to help companies predict failure in advanced materials. Siemens plans to integrate the company into Siemens Digital Industries Software, making it possible for its customers to create digital twins for materials, and predict materials’ properties and behavior.<sup>19</sup> Testing materials in hypothetical ways, and even for applications that are not yet possible, will help companies understand and maximize their products’ full physical potential.

Leading companies are extending the value of their physical products by adopting the mentalities of digitally born organizations. By embedding intelligence into physical devices and designing flexible products that can support new capabilities as they become possible, these companies are setting themselves up to increase functionality over time. Ultimately, they will form stronger relationships with customers, built on an understanding that the devices they purchase today will appreciate in value tomorrow.

# Why Now?

**Experience-driven products are redefining the relationship between people and enterprises. Customers are not only buying physical goods, but also opting into an ongoing partnership with the companies managing those products.**

**But as more organizations seek to deliver experience-driven products and engage these new relationships, they are running up against new challenges, too.**

## Connectivity, intelligence and digital experiences define today's newest products.

- | Statista predicts that IoT-connected devices will reach 75.44 billion by 2025, up from 30.73 billion in 2020.<sup>20</sup>
- | In a 2018 Accenture survey of manufacturers, 98 percent of respondents reported they had already started integrating AI in their products.<sup>21</sup>
- | The growth of AI-enabled IoT products—which often need to process data and make decisions locally—is one of the key drivers of edge computing. IDC predicts that by 2022, edge computing will be included in more than 40 percent of businesses' cloud deployments, and a quarter of endpoint devices and systems will use AI.<sup>22</sup>



1

2

3

The Dilemma of Smart Things

4

5

## Enterprises increasingly need to account for the other technology in people's lives—or risk turning them away.

On average, US homes with a broadband connection own more than 10 connected devices.<sup>23</sup>

Seventy-five percent of customers intending to buy a connected device in the upcoming year state that an important factor in their purchase decision will be the device's ability to work well with other devices.<sup>24</sup>

Digital workplace tools interrupt workers 13.9 times a day, despite 86 percent of workers reporting they expect simplicity and ease of use from the tools they use.<sup>25</sup>

## Experience-driven products and ongoing relationships with customers are letting businesses collect more data than ever. But unaddressed concerns over privacy and security are leaving customers wary.

A survey conducted by Consumers International and the Internet Society found that 63 percent of people think connected devices are 'creepy,' because of how they collect data, and 53 percent don't trust connected devices to handle their information respectfully or protect their privacy.<sup>26</sup> More than a quarter of people who did not already own smart devices said that security concerns are enough to deter them from buying one.

In Edelman's 2018 Trust Barometer, 83 percent of global respondents believe that protecting people's privacy and information is one of a company's most important responsibilities.<sup>27</sup>

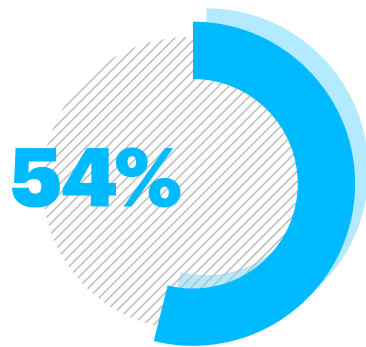
In the first half of 2019, data breaches were up 54 percent year over year.<sup>28</sup> The number of records exposed went up 52 percent.

# Survey Stories

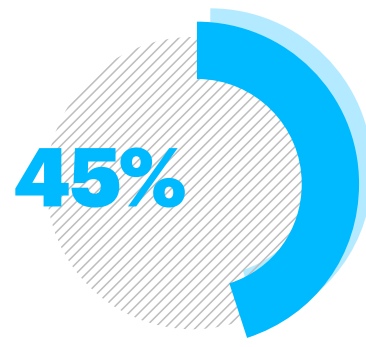
## Are customers and businesses divided on the future of products?

**47% of consumers agree: Software update cycles are increasingly becoming a burden on users to keep up to date on security patches, changes in functionality, and need to learn new interfaces.**

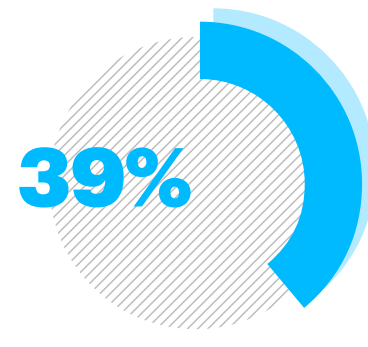
Based on role technology plays in consumers' lives:



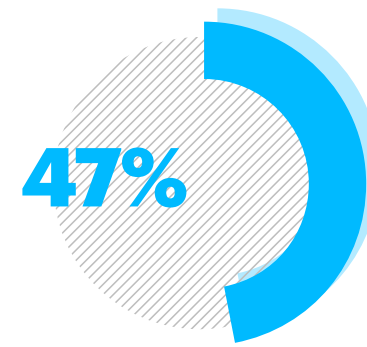
Technology plays a **minor** or **modest** role in my day-to-day life.



Technology plays a **prominent** role in my day-to-day life.



Technology is **ingrained** into almost all aspects of my day-to-day life.



Technology is so **intertwined** with all aspects of my day-to-day life that I view it as an extension of myself.

N=2,000 Global Consumers

When it comes to the next generation of products driven by digital experiences, enterprises will need to pay careful attention to the expectations of their customers if they hope to succeed.

Today, according to the Accenture Technology Vision 2020 survey, 49 percent of companies report that more than half of their products and services require subsequent software updates after the initial purchase. This number—and the speed at which new experiences are delivered—are expected to grow. Over the next three years, 74 percent of companies expect more, or significantly more, updates to their organizations' products and services.

While increased connected experiences are coming, customers remain concerned about the burden these frequent (or constant) updates introduce. Forty-seven percent of consumers believe software update cycles are increasingly becoming a burden on users to keep up to date on security patches, changes in functionality and new user interfaces. While consumers do see the need and benefit of certain updates—72 percent of consumers say they are highly tolerant of software updates that address security issues—sentiment splits when it comes to updates for features and functionality. Forty-seven percent just want to buy

something without constant updates, and 46 percent believe updates often bring new problems with them. For now, enterprises are somewhat off the mark with this sentiment. Sixty-eight percent of enterprises believe customers don't mind, or even welcome, software updates to their organization's connected products and services.

To begin addressing customer expectations, businesses should take a proactive approach to transparency. Only 48 percent of businesses believe they provide customers with detailed information on new features or security of updates for connected products and services. Ensuring businesses aren't

disrupting or distracting customers will also be critical—an outcome businesses are still striving toward, as 45 percent of executives surveyed believe updates occur with minimal disruption and inconvenience to their users.

In the long run, enterprises will have to come to terms with the fact that experience-driven products are challenging the norms of product ownership. Only 47 percent of executives believe that ownership over their connected products and services is shared with the customer or requires an ongoing customer relationship. Realigning the enterprise perspective with the new reality of ownership will be key to success in the next generation of products.

**In the long run, enterprises will have to come to terms with the fact that experience-driven products are challenging the norms of product ownership.**

[1](#)[2](#)[3](#)[The Dilemma of Smart Things](#)[4](#)[5](#)

#TECHVISION2020

Deep Dive

# Minimizing the “data burden”

**Successfully creating a digital thread, digital twin or digital experience means using potentially sensitive customer data to support intelligent service delivery and updates. This practice is bound to expand as enterprises move toward experience-driven products, and not addressing it properly will compound the effects of the beta burden.**

Whether data is generated by a camera, a microphone in someone’s home, telematics or geographic and location tracking, this information allows companies to power valuable, individualized experiences. But it also creates risk—a risk to privacy and security that is yet another extension of the beta burden. Maintaining a constant connection with customers through products demands that businesses rethink their data practices to emphasize privacy, security and accountability. Fortunately, several emerging technologies and approaches offer a path forward.



## Foster customer trust

One technique is infusing privacy directly into the way that edge devices are architected. Using edge products themselves to host AI lets enterprises keep user data local, rather than sending it to a central service for analysis. Previously, the necessary computing power and technology to support this approach were not able to fit into smaller edge devices, but advances in chips and processing power made it a viable option. Simcam, an in-home security system, uses an “intelligent edge” approach to deliver an AI solution on its in-home cameras.<sup>29</sup> A key point of value for a home security system is the ability for a camera to detect events or objects to trigger a security response. But in order to provide privacy, all facial recognition occurs on the Simcam device itself, rather than sending data to the cloud for analysis. Simcam’s cameras use Intel’s Movidius Visual Processing Unit (VPU), and analysis is run locally using Intel’s hardware. This allows for more control and privacy—and ultimately fosters more customer trust.

The ability to have and contain this intelligence on the edge is powerful. But there are cases where deriving insights requires a central analysis or combining larger pools of data from a cohort of partners. Rather than openly share data between all partners in an ecosystem, companies are turning to machine learning approaches that can combine insights from multiple, disparate datasets without directly sharing and combining the data first. A consortium of 10 large pharmaceutical companies created the Machine Learning Ledger Orchestration for Drug Discovery, a blockchain-based distributed learning model.<sup>30,31</sup> The system is allowing partners to train a drug discovery algorithm without each company directly sharing its data with the others. Raw data is never seen by the whole ecosystem, while the traceability of the blockchain ensures that every operation is seen and accepted by all partners.

Still another approach that protects data from being seen by a central system—even when it’s in fact sent to one—is homomorphic encryption. This technology enables computation on encrypted data without the need to decrypt it first; data can be transported, processed, augmented or changed by a third party, without letting that party see the data they are working with. Even the most sensitive data can now be shared for analysis without actually exposing it. Travis County, Texas is developing a voting system that uses this approach to monitor the voting process ahead of the 2020 US presidential election.<sup>32</sup> Without ever touching the actual votes (which could open up the system to bad actors manipulating data or voter fraud), analysis of voting data can be performed while it is still encrypted.



1

2

3

The Dilemma of Smart Things

4

5

**As businesses increasingly develop experience-driven products, protecting the data that powers those experiences will be critical. By developing systems that enable privacy and security from the outset, businesses will build trust with consumers and reduce the risk of collaborative efforts across organizations.**

# Decision Points

## How is your business responding to the changing nature of ownership with the products you sell?

Traditional models of ownership are shifting as devices gain the capacity to significantly change their functionality. Evaluate your organization's current ability to support a shared model of product ownership: everything from how customers are on-boarded, to how they are engaged with over time can present myriad new opportunities to build relationships with customers, but it requires changes across the organization (from product development, to marketing, to support).

## What is your company's long-term plan for products?

As the focus turns to selling continuous experiences, your company will need a different strategy for the products that support those experiences. Explore ways of helping customers through this transition to ensure long-term loyalty.

Identify the biggest stakeholders in your product ecosystem. This will include customers as well as app developers or other device providers. Design a review process that will uncover what obstacles these stakeholders may face as software updates change the functionality, interoperability and features of their products.

Help customers meet their sustainability goals. What can they do with aging hardware, and what expenses will they incur over time? Explore new strategies like developing a recycling and trade-in program or allowing people to repair devices themselves.

## How are you creating maximally valuable products?

Design products to evolve and grow over time in response to customer usage and insights. Build a feedback loop by identifying what data would be necessary to understand your customers' evolving needs. Develop the tools and platforms to capture that data.

Make future-focused design thinking a part of every product development process. Explore what customers might want in five years and work backward to consider what sensors or technologies might be necessary to support those ambitions.



1

2

3

The Dilemma of Smart Things

4

5

#TECHVISION2020

# Reinvent products, reinvent the business

# Bold Predictions

## 3 In three years

**Data portability will be a requirement for all connected products sold in the US and European Union.**

## 5 In five years

**Edge devices will have local intelligence backup for when they are disconnected from cloud-driven intelligence and analysis.**

## 7 In seven years

**The top-selling connected products will offer “digital lifetime guarantees,” allowing customers to replace devices for free when the original hardware becomes obsolete.**

Trend 4: Robots in the Wild

# Growing the enterprise's reach—and responsibility





1

2

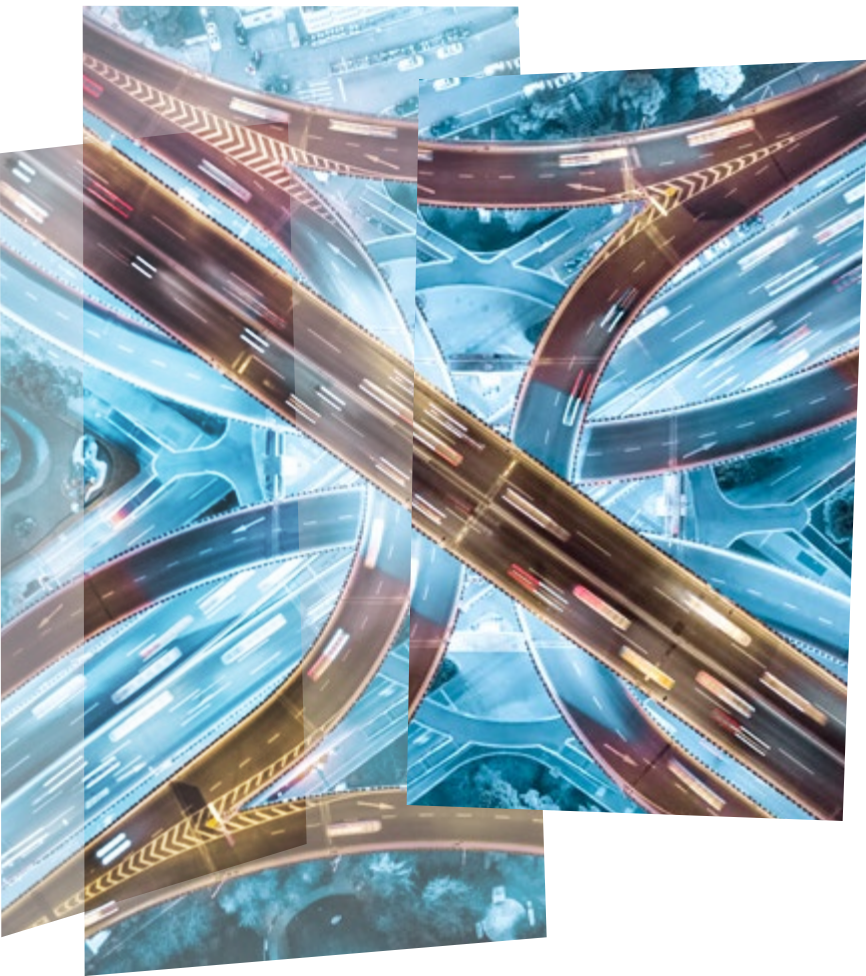
3

4

Robots in the Wild

5

**Build new models of interaction and impact as robotics move beyond the walls of the enterprise. Companies in every industry will unlock new opportunities by introducing robots to the next frontier: the open world.**



## Once upon a time, a robot went hitchhiking

Built at Ryerson University in Toronto, hitchBOT had a simple goal: go out in the world and see how people react.<sup>1</sup> With pool-noodle arms, GPS tracking and simple communication software, it hitchhiked across Canada, visited Germany and the Netherlands and racked up thousands of fans. The next year, a new hitchBOT set out from Salem, Massachusetts with “San Francisco or bust” taped around its head and a bucket list of American landmarks to visit. Two weeks later, its disassembled body was found on a street in Philadelphia.<sup>2</sup>

hitchBOT (b. 2014, d. 2015) met an untimely end, but its journey is more significant and relevant than ever. Advances in robotics, sensors, speech recognition and computer vision are combining with shrinking hardware costs to make robots accessible for companies and industries that haven’t traditionally used them.<sup>3,4</sup> IDC predicts that the global robotics

market will reach \$241 billion by 2023; only half of that will be in manufacturing, the traditional mainstay of robotics sales.<sup>5</sup> At the same time, the rollout of 5G networks will unlock opportunities for all industries to extend their autonomous capabilities outside of contained settings like warehouses and production facilities—and into the open world.

These technologies are setting the stage for a massive robot migration, beyond controlled environments into uncontrolled spaces and from specialized industries to every industry. The significance of this transition cannot be understated. Even with a cursory knowledge of manufacturing, it’s clear the advent of robotics radically changed the economics of the industry, allowing companies to scale and transform in unprecedented ways. And as the sophistication of the machines grew, what the enterprise was able to accomplish did as well.





1

2

3

4

Robots in the Wild

5

Now the same benefits and advances that were largely limited to manufacturing and adjacent industries are coming to every company in every industry. Advanced robotics are offering a path to push the intelligence of the digital world out into the physical one, and a chance to further expand the capabilities of the organization. Like the makers of hitchBOT discovered, it won't be an easy transition, but it's rife with opportunity.

Some of today's biggest companies are already using this shift to find new ways to serve customers and improve operations. As many people anticipated, Amazon is entering the robot delivery business: its small, six-wheeled delivery vehicle, called "Scout," can autonomously navigate real-world obstacles like trash cans, pets and snow blowers; Scout also features a cute exterior designed to delight customers.<sup>6</sup> Walmart is introducing a variety of robots that scrub floors, check shelf inventory and sort inbound packages,

freeing up store associates to better engage customers.<sup>7</sup> And in the building industry, Advance Construction Robotics' TyBot is using repurposed self-driving car technology to automate the otherwise highly manual and physically demanding task of tying rebar, allowing jobs to get completed faster and more safely.<sup>8</sup>

The complete realization of this migration will take years, but there are already new opportunities available today for industries that have not focused on robotics in the past.

**Advanced robotics are offering a path to push the intelligence of the digital world out into the physical one.**

Take agriculture, where 2018 saw orders of robotic devices to food and consumer product companies grow by 48 percent.<sup>9</sup> In the fields, FarmWise is looking to deploy autonomous robots to handle everything from seeding, to weeding and harvesting. The California startup, which raised \$14 million in 2019, makes devices that combine computer vision, a host of sensors and learning algorithms to gather and act on data specific to each individual plant.<sup>10</sup> And in Denmark, Rosborg Food is using robots from OnRobot with advanced gripping technology and computer vision to handle delicate greenhouse plants. These capabilities allow OnRobot's devices to account for variances like misshaped or heavier materials—challenges that would have prevented robotics applications in greenhouse agriculture in the past. As these robots demonstrate, flexible and reprogrammable devices can be applied to a variety of material-handling tasks found across industries, making their potential for impact that much greater.<sup>11</sup>

What's more, businesses are thinking beyond applications that involve moving or manipulating physical items, to applications that explore human interaction as well. Swedish company Furhat Robotics is working with TNG, a Swedish recruitment firm, to deploy Tengai, a robot interviewer.<sup>12</sup> TNG believes that a typical job interview can be filled with chances for unconscious bias—based on age, gender or other factors—that influence both the job seeker and the hiring manager. Many companies have developed algorithms that attempt to eliminate this kind of bias, but Furhat's solution goes a step further: Tengai has a physical presence. She sits at eye level to the interviewee and performs some human-like behaviors (such as smiling and blinking) to give job seekers a somewhat familiar setting for an interview. But Tengai delivers an interview experience that's aimed at eliminating human bias, giving recruiters a more objective assessment of the candidate on which to base further decisions.



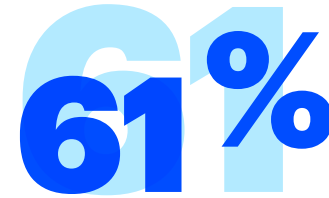
Companies have already seen the benefits of robotics in controlled spaces, from lower production costs, to higher productivity and increased capacity for analytics. Open world autonomy will amplify these benefits further—and, as these examples show, it's already unlocking new capabilities and opportunities in industries that have not traditionally benefited from robotics in the past.

These opportunities don't come free, though. As robots become feasible in more industries, the challenges and limitations that *only* robotics companies have dealt with in the past are now obstacles and opportunities every enterprise must consider.

The first major challenge will be the necessary talent investments. The global mobile robotics market is projected to grow to nearly \$31 billion by 2025—a 361 percent increase from \$8.58 billion

in 2016—and those fleets of robots won't deploy or maintain themselves.<sup>13</sup> Savvy businesses are investing in robotics hiring today, driving a 121 percent jump in demand for robotics technicians since 2017.<sup>14</sup> This is followed closely by the people who will handle all the data those robots gather and generate: data scientists, a profession that saw an 88 percent increase in demand from 2018 to 2019.

Just as important is the reality that not every company will be able to find the ready expertise in the talent market. Existing degree and certificate programs can't meet this exploding demand for talent, and leaders know it. Already, 84 percent of employers have talked about plans to upskill their workforces by 2020—up from just 21 percent in 2011.<sup>15</sup>

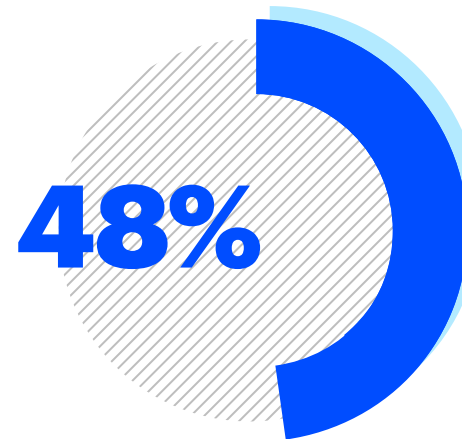


**of executives expect their organizations will use robotics in uncontrolled environments within the next two years.**

Businesses are moving beyond collecting and relying on data from their own operating environments toward a future where robots allow them to interact physically with the world. Accessing the full opportunity of this new frontier will require robotics technicians, data scientists and fleet management expertise at a level that can only be met through a strategic combination of hiring and sustained upskilling efforts.

Talent challenges are only the beginning. These forays into the open world will also force companies to consider a new audience impacted by their products and services: people with whom they have no employee or customer relationship. When robotics remained confined to companies' own controlled environments, they could draw boundary lines around specific audiences that might interact with the devices: a company's workforce or existing customers. Open-world autonomy makes those boundaries moot.

Amazon's Scout delivery device will interact with employees who send the robot into the open world, as well as customers when it arrives at their door. But in between those two endpoints, Scout may also cross paths with drivers, people walking their dogs, mail carriers and curious children or adults. Some people will find the device interesting and want to interact with it; others may find it intrusive and want to steer clear of it; and a few may even want to vandalize it. Amazon and other companies must prepare for these and myriad other eventualities, gathering data all the while to better inform future robotics efforts. That means a substantial investment in human-computer interaction expertise. It also calls for expanding that expertise beyond the strictly defined audiences that companies have focused on in the past.



**Consumers surveyed believe robots are poised to make their lives easier (48%) or more efficient (41%). At the same time, 39% state they are concerned robots will introduce more problems than they fix.**

## Get ready to meet the challenge

Finally, a large-scale migration of robotic devices into the open world poses unique challenges for development and testing of solutions. It's an area that demands a combinatorial approach to testing; a commitment to continued data collection and refinement of solutions after devices are in use; and for solutions whose fully autonomous time has not yet come, early experimentation that will inform large-scale rollouts when the technology and regulations allow.

In the self-driving car industry, companies are exploring ways of finding and accounting for edge cases in autonomous operation through simulation. Waymo, Alphabet's self-driving car business, has logged 10 million real-world driving miles so far, but it has simulated 10 billion more.<sup>16</sup> Microsoft is partnering with Toyota to develop digital twins for intelligent forklifts, allowing Toyota to simulate how an autonomous forklift will navigate an environment

and handle encounters with other pieces of equipment. Using Microsoft Azure to process data collected by devices and simulate future behavior allows Toyota to dramatically reduce the six months to a year that they would otherwise spend on automated guided vehicle implementation.<sup>17</sup>

UPS is using TuSimple, an autonomous trucking startup, to move cargo between Phoenix and Tucson, Arizona.<sup>18</sup> The system isn't fully autonomous; it's locked to a geographic location and a safety driver and engineer are always on board. But it is clear where UPS is headed. The company also created a subsidiary called UPS Flight Forward to oversee future drone operations, and is seeking government approval to launch an unmanned drone delivery service.<sup>19</sup>



Enterprises aren't just building these capabilities for themselves, either. Boston Dynamics is gearing up to release its first commercially available robot for open-world use. "Spot" is a quadrupedal bot with a long robot arm, designed so that customers can apply it to a range of use cases like pipeline inspection or 3D mapping construction sites.<sup>20</sup> For now, Spot still needs human handlers to tell it where to go. But the robot can function in open-world environments, keeping its balance on rough terrain and navigating mapped areas on its own.<sup>21</sup>

Experimentation with solutions like these today will give leaders a dramatic edge as technological advances make it possible to incorporate robots on city streets, university campuses and construction sites. Far outside the walls of the enterprise, machines are already contending with variable operating conditions, densely human-populated spaces and even other autonomous devices. Companies that get started today will position themselves to take the lead as robot migration becomes a major driver of value and growth.

Across industries, the proliferation of robots from the traditional controlled warehouse and manufacturing environments into the open world offers enormous opportunity. Increased customer interaction, data collection and even branding opportunities will be possible, as limitations on the physical services that companies can provide in customers' lives disappear. But capturing this opportunity will never be as simple as buying a robot and sending it out the door.

Finding the right way to integrate robots into organizations and the world includes challenges around talent, questions of human-computer interaction and a testbed that quite literally consists of the whole world—with no boundaries or built-in fail-safes. Businesses with an existing robotics practice may start out with an advantage in the robotics migration, but the opportunity is ripe for companies in every industry to extend their reach: beyond their controlled spaces, beyond their existing employee and customer relationships, and out into the open world.

**Across industries, the proliferation of robots from the traditional controlled warehouse and manufacturing environments into the open world offers enormous opportunity.**

# Big Takeaways

## The robots are coming

Advances in robotics, falling hardware costs and the advent of 5G are enabling a major shift. Businesses are starting to extend their robotics capabilities into uncontrolled environments and the open world, and robot use cases are expanding from specialized industries to every industry.

## Extending the business

Enterprises are being presented with exciting new paths to engage the world around them. Already, robots are being used by companies big and small to engage and delight customers, solve logistics difficulties or take on difficult and dangerous tasks. No matter the use case, advanced robotics offer enterprises an opportunity to push the intelligence of the digital world out into the physical one.

## Diving into the ecosystem

Every executive must start to see their company, at least in part, as a robotics company. This means forging new partnerships, hiring new talent and finding new vendors that will grant access to the skills, tools and machines that companies need to tackle their biggest ambitions.

Deep Dive

# Getting started with smart cities

**As robots make their way to city streets and airspace, it's critical that businesses collaborate with public leadership to ensure a safe and welcome transition.**

New technologies have always shaped the development of cities. When automobiles eliminated horse-and-carriage transportation, they transformed the look and feel of urban environments. Highways were constructed, suburbs got bigger and more space was dedicated to parking. But cities also shape the development and use of technology. Dealing with the consequences of having too many cars, New York City is adopting

congestion pricing to alleviate traffic, the city of Buffalo has eliminated minimum parking requirements for new commercial and residential projects, and several other cities have reduced or eliminated cars in their urban centers.<sup>22,23,24</sup>

Today, this relationship is once again taking center stage. As robotic capabilities grow and more businesses want to use them in the open world, companies are finding that introducing new devices and technology to the cityscape is anything but a smooth transition.

San Francisco perfectly demonstrates why. In 2019, the city took a preemptive step,

banning all government agencies from using facial recognition technology.<sup>25</sup> While this was in response to resident concerns about surveillance and privacy, it could also impede the city's ability to integrate cutting-edge technology that relies on computer vision, like optimizing traffic flow. On the other end of the spectrum, electric scooter-sharing startups Bird, Lime and Spin launched in San Francisco in 2018, distributing their scooters across the city. Initially, the devices were embraced by residents. But not long after the launch, the city banned *all* electric scooter-sharing companies, citing clashes with pedestrians, illegal scooter-riding on sidewalks and hazardous parking.<sup>26</sup>



## Robots at the watercooler, in the supermarket, on the freeway

Yet San Francisco has also shown a successful way forward: measured coordination between enterprises and the city. After the initial ban, the city developed a permitting program for electric scooters. Lime, Spin and Scoot (now owned by Bird) were all granted permits and allowed back onto city streets in 2019, alongside newcomer JUMP.<sup>27</sup> Also that year, Postmates worked with San Francisco to receive the first permit to test its autonomous delivery robot, overturning a blanket 2017 ban on the devices.<sup>28,29</sup> There are some limitations—each robot must have a human operator within 30 feet during all testing, cannot go faster than three miles per hour and must stay within a few restricted blocks. Plus, permits are only valid for 180 days. But public/private coordination like this sets everyone up for success in the long term.

Look at how UPS is preparing to run a drone delivery fleet. The delivery company has been granted certification from the FAA to run a first-of-its-kind

drone airline.<sup>30</sup> This certification does not place a cap on the number of drones that UPS can operate, which means the company has the flexibility to roll out this technology according to market demands. Additionally, the FAA has granted UPS certification to operate its drones beyond visual line of sight, meaning UPS's network will be able to cover more geography. UPS has partnered with WakeMed to bring drone delivery capabilities first to healthcare networks—where the company already has experience operating deliveries in African countries—and eventually UPS will expand to other industries as it gains operational experience.

Coordinated public/private efforts also create a level of trust that encourages local governments to not only welcome innovations, but also solicit them. Japan already has a long history with robotics; in 2017, the country employed approximately 300,000 industrial robots, the second highest number globally, and supplied nearly 55 percent

of industrial robots worldwide.<sup>31</sup> Now, in preparation for hosting the Olympics, government officials and robotics experts formed the Tokyo 2020 Robot Project, developing robots that will assist spectators throughout the Games.<sup>32</sup> The robots will provide visitors with directions and event information, and will support people who use wheelchairs.

If businesses want to introduce robots to city streets, they will need to partner with governments and gauge public sentiment. These partnerships may impose limitations and safeguards initially, but they are a key ingredient for long-term success. Continuously engaging with stakeholders will let businesses build critical support and a strong foundation for new technologies in the future.

# Why Now?

**The financial, mechanical and computational capability barriers of robotics are coming down, bolstering demand while bringing agility and scale closer than ever. Equipped to spread far beyond factory floors and repetitive tasks, the trajectory of robotics technology is outward bound.**

**Technology advancements have made robotics integration feasible across more industries than ever before.**

In the agriculture industry, robots have already improved efficiency and helped address labor shortages. More advanced robotic systems have the potential to take those gains even further, doing everything from taking care of and harvesting plants, to collecting on-site data, increasing crop yields. The global agricultural robots market exceeded \$4 billion in 2018 and is expected to reach \$10 billion by 2024, with a projected compound annual growth rate (CAGR) of 16 percent.<sup>33</sup>

Waymo developed its own line of sensors for its fleet of fully autonomous, self-driving cars, which have now driven more than 10 million miles on the road and 10 billion miles in simulations.<sup>34</sup> The equipped sensors boast a 95-degree vertical view (compared to 30 degrees for other sensors), and, in 2019, the company made its sensors commercially available.<sup>35</sup>

In 2018, the US Federal Aviation Administration (FAA) recorded 175,000 new commercial drones, an increase of 170 percent. This exceeded the 44 percent growth officials had initially predicted by such an extent that the FAA updated its long-term growth estimates—now predicting that the commercial drone market will grow to 835,000 aircraft by 2023.<sup>36</sup>



1

2

3

4

Robots in the Wild

5

## Key markets are shifting, both incrementally and radically, in ways that make robotics implementation increasingly more practical, popular and profitable.

Urban populations are on the rise, and with them grows the opportunity for robotic delivery capabilities at scale.<sup>37</sup> A recent study revealed that there is strong demand among 57 percent of global consumers for more restaurants to offer delivery; meanwhile, looking beyond food, global parcel volume is expected to more than double, from 87 billion in 2018 to 200 billion by 2025.<sup>38,39</sup> Companies are already piloting delivery robots in testbed regions.<sup>40</sup>

The growing industry of Robotics-as-a-Service (RaaS) allows manufacturing companies to outsource the often-prohibitive, up-front cost of automation, which offloads risk. The RaaS installed base is expected to experience a massive increase during a 10-year period, from approximately 4,000 units in 2016, to more than one million in 2026.<sup>41</sup>

## The advent of 5G has arrived, and with it comes a world more connected and powerful than ever before.

5G rollouts are happening worldwide. The US, UK, Germany and South Korea already have 5G in some regions, with many more countries planning to follow suit in the next year.<sup>42</sup> South Korea's SK Telecom hit one million 5G subscribers in the first 140 days of service, surpassing its 2011 4G LTE uptake.<sup>43</sup> And 5G is expected to account for 40-50 percent of global mobile connections by 2034.<sup>44</sup>

In 2019, carriers AT&T and Verizon both launched their 5G networks in more than a dozen US stadiums. The concentration of people, along with an augmented reality (AR) experience use case, made these venues the ideal place to vet the early rollouts. In the stadium, fans could connect to the network and participate in AR experiences through their smartphones, such as dancing with virtual NFL players.<sup>45</sup>

The record-breaking speeds, capacity for a higher number of connections and minimal latency of 5G are enabling a new frontier in the internet of things (IoT). In the healthcare industry, 5G devices are already being developed to enable remote surgery, which would allow for highly specialized training for the next generation of doctors. The expansion will bring previously inaccessible healthcare to worldwide populations.<sup>46</sup>

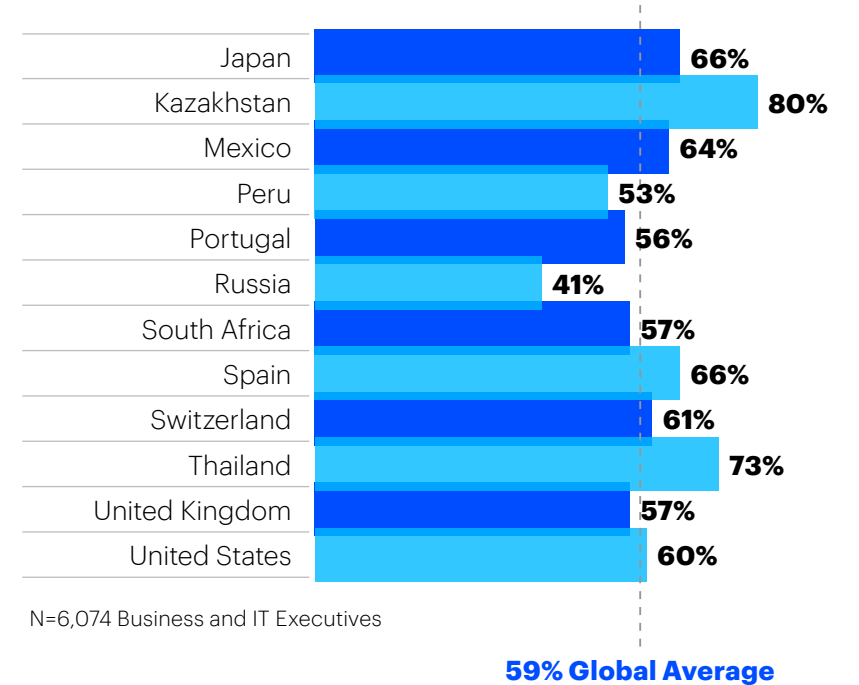
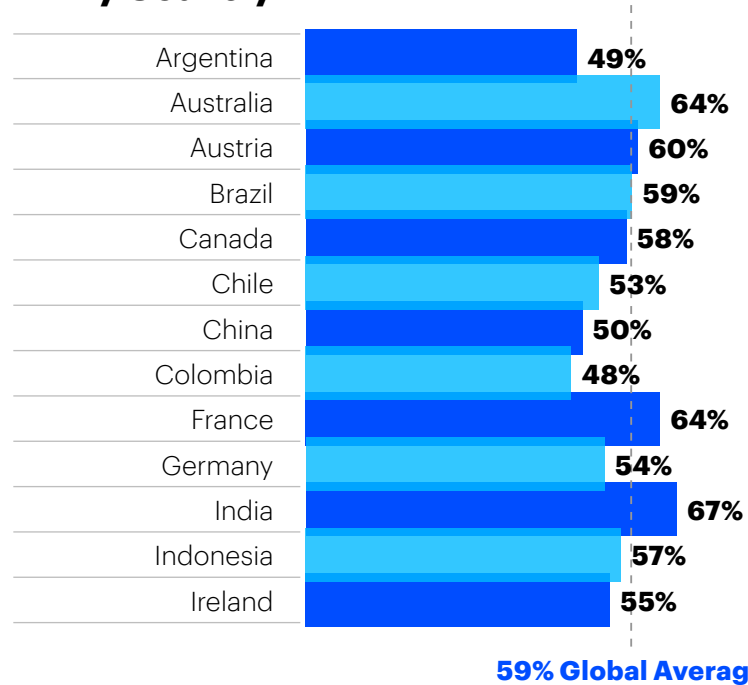
# Survey Stories

## Expanding responsibilities in a world of robotics

**59%**  
of executives agree:

**Social and service robots in public spaces will raise major ethical, legal, and societal concerns, including security threats and privacy risks.**

**By Country**



N=6,074 Business and IT Executives

The robotic revolution and 5G-powered business models are poised to dramatically alter the competitive landscape for businesses in all industries—whether those businesses know it or not. While 95 percent of executives believe their organization will be using robots in uncontrolled environments in five years or more, the trend is already under way in retail where 76 percent of executives report they are already using robotics or anticipate using them in three years or less.

However, the Accenture Technology Vision 2020 survey results show that as robots move beyond the factory and warehouse, a range of opinions is forming around how people and the workplace will be impacted. Consumers appear to be enthusiastic about the potential of robots taking a bigger role in their lives: 48 percent of consumers believe robots are poised to make their lives easier, and 30 percent think robots will make their lives more fun. Some businesses, on the other hand, hold a more conservative outlook and retain concerns about the acceptance of robots in the workplace: 45 percent of business executives believe employees will be challenged to figure out how to work with robots. Interestingly, geography seems to be at least one factor guiding sentiment—perhaps due to social and cultural norms. Business executives in Kazakhstan,

China and Indonesia hold the strongest beliefs that people in their country will fully embrace robots in public spaces, whereas executives from Ireland, Canada and France, have some concerns that people will not accept robots.

More enterprises are understanding that the key to overcoming doubt and successfully pursuing opportunity means addressing new questions and responsibilities. Fifty-nine percent of executives believe that social robots in public spaces will raise major ethical, legal and societal concerns, including security threats and privacy risks. More than immediate risk, businesses must also consider the impact robots may have on the “digital divide”—the disparity between those who have access to technology and those who do not. While 61 percent of executives believe robots can reduce the gap on inequality and the digital divide, 28 percent believe inequalities will widen, or significantly widen, as more robots emerge in society.

As executives craft strategies to guide the enterprise into a robotics-driven future, they must account for the growing impact their presence will have on customers and society at large. Ensuring safe and equitable integration with the world will be one of the pillars of success.

A large graphic of the number 45% in blue, with the 45% text overlapping a light blue circular shape.

**of executives believe employees will be challenged to figure out how to work with robots.**

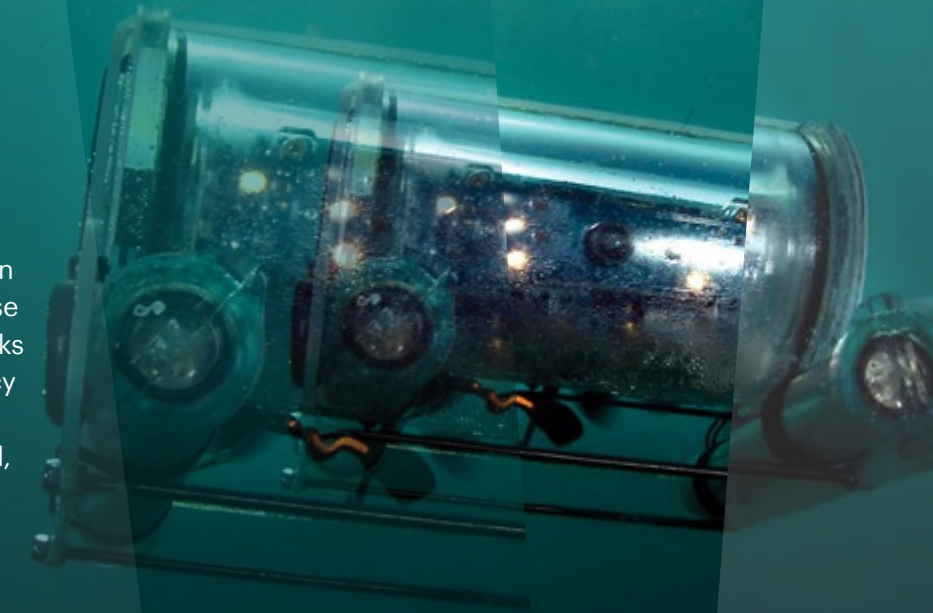
Deep Dive

# Where are robots headed first?

**Robotics technologies have been distributed disproportionately for decades.**

Concentrated mostly in manufacturing and shipping, they've been limited to a few key industries like automotive manufacturing and located almost exclusively in controlled spaces. Amazon currently relies on more than 200,000 robots to move packages and other goods throughout its warehouses.<sup>47</sup> On a daily basis, Chinese e-retailer JD.com guides 200,000 packages through an entirely automated fulfillment center.<sup>48</sup> FANUC, a Japanese manufacturing company, employs a cloud solution that connects more than 21,000 of its robots, saving customers more than 2,400 hours of unexpected downtime and the company an estimated \$72 million since its introduction.<sup>49</sup>

One reason robotics have remained concentrated in controlled spaces is latency: in factory or warehouse environments, robots largely perform repetitive tasks with little variance, so that connectivity and latency are of minimal importance. Yet in recent years, as mobile connectivity has become more widespread, faster and more reliable, companies have begun to explore the possibilities of robotics outside of controlled spaces, and new industries are getting into the game.



## Find new testbeds

In 2018, the highest number of robots ever shipped went to non-automotive businesses in North America.<sup>50</sup> Mining companies are using unmanned machines to increase safety and efficiency, with Komatsu's Front Runner autonomous haulage system moving large quantities of surface material 24 hours per day without sending human operators into dangerous sites.<sup>51</sup>

In agriculture, autonomous tractors have improved data collection, planting efficiency and accuracy; New Holland's autonomous tractor lets farmers take full advantage of good weather by operating at any time of day.<sup>52,53</sup> The trend is underway globally as well. FlyZoo, Alibaba's 290-room hotel near its headquarters in Hangzhou, China, is almost entirely autonomous, with robots delivering room service and fresh towels, and mixing drinks for guests in the hotel bar.<sup>54</sup>

Businesses that are new to this space are finding unique ways to manage the demands of open-world autonomy. On busy streets, crowded sidewalks, remote terrain or even inside homes, safe operation means reacting to irregularities instantly. At the University of California, Berkeley, Kiwibots—four-wheeled delivery vehicles approximately the size of an ice cooler—

deliver food to students around the school and in nearby neighborhoods. Someday the robots may be fully autonomous, finding their own routes. But for now, the Kiwibots are guided by remote human operators who plot “waypoints” and send the bots instructions at five- to ten-second intervals.<sup>55</sup>

Companies are also beginning to explore the value of 5G in enabling a larger impact through robotic migration, and they aren't waiting for 5G rollouts to come to them. In the US, AT&T and Badger Technologies—the product arm of manufacturing services company Jabil—are partnering to accelerate retail automation with 5G-enabled, in-store robots. Badger's robots can identify out-of-stock, mispriced or misplaced inventory, and AT&T's in-building 5G and edge-computing solutions provide the robots with the computational power and lower latency needed to function efficiently.<sup>56</sup>

Cities are also finding they can attract innovation and opportunities by rolling out 5G, turning their built environments into today's newest and most valuable testbed. The Orkney archipelago in Scotland, with a

population of just 22,000, has historically been among the last to receive new technology infrastructure. But Orkney is betting big on 5G as not only a way to improve their own connectivity, but also to drive business engagement and investment. A consortium backed by a government grant is operating a private 5G network across the islands targeted at local industrial needs: “If we can drive industrial use then there will be more demand, which means more revenue, which means more capacity,” explains Greig Paul, an academic member of the consortium.<sup>57</sup>

Similarly, the Chinese city of Chongqing opened the first 5G-enabled open-road autonomous vehicle pilot zone in the country. Local automaker Chang'an is using the 4.3-kilometer-long area to test self-driving vehicles, reportedly working on building robotic taxis and an automated parking system.<sup>58</sup>

**The robotics migration will happen across multiple fronts and in several stages. The long-term rollout of 5G will enable the full potential of open-world robotics over the coming years; leaders are finding ways to get early access or even facilitate its expansion. In the short term, there's already new value to be captured from the first phases of the robotics migration, and significant advantages to be gained for those who begin today.**



# Decision Points

## How will the advent of open-world robotics impact your industry?

- | Conduct a discovery initiative to identify the latest advancements in robotics underway in your industry.
- | Assign a cross-functional group to study these insights and forecast where the company stands to grow, or be threatened, based on the trends.
- | Develop a strategy to build, buy or partner in order to develop the necessary robotics capabilities.

## Is your business ready to engage a wider set of partners?

- | To ensure the success of robotics innovations, companies need to be prepared to interact with a larger set of stakeholders. Engage government regulators to create policies for autonomous devices in new environments and identify vendors for collaboration to shape strategic agendas.

## Are you tracking the launch of 5G networks in relevant markets—or exploring new markets based on 5G availability?

- | Increased access to 5G networks will help spur widespread adoption of connected assets, including robotics. Increased mobile network speeds and lower latency are major factors that will enable autonomous devices in new environments. Look for opportunities to capitalize on nearby launch markets and explore the industrial applications that 5G networks present.

## How will your business build trust for robots among the variety of stakeholders who will encounter them?

- | Take steps to help people who are interacting with these devices to understand machine behavior. Your company will be responsible for handling interactions with a much larger array of individuals, and many of these people will not be your customers, so these encounters may be their first interaction with your company. Consider the user experience and human-machine interaction expertise your company will need to navigate these uncertain waters.
- | To minimize potential disruptions your robots may cause in uncontrolled environments, take steps to design devices in a way that clearly conveys intent. Work with industry partners to standardize these systems whenever possible.



1

2

3

4

Robots in the Wild

5



# Robots are coming of age

# Bold Predictions

## 5 In five years

Urban dwellers will have 5 to 10 daily interactions with autonomous devices.

## 7 In seven years

A major clothing retailer will become the first to introduce consumer-facing robotics services like in-home custom tailoring and same-hour size exchanges.

## 10 In ten years

There will be a 1:1 ratio between autonomous robots and healthcare professionals in every major hospital.

Trend 5: Innovation DNA

# Create an engine for continuous innovation





1

2

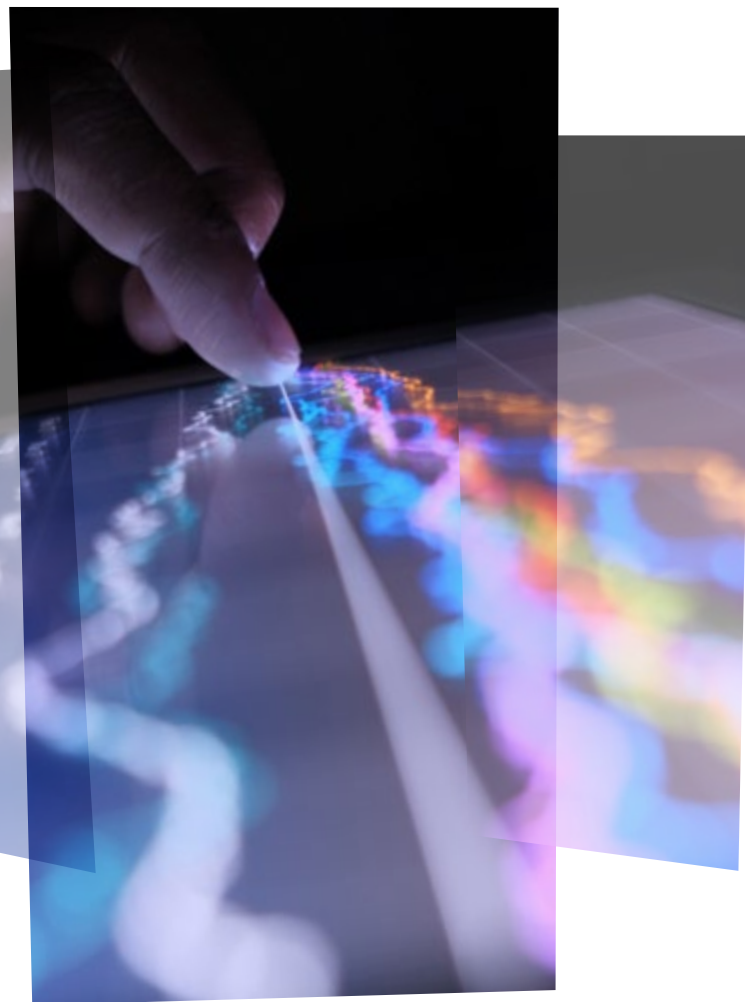
3

4

5

Innovation DNA

**Tap into the unprecedented scale of disruptive technology available today. Build the capabilities and ecosystem partnerships necessary to assemble the organization's unique innovation DNA.**



**Fujitsu wants to solve the world’s most complex problems with quantum computing—but the technology is still maturing. So, the Japanese IT giant teamed up with 1QBit, a quantum computing startup, to create something new—something not quite quantum, but quantum-inspired.**

They built a digital annealer, which can conduct calculations at quantum scale and speeds without needing to achieve a genuine quantum state. Taking inspiration from quantum designs, it’s able to solve complex problems that researchers once thought only quantum devices could solve.<sup>1</sup>

Fujitsu deployed the new digital annealer at the main manufacturing site for its flagship products. The site stocks 3,000 unique parts and gathering them for product assembly was largely inefficient.

Using the digital annealer to optimize the processes and workflows, employees reduced their distance traveled during parts gathering by 20 percent every month.<sup>2</sup> What’s more, Fujitsu isn’t planning to keep this innovation to itself. The company is expanding its business by offering new on-premises and cloud-accessible digital annealer services to clients in industries ranging from automotive production to retail.<sup>3</sup>



1

2

3

4

5

Innovation DNA

Fujitsu's efforts highlight the new approach to technology innovation all businesses must undertake as they enter an era where digital is everywhere. The company leveraged partnerships to access an emerging frontier of technology and reinvented its current tech in the process. Then Fujitsu applied the resulting new capabilities to a problem it has today, while surging toward the future by exposing new lines of business. In essence, Fujitsu turned the entire enterprise into an engine for innovation.

This level of comprehensive innovation is an imperative for companies looking to not just meet, but also exceed expectations in coming years. With mounting pressure from competitors and customers alike, the enterprise cannot afford to stand still, and incremental change won't be enough. Enterprises must continuously adapt and drive innovation through the entire organization

by pairing the opportunities yielded by an unprecedented range of technology with their own unique capabilities. The big challenge is pairing consistent, perpetual innovation with constant experimentation, using that combination to set a course for where the company will go next.

A transformation of this magnitude won't be easy. But it starts in a familiar place. The path forward begins with a renewed focus on the building blocks that have allowed companies to get to this point of opportunity in the first place: technology. To turn the enterprise into an engine for transformation, businesses must first assemble their unique innovation DNA.

**76%**

**Over three-quarters of executives (76%) believe that the stakes for innovation have never been higher—getting it 'right' will require new ways of innovating with ecosystem partners and third-party organizations.**

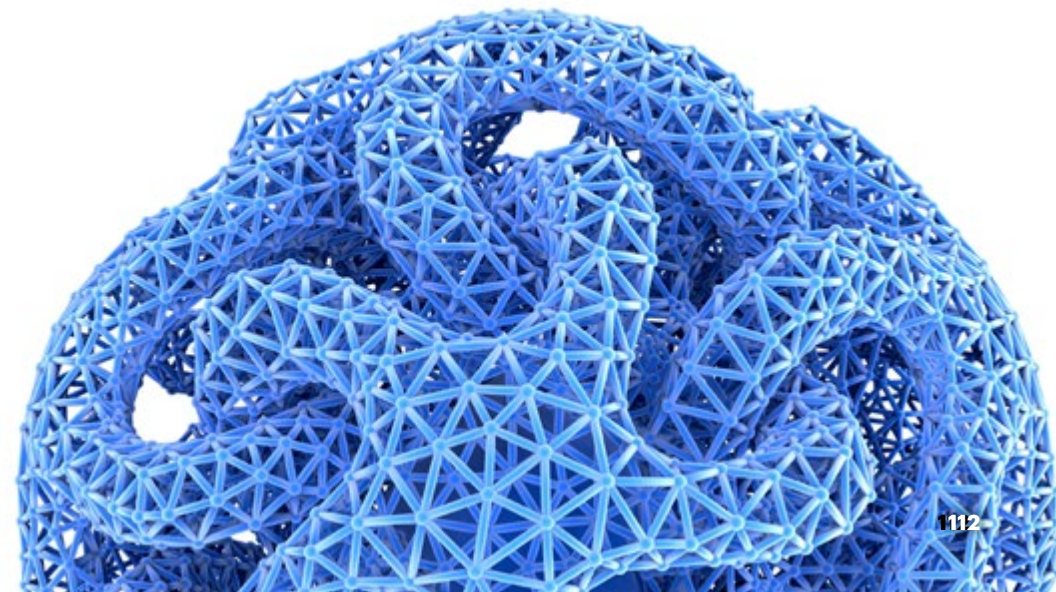
## The DIY of DNA

Just as human DNA determines individual traits, with chemical building blocks combining to set much of the course for who people will be as individuals, innovation DNA will define an enterprise as it grows into the future. Companies' innovation DNA has building blocks, too: maturing digital technology that is more commoditized and accessible; scientific advancements that are discrete yet deeply disruptive; and emerging DARQ (distributed ledgers, artificial intelligence, extended reality and quantum computing) technologies that are poised to scale rapidly. Leaders are weaving these areas of innovation together, forming their own unique triple helixes and setting their course for the future.

To develop an innovation DNA fit for the future, businesses must find their unique combination of the different building blocks. This starts with understanding the opportunities and risks of each.

Maturing digital technology is no longer an advantage, it's a requirement. But many companies are finding new value by commoditizing their systems. Choice Hotels International has started selling its cloud-based reservation system to other hoteliers, and Starbucks is licensing its mobile and loyalty program tech to Brightloom, which plans to provide the technology platform to other restaurant companies and more operators of licensed Starbucks franchises.<sup>4,5</sup> Commoditized and easily

accessible technologies are also making digital transformations increasingly straightforward—threatening any leading company that gets too comfortable. Consider how Disney is challenging current video streaming leaders with its new streaming service, Disney+. The company gained 10 million subscribers in its first day of operation, and the service is expected to become a major new competitor for customers' time and attention in the digital streaming market.<sup>6,7</sup>

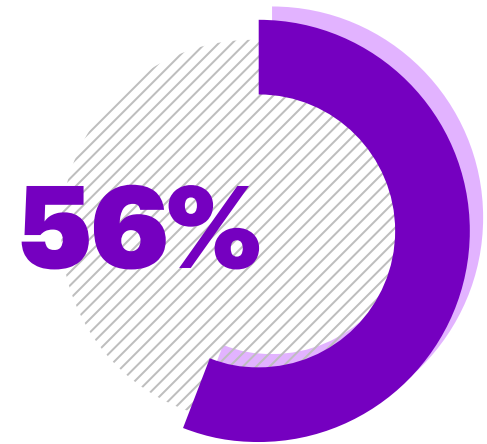




Meanwhile, scientific advancements are broadening enterprises' innovative efforts beyond digital technology and turning into competitive advantage faster than ever before. Advances in material sciences, energy, genomic editing and more are deeply disruptive in related industries, but also beginning to challenge boundaries and pull businesses in new and unexpected directions. Dyson has taken its deep understanding of mechanical engineering to explore battery technology, where the company has been making investments for several years.<sup>8,9</sup> The research opened an exciting new path. In 2018, Dyson filed a patent for an electric vehicle and planned to build a related manufacturing facility in Singapore

in 2020.<sup>10</sup> Ultimately, the company ended the program, but its research provided valuable insight for future products.<sup>11</sup>

Finally, DARQ technologies are growing in utility and adoption by the day. Leading businesses are exploring solutions with the technologies and actively building their foundation for a world with digital everywhere, while competitors may be caught off-guard by faster-than-expected change. Domino's Pizza is getting a head start by teaming up with Nuro, an autonomous-driving startup, to test self-driving pizza delivery. Customers in Houston can opt-in during the check-out process, and their pizza is delivered via Nuro's autonomous R2 vehicle.<sup>12</sup>



**of executives believe rapid advancements in new technologies and scientific innovations are poised to disrupt their industries.**

## According to the Technology Vision survey, executives rank

**1. Climate change**

**2. Sustainable development**

**3. Energy**

**as society's biggest challenges that scientific research and advances can address.**

It is imperative that enterprises leave no stone unturned with the innovation DNA process, exploring and investing in the myriad opportunities available today in these three areas. But pioneers aren't stopping there. Differentiation in the post-digital era will be driven by powerful combinations of the different innovation building blocks. While leading businesses should have efforts across all three spaces, what will truly set companies apart is the way they merge and combine the technologies with the core competencies of their business. Already, leaders are seeing the benefits—aligning seemingly separate innovation strategies to radically differentiate themselves, leapfrog industry competitors, build a new generation of products and services and even create new markets.

Kebotix is a startup that uses AI—a DARQ technology—to speed up a physical scientific endeavor: materials discovery. New materials are often discovered through the slow process of taking molecules with known properties and testing slight variations, searching for a viable new creation. Kebotix is accelerating the process by feeding 3D molecular models of compounds that have desirable properties into its AI system, which comes up with new designs that fit the same model.<sup>13,14</sup>

## Accelerate the innovation engine

Enterprises are also finding that the combination of digital technologies and scientific advancements will let them tackle bigger challenges. Anheuser-Busch, the largest user of rice in the United States, is partnering with Indigo Agriculture, which leverages microbiology and data-driven analytics to make agriculture more sustainable and profitable.<sup>15,16</sup> Indigo's scientists study bacteria and fungi that allow plants to thrive in harsh environments, and develop them into seed coats, which protect crops from extreme temperatures, water scarcity and more. The company also offers data-driven decision-making support to optimize regenerative agricultural practices and improve farm margins. By partnering with Anheuser-Busch, Indigo is offering growers both the incentive and the means to commercially produce sustainable rice.

Incorporating DARQ technologies into mature markets will also ground these tech explorations in reality. The 2019 live action *The Lion King* movie, for instance, was almost entirely shot in virtual reality (VR). Rather than building physical sets, each location in the movie was created in a videogame-like virtual environment,

with digitized animals, in which the filmmakers could roam and film. The result became the ninth highest grossing film of all time, feeding one of Disney's core businesses, but the technology used to make it was brand new—exposing an innovative potential path forward for the company.<sup>17,18</sup>

Discovering these connections and building a company's innovation DNA is about more than checking a box for each of the three categories of innovation. Leaders will use them to turn the enterprise on its head, becoming an engine for constant innovation. Well-executed strategies will not only explore and combine the different blocks, but also accelerate the discovery process by forging new partnerships, fueling experimentation and building a culture and ecosystem that will drive those efforts into disruption at scale.

Across industries, leading companies are opening dedicated spaces for exactly this—launching innovation centers where researchers are tasked with exploring how new technologies, or combinations of technologies, can enhance their business.





1

2

3

4

5

Innovation DNA

In partnership with Accenture, Cisco and Hewlett Packard Enterprise, Walt Disney Studios opened StudioLAB, a tech hub focused on using cutting-edge technologies to advance and optimize the art of storytelling.<sup>19</sup> All four companies are combining their expertise to come up with new ideas and develop new tools. They're using innovative technologies to explore the possibilities of immersive entertainment, with artificial intelligence and IoT poised to deliver the next generation of entertainment experiences and production capabilities of the future.<sup>20</sup>

Kraft-Heinz has also opened a technology-focused hub, meant to fuel innovative ideas and digital growth. The company acquired Wellio, an AI food-tech startup in San Francisco to kickstart the new lab, working on food-related digital solutions for Kraft-Heinz customers.<sup>21,22</sup> And Marriott has an innovation lab where researchers use a series of model hotel rooms to experiment with new technologies and different designs. Experimentation ranges from floor layouts, to desk size, to drones delivering cocktails.<sup>23</sup>

Not every business will have the resources to open a dedicated innovation hub. But all can translate the attitude and mindset of innovation hubs into their own strategies. Enterprises must adopt ecosystem-based innovation strategies, be it through venture-backed partnerships, academic research engagements or relationships with other companies. The problems, and potential, of continuous innovation is an undertaking that few will successfully achieve on their own.

Innovation is evolving. Success in the future means constantly exploring what's ahead, around and inside of the business. Leaders will seize opportunities through each of today's innovation building blocks and form their own unique innovation DNA.

**Innovation is evolving. Success in the future means constantly exploring what's ahead, around and inside of the business.**



1

2

3

4

5

Innovation DNA

# Big Takeaways

## Unprecedented innovation opportunities

Businesses today have an unprecedented range of innovation opportunities before them. Leaders will take advantage of this diversity, ensuring their innovation strategies include efforts from across three major categories: maturing digital technologies, scientific advancements and emerging DARQ technologies.

## Build your innovation DNA

This isn't a matter of checking three boxes. Enterprise leaders must carefully construct their organization's unique combination of technology innovation. Determining where they hold an advantage, where they are lagging and what their future ambitions are will help leaders blend efforts across all three categories to construct their innovation DNA.

## Create an innovation engine

Businesses cannot look at innovation as an incremental effort; they must design the capabilities to make it an ongoing practice in the organization. Building innovation hubs, centers of excellence and co-innovation partnerships are some of the ways successful companies are ensuring a constant injection of new skills, technologies and ideas.



1

2

3

4

5

Innovation DNA

#TECHVISION2020

Deep Dive

# Driving continuous innovation in the auto industry

**Few companies can say they excel in all areas of technology innovation today. Yet there is plenty of opportunity for businesses to learn from leaders in each area when planning their innovation strategies.**

With a keen eye, businesses will find new ways to drive competitive advantage and challenge the paradigms of their industry. A closer look at the automotive industry shows disruptive potential simmering as companies across the sector develop their innovation DNA.

One signal of maturity in a market is a company's embrace of digital-first services alongside the products for which they're traditionally known. Look at what Volvo is doing with Polestar, its electric car brand.<sup>24</sup> Rather than just sell or lease vehicles, Polestar is offering vehicle leases that include a number of services—like insurance, roadside assistance and maintenance—all managed via a comprehensive digital experience.

Lessees can use their phones to schedule their car to be picked up, serviced and returned—all during the workday when the car isn't in use. This offering represents Volvo's mature understanding about changing customer expectations in a world filled with access to digital technologies. On-demand and mobile access to car-related services demonstrate Volvo's innovation potential in the changing automotive market.

Automakers have also been longtime investors in materials science research, primarily supporting the persistent goals of better vehicle handling and fuel economy by reducing weight. Now, some leaders are pairing that goal with another: sustainability.



1

2

3

4

5

Innovation DNA

Honda R&D Americas has partnered with research groups at Clemson University and the University of Delaware to explore using composite materials for vehicle doors and hoods.<sup>25</sup> As a baseline goal, the groups are developing a door for the Acura MDX SUV that achieves a 42.5 percent weight reduction while meeting similar performance metrics on crash testing and durability. The effort also allows for production at scale while being 100 percent recyclable and adding no more than \$5 per saved pound of weight. By taking a systems approach through materials science research, Honda is setting itself up to lead in multiple industry benchmarks, while adding a level of sustainability that hasn't been possible with passenger cars in the past.

Automotive manufacturers and those developing autonomous vehicles are also paving the way for further advances in DARQ technologies, highlighting the amplifying effect that ecosystem-led innovation can have. For instance, Waymo has publicly released data from its autonomous vehicles for academic researchers to use.<sup>26</sup>

Lyft has also taken steps to release similar data in the spirit of collaborative research that can advance the entire field of autonomous vehicles.<sup>27</sup> This could eventually bode well for companies like Ford and Volkswagen, both of which have entered joint partnerships to develop autonomous vehicle technology.<sup>28</sup> The fact that two automotive competitors are joining forces to innovate speaks to how far companies must go to become innovation leaders within their industries.

These innovations will not stay contained to specific industries for long, as momentum behind transformative technology pushes more investment and advancements. Already, improvements to machine vision and image recognition capabilities—which were being led largely by advancements in autonomous vehicles—are now finding new applications in forward-thinking enterprises. Pinterest Lens is a visual search engine that recognizes more than 2.5 billion objects, “including tattoos, nails, sunglasses, cats, wedding dresses, plants, quilts, brownies, natural hairstyles, home décor, art, food and more.”<sup>29</sup> This tool is being used by

80 percent of Pinterest customers and pairs well with the company's approach to surfacing purchasable products alongside visual searches.

Looking further ahead, groups like Facebook Reality Labs and Oculus are pairing AI image recognition with extended reality (XR) experiences. They've begun collecting photo scans of indoor and outdoor spaces in their “Real World Index.”<sup>30</sup> Ultimately, the goal of this index is to help XR devices save energy by drawing from this compendium instead of re-mapping spaces when an individual enters a new area. The opportunities for cross-collaboration are rampant, waiting for bold enterprises to seize them.

When it comes to maturing markets, scientific advancements or DARQ, businesses are finding that these three horizons complement one another more often than not. While not every business has each of these lenses fully developed, it is important that companies remain open to exploring each of them and forming the partnerships to build their own unique innovation DNA.

# Why Now?

**With unprecedented opportunities coming from emerging and maturing technologies, innovation isn't just about the next incremental step. It's about building the right DNA to turn the enterprise into an engine for change.**

**With SMAC reaching nearly universal adoption, organizations can no longer rely on these technologies alone to drive growth or differentiation.**

- | The smartphone market is stalling. IDC's Worldwide Quarterly Mobile Phone Tracker found that global smartphone shipments declined 4.1 percent from 2017 to 2018.<sup>31</sup> This continued into 2019: Q1 shipments were down from 2018 numbers by 6.6 percent.<sup>32</sup> In Q2, they were down 2.3 percent year over year.<sup>33</sup> Only in Q3 did the industry see an uptick, with shipments rising 0.8 percent year over year, ending nearly two years of decline.<sup>34</sup>
- | A recent report showed that 91 percent of organizations use social media platforms for marketing.<sup>35</sup> However, social media user growth is starting to decelerate. After years of impressive growth, social media platforms saw just a one percent year-over-year increase between 2018 and 2019.<sup>36</sup>
- | NewVantage Partners' 2019 Big Data and AI Executive survey found that data analytics and big data investments are nearly universal across Fortune 1000 companies.<sup>37</sup> Almost 92 percent of surveyed companies said they are increasing their pace of investment in big data and AI, and nearly 68 percent have appointed a Chief Data Officer.
- | The RightScale 2019 State of the Cloud report, from Flexera, indicated that 94 percent of respondents use a cloud service, and 84 percent have a multi-cloud strategy.<sup>38</sup>



## The imminent rise of DARQ technologies has become undeniable as investments and research initiatives increase.

Organizations are starting to see AI investment as a core part of their innovation strategies. In NewVantage Partners' 2019 Big Data and AI Executive survey, 96 percent of participating companies said they are investing in AI, compared to less than 70 percent in 2017.<sup>39</sup> And 80 percent said AI is their most important disrupter.

Growth is forecasted across DARQ technologies. IDC predicts that global spending on AI systems will grow at a CAGR of 28 percent between 2018 and 2023, with spending by 2023 reaching \$97.9 billion.<sup>40</sup> The industry analyst also forecasted 2019 blockchain spending of \$2.7 billion—80 percent higher than in 2018—and predicts the market to reach \$15.9 billion in 2023.<sup>41</sup> In AR and VR, spending is predicted to exceed \$16 billion for 2019 and \$160 billion in 2023.<sup>42</sup>

Even in quantum—arguably the most nascent DARQ technology—investment has been growing rapidly. An analysis by *Nature* found in excess of \$450 million in private funding for quantum technology companies in 2017 and 2018, separate from the efforts of major players like Google, Alibaba, IBM, Baidu and Hewlett Packard doing their own research.<sup>43</sup>

## As scientific research drives new cross-industry partnerships, organizations are recognizing how important these advancements are for their long-term innovation strategies.

Rising demand for cleaner, greener and more powerful energy storage solutions is driving cross-industry investment in battery and energy grid innovation. In the first half of 2019, organizations invested \$350 million in advanced lithium-ion technologies, compared to \$600 million for all of 2018.<sup>44</sup> While much of the demand comes from the electric car market, investments are deriving from many other sources, including solar and wind power companies and the US Department of Energy.<sup>45</sup>

Collaborative partnerships are also emerging in response to demand for smart materials in aerospace and defense, but the value of this research could cross industries. According to Grand View Research, the global market for smart materials is expected to reach \$98.2 billion by 2025.<sup>46,47</sup>



1

2

3

4

5

Innovation DNA

#TECHVISION2020

Deep Dive

# Evolving technology architecture in the quest for innovation agility

**Today's fast-moving world requires in-the-moment, individualized experiences and choice. But the technical architectures and patterns of the past are not built for these ephemeral conditions.**

When a technical component may only be needed for a short burst of time, and at a scale exponentially higher than the norm, efficiency demands dynamic and adaptable architectures made up of APIs, microservices, containers and software-driven infrastructure.



1

2

3

4

5

Innovation DNA

This type of adaptability in architecture has allowed leaders to realize innovation at scale across the enterprise and into new technology areas. Spotify built its adaptable architecture using these technologies to support more than 200 million monthly active customers and hundreds of billions of events per day.<sup>48</sup> The company has extended these interfaces to support emerging technology channels like XR, creating a new way to interface with Spotify's music service in Magic Leap headsets.<sup>49</sup>

Other companies are radically reimagining how data is stored. A Microsoft Research project called "Project Silica" used recent ultra-fast laser optics discoveries and machine learning to encode data into quartz glass.<sup>50</sup> The glass is more resilient to environmental factors than traditional storage methods and is designed specifically for storage and retrieval from the cloud. When Warner Bros. learned about it, the two companies collaborated on the experiment's first proof of concept—and successfully stored and retrieved the entire 1978 Superman movie.

But many enterprises have legacy systems holding them back from accessing the capabilities that would allow them to reinvent the business. In an Accenture survey, more than 80 percent of respondents indicated they would like to replace all of their core legacy systems, but remain dependent on them.<sup>51</sup> And 83 percent of respondents say technical debt—the flaws, complexities and inadequacies that make legacy systems unfit for today's business environment—severely limits their organizations' ability to be innovative. Struggling to manage this debt takes up time and investment that is needed to innovate, limiting the opportunity to be a leader in these future systems.

Businesses challenged with legacy systems should focus on gradual, but targeted, technology transition strategies that will help them build the digital foundation they need to support today's constantly changing environment. This approach will provide the basis for integration of DARQ and future technologies.

A digital decoupling approach takes stock of where an organization's legacy systems are creating bottlenecks or inefficiencies, then introduces different technological approaches to solve those issues. Businesses can run new technologies in parallel with their legacy systems—such as APIs, microservices, event-driven architectures, DevSecOps, data lakes and more using Agile and domain-driven methodology approaches to manage the changes. With these in place, companies can gradually migrate data and critical functionality, maximizing value.

Goldman Sachs, for instance, built a platform called Marquee, which the company used to decouple data from its respective data silos.<sup>52</sup> The platform combines transaction, research, market data and more into a data lake, and uses machine learning algorithms to generate fresh insights that guide decision-making.

**While technical architecture is an often-overlooked component in the quest for business agility, it is one of the most urgent investments for companies looking to compete in the post-digital era. Digital decoupling is the architectural approach that will enable enterprises to unlock the speed and technology transformation they need to support continuous innovation at scale.**

# Decision Points

## How is your enterprise exploring multiple fronts of innovation today?

- | Examine your current approaches to the three categories of innovation. Identify where your strengths are and what areas may be untouched.
- | Set organizational goals and strategies that build towards a comprehensive innovation DNA. Grow existing efforts or stake out new areas across all three fronts.

## Is your organization developing an integrated innovation strategy?

- | Gather input from internal groups to determine the breadth of each team's innovation agendas. With this input, work with your organization's leadership to recalibrate and reflect the shared goals of the various teams.

## Does your company have resources (time, space, people) dedicated to continuous innovation?

- | As your organization develops and refines its innovation strategy, explore the potential of launching a dedicated innovation practice. These practices can present a more straightforward way of exploring multiple innovation frontiers in a systematic fashion, while giving other groups in your organization a resource when they are interested in a technology with future potential.

## Which organizations are possible partners for co-innovation efforts?

- | Seek out industry and ecosystem partnerships to help your company establish a dedicated innovation practice or oversee specific co-innovation projects. Your organization's ability to innovate around multiple innovation frontiers will depend on looking outward and understanding advances that are happening. A strong set of partners is necessary for this to succeed.



1

2

3

4

5

Innovation DNA

#TECHVISION2020

# Get disruptive with your DNA

# Bold Predictions

## 2 In two years

**An independent group of academics will announce quantum supremacy has been achieved. In six years, 65 percent of the Global 2000 will have hired quantum computing specialists.**

## 7 In seven years

**The largest user of CRISPR technology will be the agricultural and food industry.**

## 15 In fifteen years

**The majority of the world's cold data will be stored through a medium almost no organization is using today, such as glass or DNA.**

# About the Technology Vision

**Every year, the Technology Vision team partners with Accenture Research to pinpoint the emerging IT developments that will have the greatest impact on companies, government agencies and other organizations in the coming years. These trends have significant impact across industries and are actionable for businesses today.**

The research process begins by gathering input from the Technology Vision External Advisory Board, a group of more than two dozen experienced individuals from the public and private sectors, academia, venture capital and entrepreneurial companies. In addition, the Technology Vision team conducts interviews with technology luminaries and industry experts, as well as nearly 100 Accenture business leaders from across the organization.

The research process also includes a global survey of thousands of business and IT executives from around the world, to understand their perspectives on the impact of technology in business. Survey responses help to identify the technology strategies and priority investments of companies from across industries and geographies. In parallel, a consumer survey is conducted to understand the use and role of technology in people's lives.

As a shortlist of themes emerges from the research process, the Technology Vision team reconvenes its advisory board. The board's workshop, a series of 'deep-dive' sessions with Accenture leadership and external subject-matter experts, validates and further refines the themes.

These processes weigh the themes for their relevance to real-world business challenges. The Technology Vision team seeks ideas that transcend the well-known drivers of technological change, concentrating instead on the themes that will soon start to appear on the C-level agendas of most enterprises.



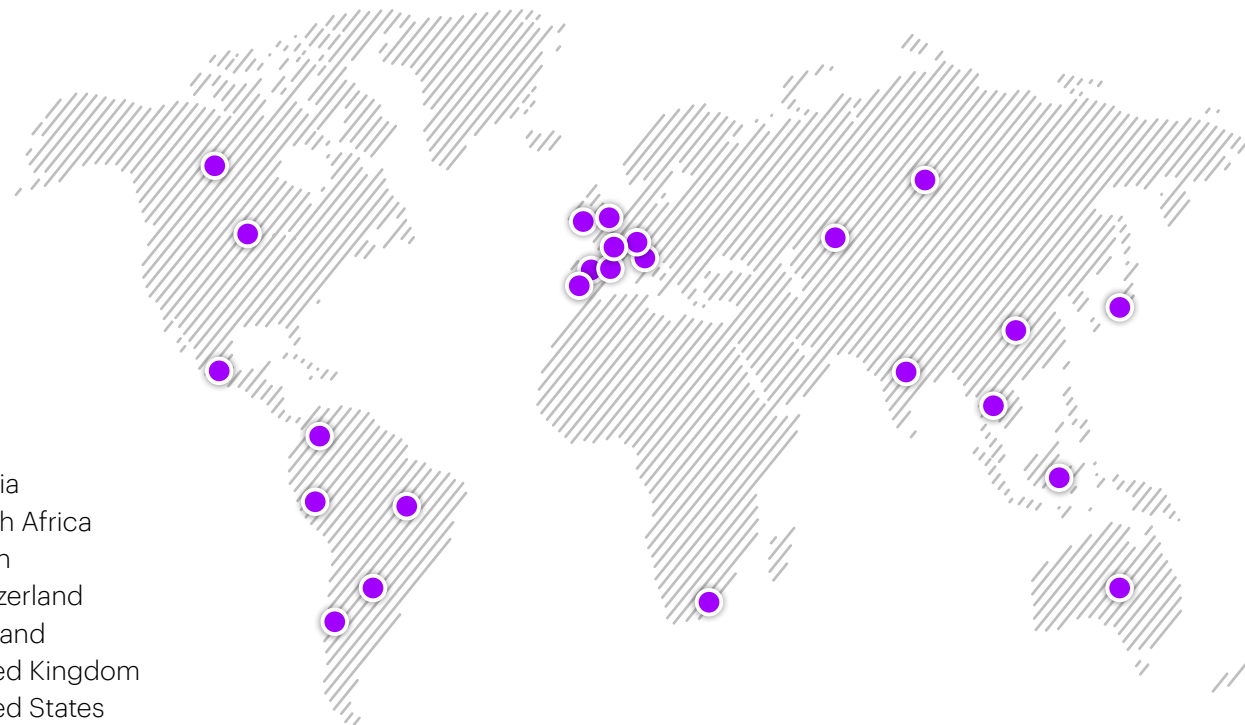
# Survey demographics

## Business survey

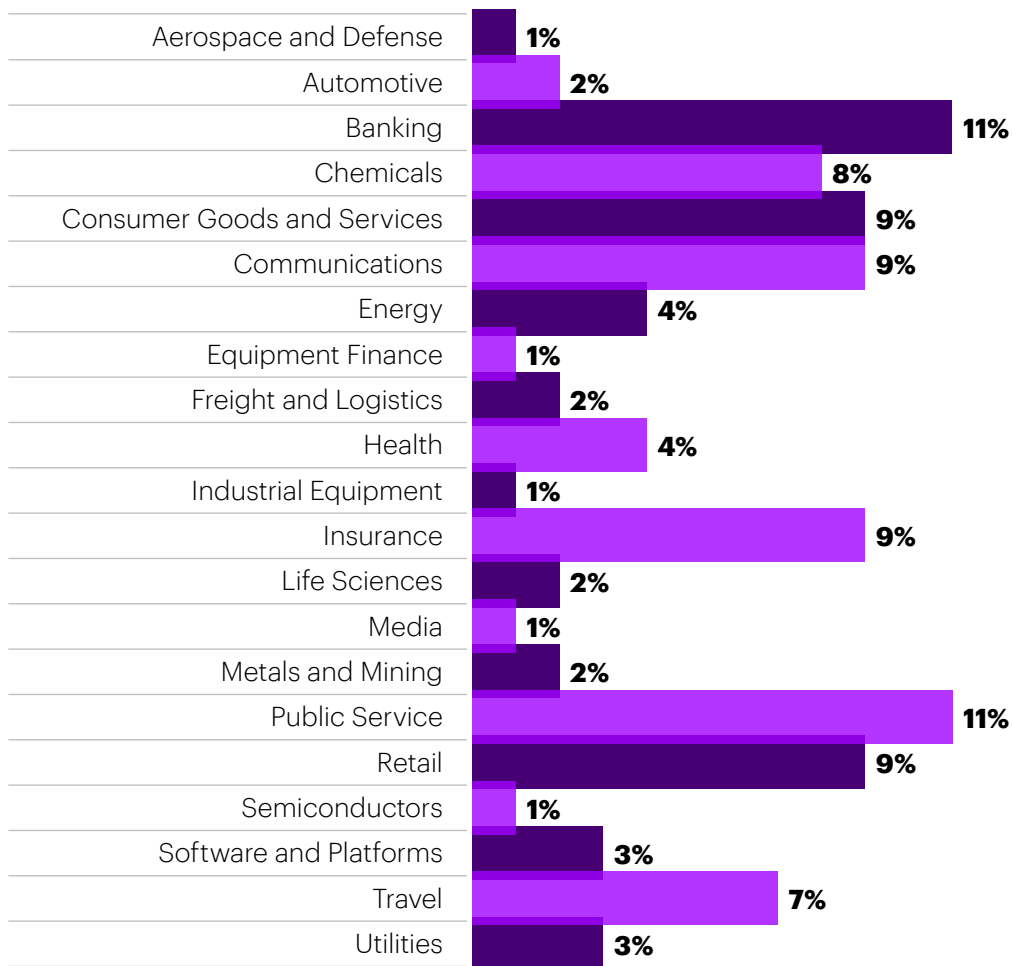
Accenture Research conducted a global survey of 6,074 business and IT executives to capture insights into the adoption of emerging technologies. The survey, fielded from November 2019 through January 2020, helped identify the key issues and priorities for technology adoption and investment. Respondents were C-level executives and directors at companies across 25 countries and 21 industries, with the majority having annual revenues greater than US\$5 billion.

### 25 Countries

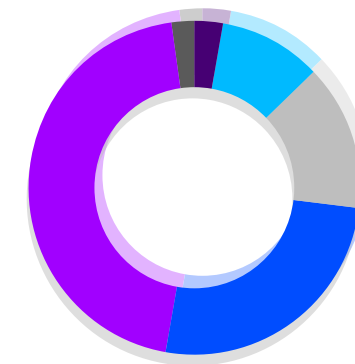
- |                    |                      |                          |
|--------------------|----------------------|--------------------------|
| <b>1</b> Argentina | <b>10</b> Germany    | <b>19</b> Russia         |
| <b>2</b> Australia | <b>11</b> India      | <b>20</b> South Africa   |
| <b>3</b> Austria   | <b>12</b> Indonesia  | <b>21</b> Spain          |
| <b>4</b> Brazil    | <b>13</b> Ireland    | <b>22</b> Switzerland    |
| <b>5</b> Canada    | <b>14</b> Japan      | <b>23</b> Thailand       |
| <b>6</b> Chile     | <b>15</b> Kazakhstan | <b>24</b> United Kingdom |
| <b>7</b> China     | <b>16</b> Mexico     | <b>25</b> United States  |
| <b>8</b> Colombia  | <b>17</b> Peru       |                          |
| <b>9</b> France    | <b>18</b> Portugal   |                          |



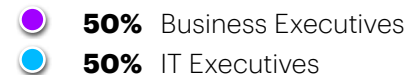
### 21 Industries



### Revenues



### Roles



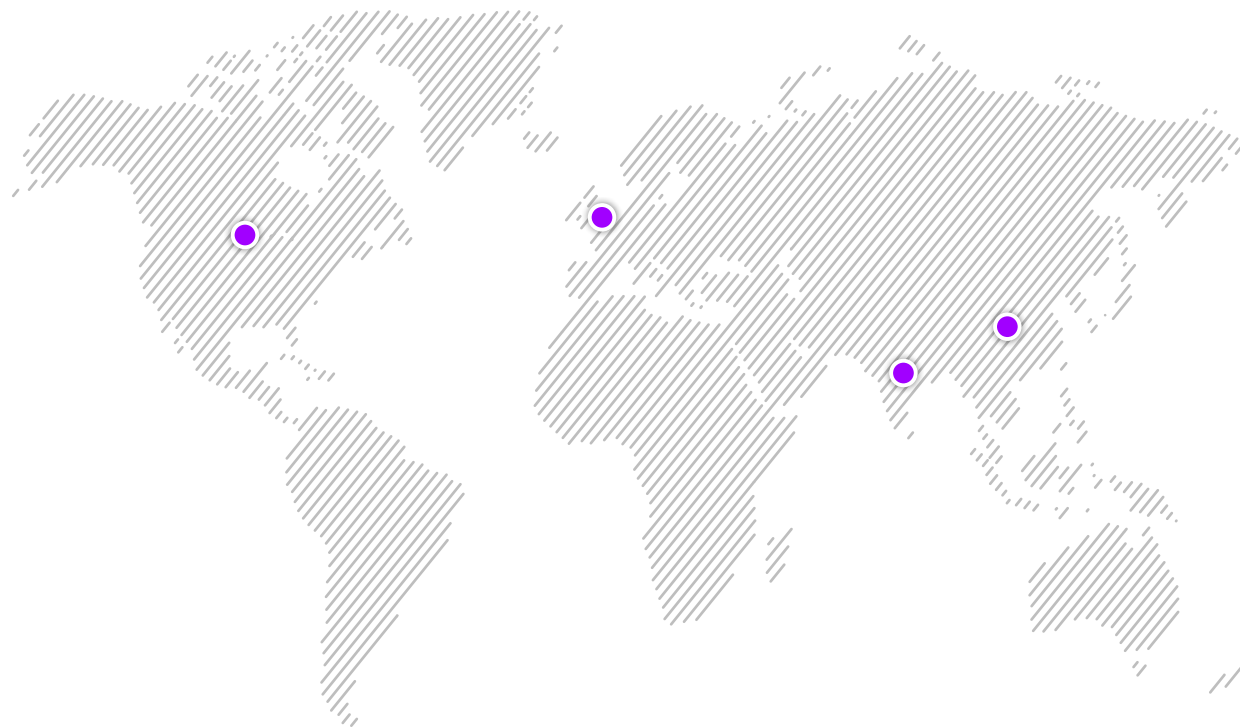
- 8%** Chief Information Officer
- 2%** Chief Mobility Officer
- 9%** Chief Technology Officer
- 7%** Chief Marketing Officer
- 8%** Chief Finance Officer
- 9%** Chief Operating Officer
- 3%** Chief Security Officer
- 4%** Chief Information Security Officer
- 4%** Chief Strategy Officer
- 11%** Director of Technology
- 13%** Director, IT
- 15%** Director of Business Function (Non IT-related)
- 7%** Director, Line of Business (Non IT-related)

## Consumer survey

Between November and December 2019, Accenture Research surveyed 2,000 people in four countries with respondents representing different age and demographic groups. The survey asked consumers about their viewpoints and use of technology in their daily lives, including voice assistants, robots and connected products.

### Four Countries

- 1 China
- 2 India
- 3 United Kingdom
- 4 United States





1

2

3

4

5

# References

## Introduction

- 1 Internet World Stats: Usage and Population Statistics. (n.d.): <https://internetworldstats.com/stats.htm>
- 2 Salim, S. (2019, February 4). More Than Six Hours of Our Day Is Spent Online. Digital Information World: <https://www.digitalinformationworld.com/2019/02/internet-users-spend-more-than-a-quarter-of-their-lives-online.html>
- 3 Revolution in the Cockpit. (n.d.) Daimler: <https://www.daimler.com/innovation/case/connectivity/mbux-2.html>
- 4 Crist, R. (2019, January 10). Samsung's Bixby Will Soon ID the Foods in Your Family Hub Fridge. CNET: <https://www.cnet.com/news/samsungs-bixby-will-soon-id-the-foods-in-your-family-hub-fridge>
- 5 Wing Drone Deliveries Take Flight in First-Of-Its-Kind Trial with FedEx. (2019, October 18). Business Wire: <https://www.businesswire.com/news/home/20191018005509/en/Wing-Drone-Deliveries-Flight-First-of-its-Kind-Trial-FedEx>
- 6 China Education Resources. (n.d.): <http://www.chinaeducationresources.com/s/OurMarket.asp>
- 7 Emmanuel, N. (2018, January 19). Education Technology Is a Global Opportunity. TechCrunch: <https://techcrunch.com/2018/01/19/education-technology-is-a-global-opportunity>
- 8 Valentina, J. (2018, February 9). Room to Read Collaborates with Google To Develop Indonesia's Reading Culture. The Jakarta Post: <https://www.thejakartapost.com/life/2018/02/09/room-to-read-collaborates-with-google-to-develop-indonesias-reading-culture.html>
- 9 Room to Read. (n.d.): <https://www.google.org/our-work/education/room-to-read>
- 10 Eggleston, L. (2019, August 1). 2019 Coding Bootcamp Market Size Study. Course Report: <https://www.coursereport.com/reports/coding-bootcamp-market-size-research-2019>
- 11 Thompson, Derek. (2019, June 20). Should We Be Afraid of AI in the Criminal-Justice System? The Atlantic. <https://www.theatlantic.com/ideas/archive/2019/06/should-we-be-afraid-of-ai-in-the-criminal-justice-system/592084/>
- 12 Smith, A. (2018, November 16). Public Attitudes Toward Computer Algorithms. Pew Research Center: <https://www.pewinternet.org/2018/11/16/public-attitudes-toward-computer-algorithms>
- 13 Vincent, J. (2019, March 26). Europe's Controversial Overhaul of Online Copyright Receives Final Approval. The Verge: <https://www.theverge.com/2019/3/26/18280726/europe-copyright-directive>
- 14 Sterling, G. (2019, July 1). With 6 Months to Go Until CCPA Kicks In, Confusion and Growing Uncertainty Prevail. Marketing Land: <https://marketingland.com/with-6-months-to-go-until-ccpa-kicks-in-confusion-and-growing-uncertainty-prevail-263236>
- 15 Blickensderfer, S., Swanson, J., and Rego Jr., A.C. (2019, May 2). Brazil's New Data Protection Law: An Overview and Four Key Takeaways for U.S. Companies. The National Law Review: <https://www.natlawreview.com/article/brazil-s-new-data-protection-law-overview-and-four-key-takeaways-us-companies>
- 16 Solid. (n.d.): <https://solid.inrupt.com/>
- 17 The Known Traveller: Unlocking the Potential of Digital Identity for Secure and Seamless Travel. (2018, January). World Economic Forum: [http://www3.weforum.org/docs/WEF\\_The\\_Known\\_Traveller\\_Digital\\_Identity\\_Concept.pdf](http://www3.weforum.org/docs/WEF_The_Known_Traveller_Digital_Identity_Concept.pdf)
- 18 Warren, T. (2019, September 26). Microsoft Brings Google Assistant Support to the Xbox One. The Verge: <https://www.theverge.com/2019/9/26/20885072/microsoft-xbox-one-google-assistant-integration-features>
- 19 Blanco, S. (2019, June 20). Volvo Trucks Wants to Know If You're Going to Cross That Street. Forbes: <https://www.forbes.com/sites/sebastianblanco/2019/06/20/volvo-trucks-wants-to-know-if-youre-going-to-cross-that-street/#68e8f7fc4a8e>
- 20 Technology Pioneers 2019: Perceptive Automata. (2019). World Economic Forum: <https://widgets.weforum.org/techpioneers-2019/companies/perceptive-automata>
- 21 Perceptive Automata. (n.d.): <https://www.perceptiveautomata.com>
- 22 Weise, K. (2019, January 16). Microsoft Pledges \$500 Million for Affordable Housing in Seattle Area. The New York Times: <https://www.nytimes.com/2019/01/16/technology/microsoft-affordable-housing-seattle.html>
- 23 Bass, D. (2019, February 7). Microsoft Backs Washington State's Facial Recognition Bill as Amazon Mulls Support. The Seattle Times: <https://www.seattletimes.com/business/microsoft-backs-washington-states-facial-recognition-bill-as-amazon-mulls-support>
- 24 Microsoft AI Principles. (n.d.): <https://www.microsoft.com/en-us/ai/our-approach-to-ai>
- 25 Gelles, D., and Yaffe-Bellany, D. (2019, August 19). Shareholder Value Is No Longer Everything, Top C.E.O.s Say. The New York Times: <https://www.nytimes.com/2019/08/19/business/business-roundtable-ceos-corporations.html>

## Trend 1: The I in Experience

- 1 Solsman, J. (2019, January 17). Netflix's Black Mirror: Bandersnatch Reveals Which Ending Remains the Most Hidden. CNET: <https://www.cnet.com/news/netflix-black-mirror-bandersnatch-guide-to-endings-and-easter-eggs-most-hidden>
- 2 Kaye, D. (2018, December 28). Fan-Generated Infographic Maps Out All the Ways Black Mirror's Bandersnatch Can Go. Syfy Wire: <https://www.syfy.com/syfywire/fan-generated-infographic-maps-out-all-the-ways-black-mirrors-bandersnatch-can-go>
- 3 Liao, S. (2019, March 12). Netflix Wants to Make More Interactive Shows After the Success of Black Mirror: Bandersnatch. The Verge: <https://www.theverge.com/2019/3/12/18261615/netflix-bandersnatch-black-mirror-more-interactive-shows-success>
- 4 Thomas, Z. (2019, March 21). Netflix Is Doubling Down on Interactive TV. Film School Rejects: <https://filmschoolrejects.com/netflix-interactive-tv>
- 5 Alexander, J. (2019, April 9). YouTube Is Planning Its Own Interactive Choose Your Own Adventure-Style Content. The Verge: <https://www.theverge.com/2019/4/9/18303407/youtube-choose-your-own-adventure-netflix-black-mirror-bandersnatch-originals>



1

2

3

4

5

## References

- 6** Lee, N. (2019, February 4). Audible Has A 'Choose Your Own Adventure' Experience On Alexa. Engadget: <https://www.engadget.com/2019/02/04/audible-alex-choose-your-own-adventure>
- 7** Perez, S. (2019, April 29). Interactive Content Is Coming to Walmart's Vudu & The BBC. TechCrunch: <https://techcrunch.com/2019/04/29/interactive-content-is-coming-to-walmarts-vudu-the-bbc>
- 8** Cheng, A. (2019, June 20). McDonald's First Major Acquisition in Years Could Be A Game Changer. Forbes: <https://www.forbes.com/sites/andriacheng/2019/06/20/mcdonalds-first-major-acquisition-in-years-could-be-a-game-changer/#7ee9037361d6>
- 9** Adams, E. (2019, March 26). McDonald's \$300 Million Bet on Personalized Menus Makes Sense: Here's Why. Skift Table: <https://table.skift.com/2019/03/26/mcdonalds-300-million-bet-on-personalized-menus-makes-sense-heres-why>
- 10** Maidenberg, M. (2019, May 13). McDonald's Strategy to Personalize Ordering. Wall Street Journal: <https://www.wsj.com/articles/mcdonalds-strategy-to-transform-mobile-ordering-11557760396>
- 11** Fisher, M., and Taub, A. How YouTube Radicalized Brazil. The New York Times: <https://www.nytimes.com/2019/08/11/world/americas/youtube-brazil.html>
- 12** Shaw, L., and De Vynck, G. (2019, June 26). YouTube Lets Users Override Recommendations After Criticism. Bloomberg Technology: <https://www.bloomberg.com/news/articles/2019-06-26/youtube-lets-users-override-recommendations-after-criticism>
- 13** The Dark Side of Customer Data. (2019, February 6). RSA Security: <https://www.rsa.com/en-us/company/news/the-dark-side-of-customer-data>
- 14** Engel Bromwich, J. (2019, August 6). Wait, People Pay for Tinder? The New York Times: <https://www.nytimes.com/2019/08/06/style/tinder-gold.html>
- 15** Engel Bromwich, J. (2019, September 20). Tinder Created A Show to Give Its Users Something to Hook Up About. The New York Times: <https://www.nytimes.com/2019/09/20/style/tinder-swipenight-scripted-show.html>
- 16** Lee, D. (2019, September 20). Tinder's Choose Your Own Adventure-style Series Will Pair Matches Based on Their Choices. The Verge: <https://www.theverge.com/2019/9/20/20874026/tinder-swipe-night-interactive-series-choose-your-own-adventure>
- 17** Grayson, N. (2019, July 11). Steam's New Customizable AI Tool Scans Your Playtime and Tells You What To Buy Next. Kotaku: <https://kotaku.com/steams-new-customizable-ai-tool-scans-your-playtime-and-1836284275>
- 18** Steam Labs Update. (2019, July 31). Valve Corporation: <https://steamcommunity.com/groups/SteamLabs/announcements/detail/1600386073102256667>
- 19** Sini, R. (2019, May 17). 'Shut Up and Drive': Uber's Quiet Option for Silent Rides. BBC News: <https://www.bbc.com/news/business-48315229>
- 20** Sawers, P. (2019, July 9). Uber Comfort Launches with Bigger Cars and 'No Conversation' Option. VentureBeat: <https://venturebeat.com/2019/07/09/uber-comfort-launches-with-bigger-cars-and-no-conversation-option>
- 21** Cyberverse: Huawei Unveils a New World. (2019, August 11). Huawei press release: <https://consumer.huawei.com/en/press/news/2019/huawei-cyberverse-a-new-world>
- 22** Apple Offers New Augmented Reality Art Sessions. (2019, July 30). Apple press release: <https://www.apple.com/newsroom/2019/07/apple-offers-new-augmented-reality-art-sessions>
- 23** Marston, J. (2019, May 23). How THE.FIT Uses AI to Better Meet Your Dietary Needs at the Restaurant. The Spoon: <https://thespoon.tech/how-the-fit-uses-ai-to-better-meet-your-dietary-needs-at-the-restaurant>
- 24** Everhard, J. (2019, January 15). What Really Is Low-Code/No-Code Development? Forbes: <https://www.forbes.com/sites/johneverhard/2019/01/15/what-really-is-low-codeno-code-development/#616f4b512a8e>
- 25** Amazon Sumerian. (n.d.): <https://aws.amazon.com/sumerian>
- 26** Christou, L. (2019, September 12). Slack Announces Data Residency Controls, Allowing Businesses to Store Their Data Closer to Home. The Verdict: <https://www.verdict.co.uk/slack-data-residency-controls>
- 27** Schechner, S., & Drozdiak, N. (2018, May 24). From Restaurants to Insurers, the Race to Comply With New GDPR Privacy Rules. The Wall Street Journal: <https://www.wsj.com/articles/gdpr-has-companies-big-and-small-racing-to-comply-1527154200>
- 28** Brans, P. (2019, August 14). GDPR Faces Growing Pains Across Europe. Computer Weekly: <https://www.computerweekly.com/news/252468372/GDPR-faces-growing-pains-across-Europe>
- 29** Major GDPR Fine Tracker – An Ongoing, Always-Up-To-Date List of Enforcement Actions. (n.d.). Alpin: <https://alpin.io/blog/gdpr-fines-list>
- 30** Facial Recognition: School ID Checks Lead to GDPR Fine. (2019, August 27). BBC News: <https://www.bbc.com/news/technology-49489154>
- 31** Haggin, P. (2019, September 8). Businesses Across the Board Scramble to Comply with California Data-Privacy Law. The Wall Street Journal: <https://www.wsj.com/articles/businesses-across-the-board-scramble-to-comply-with-california-data-privacy-law-11567947602>
- 32** Thomas, L. (2019, August 21). Brazil's New Privacy Law One Year Away. The National Law Review: <https://www.natlawreview.com/article/brazil-s-new-privacy-law-one-year-away>
- 33** Winder, D. (2019, May 5). Google Confirms It Will Automatically Delete Your Data – What You Need to Know. Forbes: <https://www.forbes.com/sites/daveywinder/2019/05/05/google-confirms-it-will-automatically-delete-your-data-what-you-need-to-know/#63fa9e0820d4>
- 34** Millennials: Fueling the Experience Economy. (n.d.). Eventbrite: [http://eventbrite-s3.s3.amazonaws.com/marketing/Millennials\\_Research/Gen\\_PR\\_Final.pdf](http://eventbrite-s3.s3.amazonaws.com/marketing/Millennials_Research/Gen_PR_Final.pdf)
- 35** Abramovich, G. (n.d.). Consumer Demand for Personalized Content Reaches All-Time High. Adobe: <https://cmo.adobe.com/articles/2018/1/adobe-2018-consumer-content-survey.html#gs.b0mytb>



1

2

3

4

5

- 36** Davis, G. (2018, January 2). Key Findings from Our Survey on Identity Theft, Family Safety and Home Network Security. McAfee: <https://securingtomorrow.mcafee.com/consumer/key-findings-from-our-survey-on-identity-theft-family-safety-and-home-network-security>
- 37** One Year After Cambridge Analytica, Survey Reveals Strong Consumer Privacy Fears Remain. (2019, February). SlickText: <https://www.slicktext.com/blog/2019/02/survey-consumer-privacy-fears-after-cambridge-analytica>
- 38** The Dark Side of Customer Data. (2019, February 6). RSA Security: <https://www.rsa.com/en-us/company/news/the-dark-side-of-customer-data>
- 39** Put Your Trust in Hyper-Relevance. (2017). Accenture: <https://www.accenture.com/us-en/insight-hyper-relevance-gcpr>
- 40** Petrock, V. (2019, March 27). Virtual and Augmented Reality Users 2019. eMarketer: <https://www.emarketer.com/content/virtual-and-augmented-reality-users-2019>
- 41** Worldwide Spending on Augmented and Virtual Reality Expected to Reach \$18.8 Billion in 2020, According to IDC. (2019, November 29.) (Doc #prUS45679219). <https://www.idc.com/getdoc.jsp?containerId=prUS45679219>
- 42** Commercial and Public Sector Investments Will Drive Worldwide AR/VR Spending to \$160 Billion in 2023, According to a New IDC Spending Guide, (2019, June 4). IDC. (Doc #prUS45123819): <https://www.idc.com/getdoc.jsp?containerId=prUS45123819>
- 43** 5G Infrastructure Market Size, Share and Industry Analysis By Component (Fibers, Cables, Antenna, Transceiver, Wireless Backhaul, Modem, Router), By Communication Infrastructure (Small Cell, Macro Cell, Radio Access Network (RAN), Distributed Antenna Syst. (2019, November). Fortune Business Insights: <https://www.fortunebusinessinsights.com/industry-reports/5g-infrastructure-market-100869>
- 44** Russell, J. (2018, December 27). Epic Games, the Creator of Fortnite, Banked A \$3 Billion Profit in 2018. TechCrunch: <https://techcrunch.com/2018/12/27/epic-fortnite-3-billion-profit>
- 45** AWS re:Invent 2018: Chris Dyl, Director of Platform at Epic Games, Speaks at Monday Night Live. (2018, November 28). Amazon Web Services: <https://www.youtube.com/watch?v=MCLrA401vHw%3e>

- 46** Marr, B. (2019, June 10). Fortnite: How Artificial Intelligence and Analytics Make It More Fun. Forbes: <https://www.forbes.com/sites/bernardmarr/2019/06/10/fortnite-how-artificial-intelligence-and-analytics-make-it-more-fun>
- 47** 'Fortnite' Details How AI Opponents Will Fit In. (2019, October 4). Yahoo! News: <https://news.yahoo.com/fortnite-details-ai-opponents-fit-105453899.html>
- 48** Pimentel, K. (2019, March 13). HOK On Architectural Visualization: Aggregate, Iterate, Communicate. Unreal Engine: <https://www.unrealengine.com/en-US/spotlights/hok-architectural-visualization-aggregate-iterate-communicate>
- 49** Streamlining Flight Operations with VR Aircraft Simulation. (2019, September 23). Unreal Engine: <https://www.unrealengine.com/en-US/spotlights/streamlining-flight-operations-with-vr-aircraft-simulation>

## Trend 2: AI and Me

- 1** Generative Design Holds the Key to the Future of Cool, Fuel-Efficient Car Design. (2019, July 30). Autodesk: <https://www.youtube.com/watch?v=nyktrlgj2C4>
- 2** Deplazes, R. (2019, July 8). Autodesk Collaborates With Volkswagen Group on Generative Design in Electric Showcase Vehicle. Autodesk website: <https://adsknews.autodesk.com/news/autodesk-volkswagen-generative-design-electric-showcase-vehicle>
- 3** Payne, C. (2019, April 25). MuseNet. OpenAI website: <https://openai.com/blog/musenet>
- 4** Devlin, J., and Chang, Ming-Wei. (2018, November 2). Open Sourcing BERT: State-of-the-Art Pre-training for Natural Language Processing. Google AI blog: <https://ai.googleblog.com/2018/11/open-sourcing-bert-state-of-art-pre.html>
- 5** Baidu's Optimized ERNIE Achieves State-of-the-Art Results in Natural Language Processing Tasks. (2019, July 30). Baidu research website: <http://research.baidu.com/Blog/index-view?id=121>
- 6** Casetext. (2019): <https://casetext.com>
- 7** Qadrud-Din, J. (2019, March 26). Use of AI at Casetext. Casetext blog: <https://blog.casetext.com/use-of-ai-at-casetext-7bda0c31d0e7>
- 8** HoloLens 2: inside Microsoft's new headset. (2019, February 24). The Verge: <https://www.youtube.com/watch?v=6lxGU66wONM>
- 9** Langston, J. (2019, February 24). New HoloLens 2 gives Microsoft the edge in the next generation of computing. Microsoft Innovation Stories: <https://news.microsoft.com/innovation-stories/hololens-2>
- 10** Mc Grath, R., Costabello, L., et al. (2018, November 16). Interpretable Credit Application Predictions With Counterfactual Explanations. arXiv.org: <https://arxiv.org/abs/1811.05245>
- 11** Aharonov, R., and Slonim, N. (2019, February 8). Watch IBM's AI System Debate a Human Champion Live at Think 2019. IBM Research blog: <https://www.ibm.com/blogs/research/2019/02/ai-debate-think-2019>
- 12** Pushing the Frontiers of AI: Project Debater. (2019, February 11, 43:50). IBM Events: <https://www.ibm.com/events/think/watch/replay/120118800>
- 13** Lemonade. (2019): <https://www.lemonade.com>
- 14** Azulay, D. (2019, March 5). AI for Claims Processing and Underwriting in Insurance – A Comparison of 6 Applications. Emerj: <https://emerj.com/ai-sector-overviews/ai-for-claims-processing-and-underwriting-in-insurance>
- 15** Ralph, O. (2019, September 23). AI Can Streamline Insurance Claims – But At What Cost? Financial Times: <https://www.ft.com/content/2df82a56-9c22-11e9-9c06-a4640c9feebb>
- 16** LEADx Launches 'Executive Coach Amanda' Built with IBM Watson Assistant. (2018, September 10). MarketWatch: <https://www.marketwatch.com/press-release/leadx-launches-executive-coach-amanda-built-with-ibm-watson-assistant-2018-09-10>
- 17** LeadX – Red Nucleus. (n.d.): <https://www.welcome.ai/leadx/case-study/red-nucleus>
- 18** Lardinois, F. (2019, September 25). Microsoft Launches its AI Presentation Coach for PowerPoint. TechCrunch: <https://techcrunch.com/2019/09/25/microsoft-launches-its-ai-presentation-coach-for-powerpoint>



1

2

3

4

5

19 Cogito. (n.d.): <https://www.cogitocorp.com>

20 Liu, S. (2019, November 25). Forecast Growth of the Artificial Intelligence Software Market Worldwide from 2019 to 2025. Statista: <https://www.statista.com/statistics/607960/worldwide-artificial-intelligence-market-growth>

21 Enterprise Virtual Digital Assistant Users to Surpass 1 Billion by 2025. (2018, January 2). Tractica: <https://www.tractica.com/newsroom/press-releases/enterprise-virtual-digital-assistant-users-to-surpass-1-billion-by-2025>

22 The ROI of AI. (2019, April 12). Accenture Applied Intelligence: <https://www.accenture.com/us-en/insights/artificial-intelligence/roi-artificial-intelligence>

23 AI: Built to Scale. (2019, November 14). Accenture: <https://www.accenture.com/us-en/insights/artificial-intelligence/ai-investments>

24 Anadiotis, G. (2019, July 8). The State of AI in 2019: Breakthroughs In Machine Learning, Natural Language Processing, Games, and Knowledge Graphs. ZDNet: <https://www.zdnet.com/article/the-state-of-ai-in-2019-breakthroughs-in-machine-learning-natural-language-processing-games-and-knowledge-graphs>

25 Schalkwyk, J. (2019, March 12). An All-Neural On-Device Speech Recognizer. The Google AI Blog: <https://ai.googleblog.com/2019/03/an-all-neural-on-device-speech.html>

26 These Star Trek-Style Translation Devices Are Smashing the Language Barrier, Thanks to AI and Cloud Computing. (2019, January 11). South China Morning Post: <https://www.scmp.com/news/world/united-states-canada/article/2181601/these-near-real-time-translation-devices-are>

27 Kozak, B. (2019, September 3). New Smart Home Strategies to Push Market Revenue Above \$192 Billion in 2023. IHS Markit: <https://technology.ihs.com/617093/new-smart-home-strategies-to-push-market-revenue-above-192-billion-in-2023>

28 Press, G. (2019, October 25). AI Stats News: 62% of US Consumers Like Using Chatbots To Interact with Businesses. Forbes: <https://www.forbes.com/sites/gilpress/2019/10/25/ai-stats-news-us-consumers-interest-in-using-chatbots-to-interact-with-businesses-rise-to-62/#3122bc823974>

29 80% of Businesses Want Chatbots by 2020. (2016, December 14). Business Insider Intelligence: <https://www.businessinsider.com/80-of-businesses-want-chatbots-by-2020-2016-12>

30 The 2019 State of Artificial Intelligence in Talent Acquisition. (2019, June). The HR Research Institute: <https://www.oracle.com/a/ocom/docs/artificial-intelligence-in-talent-acquisition.pdf>

31 Global Growth Insight – Role of AI in the Pharmaceutical Industry 2018-2022: Exploring Key Investment Trends, Companies-to-Action, and Growth Opportunities for AI in the Pharmaceutical Industry. (2019, October 8). PR Newswire: <https://www.prnewswire.com/news-releases/global-growth-insight--role-of-ai-in-the-pharmaceutical-industry-2018-2022-exploring-key-investment-trends-companies-to-action-and-growth-opportunities-for-ai-in-the-pharmaceutical-industry-300934009.html>

32 Global Generative Design Market 2019-2023. (2019, May). Technavio: <https://www.technavio.com/report/global-generative-design-market-industry-analysis>

33 Zuckerman, G., Levy, R., et al. (2018, December 25). Behind the Market Swoon: The Herdlike Behavior of Computerized Trading. The Wall Street Journal: <https://www.wsj.com/articles/behind-the-market-swoon-the-herdlike-behavior-of-computerized-trading-11545785641>

34 Adobe Sensei. (n.d.): <https://www.welcome.ai/tech/sentiment-analysis/adobe-adobe-sensei>

35 Voice Search & AI in Stock Powered by Adobe Sensei. (2019, March 13). Adobe: [https://www.youtube.com/watch?v=d\\_l27Wx-Csl](https://www.youtube.com/watch?v=d_l27Wx-Csl)

36 Annunziata, M. (2019, July 16). Creativity and AI: Adobe Sensei as Assistant, Teacher, and Muse. Forbes: <https://www.forbes.com/sites/marcoannunziata/2019/07/16/creativity-and-ai-adobe-sensei-as-assistant-teacher-and-muse/#4cf368806750>

37 Copperman, A. (2018, May 17). How Spark Uses Artificial Intelligence to Help You Make Standout Graphics. Adobe Spark blog: <https://blog.adobespark.com/2018/05/17/powered-by-adobe-sensei-how-spark-uses-ai-and-machine-learning-to-help-you-make-standout-graphics>

## Trend 3: The Dilemma of Smart Things

1 Dellinger, A. (2019, March 4). Social Robot Jibo Does One Last Dance Before Its Servers Shut Down. Engadget: <https://www.engadget.com/2019/03/04/social-robot-jibo-shutting-down-message>

2 Wroclawski, D. (2019, August 31). Works With Nest Users Face a Choice: Should I Stay Or Should I Go? Consumer Reports: <https://www.consumerreports.org/smart-home/things-to-know-about-works-with-nest-shutdown>

3 Turner, M. (2019, May 16). We Hear You: Updates to Works With Nest. The Keyword: <https://blog.google/products/google-nest/updates-works-with-nest>

4 Statista Research Department. (2016, November 27). Internet of Things Connected Devices Installed Base Worldwide from 2015 to 2025. Statista: <https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide>

5 Internet of Things (IoT) Market 2019: Global Industry Analysis, Size, Share, Trends, Market Demand, Growth, Opportunities and Forecast 2026. (2019, July 16). VC NewsNetwork: <https://www.prnewswire.com/news-releases/internet-of-things-iot-market-to-reach-us-1111-3-bn-by-2026--at-a-ferocious-cagr-of-24-7---market-is-predominantly-driven-by-rising-adoption-of-ai-and-machine-learning-fortune-business-insights-300881405.html>

6 Barkai, J. (n.d.). Caterpillar: Smart Iron Delivers Customer Value. Icons of Infrastructure: <https://iconsofinfrastructure.com/caterpillar-smart-iron-delivers-customer-value>

7 Caterpillar Introduces Remote Cat Connect Tech. (2019, January 15). Equipment Journal: <https://www.equipmentjournal.com/tech-news/caterpillar-remote-cat-connect>

8 O’Kane, S. (2019, July 16). Tesla to Charge \$1,000 More for ‘Full Self-Driving’ Autopilot Package in August. The Verge: <https://www.theverge.com/2019/7/16/20696513/tesla-full-self-driving-autopilot-package-august-price-raise-tier>



1

2

3

4

5

- 9 Lawler, R. (2019, February 14). Tesla Pushes Sentry Mode, Dog Mode Updates to its EVs. Engadget: <https://www.engadget.com/2019/02/14/tesla-sentry-dog-dashcam-autopilot>
- 10 Shi, A. (2018, September 8). Batterygate: A Complete History of Apple Throttling iPhones. iFixit: <https://www.ifixit.com/News/batterygate-timeline>
- 11 Smith, D. (2018, December 30). If You Own an iPhone 6 or Later That Isn't Holding Its Charge, Now is the Time to Get Your Battery Replaced. Business Insider: <https://www.businessinsider.com/apple-iphone-battery-replacement-program-december-2018-9>
- 12 Signify Circular Lighting. (n.d.) Signify: <https://www.signify.com/global/lighting-services/managed-services/circular-lighting>
- 13 Dwyer, K. (2019, July 2). Shiseido Launches Internet of Things Skincare System. Fortune: <https://fortune.com/2019/07/02/shiseido-optune-internet-of-things-ai-and-ar-skincare-system>
- 14 Shiseido Launches Full-Scale IoT Skincare Service Brand "Optune". (2019, July 1). Shiseido: <https://www.shiseidogroup.com/news/detail.html?n=00000000002712>
- 15 We Tried Shiseido's IoT Skincare System Optune and Here's What We Think. (2018, November 14). BeautyTech.jp: <https://medium.com/beautytech-jp/we-tried-shiseidos-iot-skincare-system-optune-and-here-s-what-we-think-533d541bfc8f>
- 16 Aibo AI Cloud Plan. (n.d.): <https://us.aibo.com/feature/ai.html>
- 17 Warren, T. (2019, September 25). Amazon's New Echo Flex Lets You Put Alexa Everywhere in Your Home. The Verge: <https://www.theverge.com/2019/9/25/20883839/amazon-echo-flex-home-security-safety-speaker-features-specs-price-alexa-ring>
- 18 Hawkins, A. (2019, May 21). GM's New 'Digital Nerve System' Will Enable Over-the-Air Software Updates on All Vehicles. The Verge: <https://www.theverge.com/2019/5/21/18633000/gm-ota-software-updates-digital-platform-reuss>
- 19 Siemens Adds Material Modeling to Simcenter Through Acquisition of MultiMechanics. (2019, November 15). Yahoo Finance: <https://finance.yahoo.com/news/siemens-adds-material-modeling-simcenter-164700918.html>

- 20 Internet of Things Connected Devices Installed Base Worldwide from 2015 to 2025. (2019, November 14). Statista: <https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide>
- 21 AI Turns Ordinary Products into Industry Game-Changers. (2018, April 20). Accenture: <https://www.accenture.com/us-en/insights/industry-x-0/ai-transforms-products>
- 22 IDC FutureScape: Multiplied Innovation Takes Off, Powered by AI, Distributed Public Cloud, Microservices, Developer Population Explosion, Greater Specialization and Verticalization, and Scaling Trust. (2018, October 30). IDC. (Doc #prUS44417618): <https://www.idc.com/getdoc.jsp?containerId=prUS44417618>
- 23 Parks Associates: Consumers Own More Than 10 Connected Devices. (2019, March 27). PR Newswire: <https://www.prnewswire.com/news-releases/parks-associates-consumers-own-more-than-10-connected-devices-300819407.html>
- 24 Parks Associates: Consumers Own More Than 10 Connected Devices. (2019, March 27). PR Newswire: <https://www.prnewswire.com/news-releases/parks-associates-consumers-own-more-than-10-connected-devices-300819407.html>
- 25 Torres, R. (2019, October 3). Digital Tools Interrupt Workers 14 Times A Day. CIO Dive: <https://www.ciodive.com/news/digital-tools-interrupt-workers-14-times-a-day/564284>
- 26 The Trust Opportunity: Exploring Consumer Attitudes to the Internet of Things. (2019, May 1). Internet Society: <https://www.internetsociety.org/resources/doc/2019/trust-opportunity-exploring-consumer-attitudes-to-iot>
- 27 2018 Edelman Trust Barometer. (2018). Edelman: [https://www.edelman.com/sites/g/files/aatuss191/files/2018-10/2018\\_Trust\\_Barometer\\_Brands\\_Social\\_Media\\_Special\\_Full\\_Report.pdf](https://www.edelman.com/sites/g/files/aatuss191/files/2018-10/2018_Trust_Barometer_Brands_Social_Media_Special_Full_Report.pdf)
- 28 Cyber Risk Analytics 2019 MidYear QuickView Data Breach Report. (2019, August). Risk Based Security: <https://pages.riskbasedsecurity.com/2019-midyear-data-breach-quickview-report>
- 29 Wiggers, K. (2019, October 3). SimCam Raises \$8 Million For An AI-Powered Offline Home Security Camera. VentureBeat: <https://venturebeat.com/2019/10/03/simcam-raises-8-million-for-an-ai-powered-offline-home-security-camera>

- 30 Kuchler, H. (2019, June 4). Pharma Groups Combine to Promote Drug Discovery with AI. Financial Times: <https://www.ft.com/content/ef7be832-86d0-11e9-a028-86cea8523dc2>
- 31 New Research Consortium Seeks to Accelerate Drug Discovery Using Machine Learning to Unlock Maximum Potential of Pharma Industry Data. (n.d.). Janssen: <https://www.janssen.com/emea/new-research-consortium-seeks-accelerate-drug-discovery-using-machine-learning-unlock-maximum>
- 32 Corley, K. (2019, March 26). Travis County Clerk's Dream Voting System Gains New Life. Reporting Texas: <https://reportingtexas.com/travis-county-clerks-dream-voting-system-gains-new-life>

## Trend 4: Robots in the Wild

- 1 Wakefield, J. (2019, March 17). Can You Murder A Robot? BBC News: <https://www.bbc.com/news/technology-47090174>
- 2 Victor, D. (2015, August 3). Hitchhiking Robot, Safe in Several Countries, Meets Its End in Philadelphia. The New York Times: <https://www.nytimes.com/2015/08/04/us/hitchhiking-robot-safe-in-several-countries-meets-its-end-in-philadelphia.html>
- 3 Korus, S. (2019, April 17). Industrial Robot Cost Declines Should Trigger Tipping Points in Demand. ARK Invest: <https://ark-invest.com/research/industrial-robot-cost-declines>
- 4 Robots and the Workplace of the Future. (2018, March). International Federation of Robotics: [https://ifr.org/downloads/papers/IFR\\_Robots\\_and\\_the\\_Workplace\\_of\\_the\\_Future\\_Positioning\\_Paper.pdf](https://ifr.org/downloads/papers/IFR_Robots_and_the_Workplace_of_the_Future_Positioning_Paper.pdf)
- 5 Worldwide Spending on Robotics Systems and Drones Forecast to Reach \$128.7 Billion in 2020, According to New IDC Spending Guide. (2020, January 2.) IDC. (Doc #prUS45800320): <https://www.idc.com/getdoc.jsp?containerId=prUS45800320>
- 6 Scott, S. (2019, August 6). What's Next for Amazon Scout? The Amazon blog: <https://blog.aboutamazon.com/transportation/whats-next-for-amazon-scout>





1

2

3

4

5

## References

- 7** Meyersohn, N. (2019, April 9). Walmart Is Doubling Down on Robot Janitors. Here's Why. CNN: <https://www.cnn.com/2019/04/09/business/walmart-robots-retail-jobs/index.html>
- 8** Linder, C. (2018, October 30). Meet the 145-Foot Wide Construction Robot from Hampton That Doesn't Want to Steal Your Job. The Pittsburgh Post-Gazette: <https://www.post-gazette.com/business/tech-news/2018/10/28/advanced-construction-robotics-tybot-jeremy-searock-stephen-muck-pittsburgh-cmu/stories/201806030005>
- 9** Black, T. (2019, July 13). New, More Agile Robots Speed the Takeover of Jobs Once Done Only by Humans. The Los Angeles Times: <https://www.latimes.com/business/la-fi-robots-more-like-humans-20190713-story.html>
- 10** Coldeway, D. (2019, September 17). FarmWise and its Weed-Pulling Agribot Harvest \$14.5M in Funding. TechCrunch: <https://techcrunch.com/2019/09/17/farmwise-and-its-weed-pulling-agribot-harvest-14-5m-in-funding>
- 11** Rosborg Greenhouse Packs Delicate Herbs with OnRobot Collaborative Grippers. (n.d.). OnRobot A/S: <https://onrobot.com/en/rosborg-greenhouse-packs-delicate-herbs-with-onrobot-collaborative-grippers>
- 12** Savage, M. (2019, March 12). Meet Tengai, the Job Interview Robot Who Won't Judge You. BBC News: <https://www.bbc.com/news/business-47442953>
- 13** Whitney, L. (2019, April 9). Mobile Robotics Market to Surge Thanks to New Players and Increased Demand. TechRepublic: <https://www.techrepublic.com/article/mobile-robotics-market-to-surge-thanks-to-new-players-and-increased-demand>
- 14** Demand for Robotics and Data Experts Skyrockets. (2019, May 6). Thomas Industry Update: <https://www.thomasnet.com/insights/demand-for-robotics-and-data-experts-skyrockets-jobs-of-the-future-report-part-1>
- 15** Humans Wanted: Robots Need You. (2019). Manpower Group: [https://www.manpowergroup.com/wps/wcm/connect/84b36237-eb5e-460b-bd52-35c28ab187a9/MPG\\_WEF\\_SkillsRevolution\\_4.0\\_paper\\_lo.pdf?MOD=AJPERES&CONVERT\\_TO=URL](https://www.manpowergroup.com/wps/wcm/connect/84b36237-eb5e-460b-bd52-35c28ab187a9/MPG_WEF_SkillsRevolution_4.0_paper_lo.pdf?MOD=AJPERES&CONVERT_TO=URL)
- 16** Etherington, D. (2019, July 10). Waymo Has Now Driven 10 Billion Autonomous Miles in Simulation. TechCrunch: <https://techcrunch.com/2019/07/10/waymo-has-now-driven-10-billion-autonomous-miles-in-simulation>
- 17** Ho, V. (2019, April 4). Toyota Material Handling Group Innovates Forklift, Factory, Service and Logistics Solutions with Digital Transformation. Microsoft Transform: <https://news.microsoft.com/transform/toyota-forklift-factory-logistics-digital-transformation>
- 18** O'Kane, S. (2019, August 15). UPS Has Been Quietly Delivering Cargo Using Self-Driving Trucks. The Verge: <https://www.theverge.com/2019/8/15/20805994/ups-self-driving-trucks-autonomous-delivery-tusimple>
- 19** Hawkins, A. (2019, July 23). UPS Seeks Government Approval for 'Advanced' Drone Delivery Service. The Verge: <https://www.theverge.com/2019/7/23/20707470/ups-drone-delivery-faa-certification-approval>
- 20** SPOT. (n.d.) Boston Dynamics: <https://www.bostondynamics.com/spot>
- 21** Vincent, J. (2019, June 5). Boston Dynamics Prepares to Launch Its First Commercial Robot: Spot. The Verge: <https://www.theverge.com/2019/6/5/18653710/boston-dynamics-first-commercial-robot-spot-demo-amazon-remars-conference-marc-raibert>
- 22** Hu, W. (2019, April 24). Confused About Congestion Pricing? Here's What We Know. The New York Times: <https://www.nytimes.com/2019/04/24/nyregion/what-is-congestion-pricing.html>
- 23** Poon, L. (2017, January 9). Buffalo Becomes First City to Bid Minimum Parking Goodbye. CityLab: <https://www.citylab.com/equity/2017/01/buffalo-is-first-to-remove-minimum-parking-requirements-citywide/512177>
- 24** Garfield, L. (2018, June 1). 13 cities that are starting to ban cars. Business Insider: <https://www.businessinsider.com/cities-going-car-free-ban-2017-8>
- 25** Ghaffary, S. (2019, May 14). San Francisco's facial recognition technology ban, explained. Vox: <https://www.vox.com/recode/2019/5/14/18623897/san-francisco-facial-recognition-ban-explained>
- 26** New law bans electric scooters in San Francisco until companies obtain city permits. (2018, June 4). ABC 7 News: <https://abc7news.com/business/new-law-bans-electric-scooters-in-san-francisco/3560740>
- 27** Dickey, M. (2019, September 25). JUMP, Lime, Scoot and Spin receive permits to operate scooters in SF. TechCrunch: <https://techcrunch.com/2019/09/25/jump-lime-scoot-and-spin-receive-permits-to-operate-scooters-in-sf>
- 28** Etherington, D. (2019, August 16). Postmates lands permit to test its Serve autonomous delivery robots in SF. TechCrunch: <https://techcrunch.com/2019/08/16/postmates-lands-permit-to-test-its-serve-autonomous-delivery-robots-in-sf>
- 29** Nichols, G. (2017, December 12). San Francisco bans delivery robots in most of the city. ZDNet: <https://www.zdnet.com/article/san-francisco-bans-delivery-robots-in-most-of-the-city>
- 30** UPS Flight Forward Attains FAA's First Full Approval For Drone Airline. (2019, October 1). UPS Pressroom: <https://pressroom.ups.com/pressroom/ContentDetailsViewer.page?ConceptType=PressReleases&id=1569933965476-404>
- 31** Fujiwara, H. (2018, December 17). Why Japan leads industrial robot production. International Federation of Robotics: <https://ifr.org/post/why-japan-leads-industrial-robot-production>
- 32** Tokyo 2020 Unveils Games Robots. (2019, March 15). Tokyo 2020: <https://tokyo2020.org/en/news/notice/20190315-02.html>
- 33** Global Agricultural Robots Market Report 2019: Industry Trends, Share, Size, Growth, Opportunity and Forecasts 2011-2018 & 2019-2024. (2019, May 24). PR Newswire: <https://www.prnewswire.com/news-releases/global-agricultural-robots-market-report-2019-industry-trends-share-size-growth-opportunity-and-forecasts-2011-2018--2019-2024-300856526.html>
- 34** Etherington, D. (2019, July 10). Waymo has now driven 10 billion autonomous miles in simulation. TechCrunch: <https://techcrunch.com/2019/07/10/waymo-has-now-driven-10-billion-autonomous-miles-in-simulation>





1

2

3

4

5

## References

- 6 Spangler, T. (2019, November 13). Disney Says Disney Plus Has Over 10 Million Sign-Ups After Launch Day. Variety: <https://variety.com/2019/digital/news/disney-says-disney-plus-has-over-10-million-signups-1203403515>
- 7 Gupta, R. (2019, August 27). Disney+ Streaming Service Is A Direct Challenge to Netflix. Market Realist: <https://marketrealist.com/2019/08/disney-streaming-service-is-a-direct-challenge-to-netflix>
- 8 White, J. (2018, April 7). James Dyson on Batteries, Electric Cars and the Future of Design. Wired: <https://www.wired.co.uk/article/james-dyson-wired-interview-electric-batteries-cars-design>
- 9 Roberson, B. (2019, May 29). Can the Dyson Vacuum Cleaner Guy Build A Better Electric Car Than Tesla's Elon Musk? Forbes: <https://www.forbes.com/sites/billroberson/2019/05/29/can-the-dyson-vacuum-cleaner-guy-build-a-better-electric-car-than-teslas-elon-musk/#5a2e662411c2>
- 10 Dyson Electric Car Patents Filed, Testing to Ramp Up in June. (2019, May Dyson Automotive Update. (2019, May). The Straits Times: <https://www.straitstimes.com/world/united-states/dyson-electric-car-patents-filed-testing-to-ramp-up-in-june>
- 11 Dyson Automotive Update. (2019, October 10): <https://www.dyson.com/automotive.html>
- 12 Etherington, D. (2019, June 17). Domino's Serves Up Self-Driving Pizza Delivery Pilot in Houston. TechCrunch: <https://techcrunch.com/2019/06/17/dominos-serves-up-self-driving-pizza-delivery-pilot-in-houston>
- 13 AI and Robotics in the Lab: Accelerating Materials Discovery. (2019, March 25). MIT Technology Review: <https://events.technologyreview.com/video/watch/jill-becker-accelerating-materials-discovery>
- 14 Knight, W. (2018, November 7). A Robot Scientist Will Dream Up New Materials to Advance Computing and Fight Pollution. MIT Technology Review: <https://www.technologyreview.com/s/612388/a-robot-scientist-will-dream-up-new-materials-to-advance-computing-and-fight-pollution>
- 15 Indigo Agriculture and Anheuser-Busch Partner to Meet Sustainability Goals for Rice Production. (2019, March 11). Indigo Ag: <https://www.indigoag.com/pages/news/indigo-partners-with-anheuser-busch-for-sustainable-rice>
- 16 Indigo Microbial Science. (n.d.): <https://www.indigoag.com/indigo-microbial-science>
- 17 Rubin, P. (2019, July 18). Disney's New Lion King Is the VR-Fueled Future of Cinema. Wired: <https://www.wired.com/story/disney-new-lion-king-vr-fueled-future-cinema>
- 18 Van Boom, D. (2019, August 18). Lion King Remake Is the 9th Highest-Grossing Film Ever. CNET: <https://www.cnet.com/news/lion-king-remake-is-the-9th-highest-grossing-film-ever>
- 19 The Walt Disney Studios StudioLAB Advances the Art of Storytelling Through Next-Generation Technology. (2018, July 16). The Walt Disney Company: <https://www.thewaltdisneycompany.com/the-walt-disney-studios-studiolab-advances-the-art-of-storytelling-through-next-generation-technology>
- 20 Reimagining the Future of Entertainment. (n.d.): <https://www.accenture.com/us-en/services/interactive/disney-studiolab>
- 21 The Kraft Heinz Company Opens a New Digital Hub. (2018, November 5). Kraft Heinz press release: <https://news.kraftheinzcompany.com/press-release/corporate/kraft-heinz-company-opens-new-digital-hub>
- 22 White, M. (2018, November 6). Kraft Heinz Opens Digital Hub After Acquiring AI Firm Wellio. FoodBev Media: <https://www.foodbev.com/news/kraft-heinz-opens-digital-hub-after-acquiring-ai-firm-wellio>
- 23 Locker, M. (2019, June 1). Inside the Secret Laboratory Where Marriott is Cooking Up the Hotel of the Future. Fast Company: <https://www.fastcompany.com/90350173/inside-the-innovation-lab-where-marriott-is-creating-the-hotel-room-of-the-future>
- 24 Baldwin, R. (2018, September 4). Polestar Wants to Change Almost Everything About How You Own A Car. Engadget: <https://www.engadget.com/2018/09/04/polestar-wants-to-change-almost-everything-about-how-you-own-a-c>
- 25 Black, S. (2019, January 31). Thermoplastic Door A First for Automotive Composites. CompositesWorld: <https://www.compositesworld.com/blog/post/thermoplastic-door-a-first-for-automotive-composites>
- 26 Etherington, D. (2019, August 21). Waymo Releases A Self-Driving Open Data Set for Free Use by the Research Community. TechCrunch: <https://techcrunch.com/2019/08/21/waymo-releases-a-self-driving-open-data-set-for-free-use-by-the-research-community>
- 27 Etherington, D. (2019, July 23). Lyft Opens to the Public Autonomous Driving Data Set from its Level 5 Self-Driving Fleet. TechCrunch: <https://techcrunch.com/2019/07/23/lyft-opens-autonomous-driving-dataset-from-its-level-5-self-driving-fleet-to-the-public>
- 28 Boudette, N., and Ewing, J. (2019, July 12). Ford and VW Agree to Share Costs of Self-Driving and Electric Cars. The New York Times: <https://www.nytimes.com/2019/07/12/business/ford-vw-self-driving-electric-cars.html>
- 29 Wiggers, K. (2019, September 17). Pinterest's Lens Can Now Recognize 2.5 Billion Home and Fashion Objects. VentureBeat: <https://venturebeat.com/2019/09/17/pinterests-lens-can-now-recognize-2-5-billion-home-and-fashion-objects>
- 30 Machkovech, S. (2019, September 25). Oculus Announces Plans to Build Augmented Reality Glasses. ArsTechnica: <https://arstechnica.com/gaming/2019/09/oculus-announces-plans-to-build-augmented-reality-glasses>
- 31 Smartphone Woes Continue with Worldwide Shipments Down 4.9% in the Holiday Quarter Capping off the Worst Year Ever, According to IDC. (2019, January 30). IDC. (Doc #prUS44826119): <https://www.idc.com/getdoc.jsp?containerId=prUS44826119>
- 32 Smartphone Shipments Experience Deeper Decline in Q1 2019 with a Clear Shakeup Among the Market Leaders, According to IDC. (2019, April 30). IDC. (Doc #prUS45042319): <https://www.idc.com/getdoc.jsp?containerId=prUS45042319>
- 33 Smartphone Shipments Decline 2.3% in the Second Quarter on Continued Challenges Across Most Major Regions, According to IDC. (2019, July 31). IDC. (Doc #prUS45414919): <https://www.idc.com/getdoc.jsp?containerId=prUS45414919>



1

2

3

4

5

- 34** Worldwide Smartphone Shipments Rise by 0.8% in the Third Quarter as Huawei Went Full Steam in China, According to IDC. (2019, November 7). IDC. (Doc #prUS45636719): <https://www.idc.com/getdoc.jsp?containerId=prUS45636719>
- 35** Guttman, A. (2019, May 13). Social media marketing usage rate in the United States from 2013 to 2019. Statista: <https://www.statista.com/statistics/203513/usage-trends-of-social-media-platforms-in-marketing>
- 36** Meeker, M. (2019, June 11). Internet Trends 2019 [slide 164]. Bond Capital: <https://www.bondcap.com/report/itr19/#view/164>
- 37** Big Data and AI Executive Survey 2019: Executive Summary of Findings. (2019). NewVantage Partners: <http://newvantage.com/wp-content/uploads/2018/12/Big-Data-Executive-Survey-2019-Findings-Updated-010219-1.pdf>
- 38** Cloud Computing Trends: 2019 State of the Cloud Survey. (2019, February 27). Flexera: <https://www.flexera.com/blog/cloud/2019/02/cloud-computing-trends-2019-state-of-the-cloud-survey>
- 39** NewVantage Partners. (n 7)
- 40** Worldwide Spending on Artificial Intelligence Systems Will Be Nearly \$98 Billion in 2023, According to New IDC Spending Guide. (2019, September 4). IDC. (Doc #prUS45481219): <https://www.idc.com/getdoc.jsp?containerId=prUS45481219>
- 41** New IDC Spending Guide Sees Strong Growth in Blockchain Solutions Leading to \$15.9 Billion Market in 2023. (2019, August 8). IDC. (Doc #prUS45429719): <https://www.idc.com/getdoc.jsp?containerId=prUS45429719>
- 42** Commercial and Public Sector Investments Will Drive Worldwide AR/VR Spending to \$160 Billion in 2023, According to a New IDC Spending Guide. (2019, June 4). IDC. (Doc #prUS45123819): <https://www.idc.com/getdoc.jsp?containerId=prUS45123819>
- 43** Gibney, E. (2019, October 2). Quantum Gold Rush: The Private Funding Pouring into Quantum Start-Ups. Nature: <https://www.nature.com/articles/d41586-019-02935-4>
- 44** Advanced Lithium-Ion Technologies on Track for Record Annual Investment. (2019, October 28). Wood Mackenzie: <https://www.woodmac.com/press-releases/advanced-lithium-ion-technologies-on-track-for-record-annual-investment>
- 45** Department of Energy Announces \$120 Million for Battery Innovation Hub. (2018, September 18). U.S. Department of Energy: <https://www.energy.gov/articles/department-energy-announces-120-million-battery-innovation-hub>
- 46** Jorgensen, B. (2019, April 8). Aerospace & Defense Expected to Drive Smart-Materials Demand. EE Times: [https://www.eetimes.com/document.asp?doc\\_id=1334534](https://www.eetimes.com/document.asp?doc_id=1334534)
- 47** Smart Materials Market to Gain Boost Owing to Enhanced Demand of Sensors and Actuators From Aerospace & Defense Sector Till 2025. (2019, March 6). PR Newswire: <https://www.prnewswire.com/news-releases/smart-materials-market-to-gain-boost-owing-to-enhanced-demand-of-sensors-and-actuators-from-aerospace--defense-sector-till-2025--million-insights-300807489.html>
- 48** Janota, B., and Stephenson, R. (2019, November 12). Spotify's Event Delivery – Live in the Cloud. Spotify Labs: <https://labs.spotify.com/2019/11/12/spotify-event-delivery-life-in-the-cloud>
- 49** Porter, J. (2019, November 13). Spotify's Magic Leap App Will Change Playlists as You Change Rooms. The Verge: <https://www.theverge.com/2019/11/13/20962662/spotify-magic-leap-app-music-streaming-augmented-reality>
- 50** Langston, J. (2019, November 4). Project Silica Proof of Concept Stores Warner Bros. 'Superman' Movie on Quartz Glass. Microsoft Innovation Stories: <https://news.microsoft.com/innovation-stories/ignite-project-silica-superman>
- 51** Embrace Digital Decoupling. (2018, September 13). Accenture: <https://www.accenture.com/us-en/insights/us-federal-government/embrace-digital-decoupling>
- 52** Exponential IT: Unlock Agility, Innovate at Speed. (2018, February 26). Accenture: <https://www.accenture.com/us-en/insight-exponential-it>

## About Accenture

Accenture is a leading global professional services company, providing a broad range of services and solutions in strategy, consulting, digital, technology and operations. Combining unmatched experience and specialized skills across more than 40 industries and all business functions—underpinned by the world’s largest delivery network—Accenture works at the intersection of business and technology to help clients improve their performance and create sustainable value for their stakeholders. With 505,000 people serving clients in more than 120 countries, Accenture drives innovation to improve the way the world works and lives. Visit us at [www.accenture.com](http://www.accenture.com)

## About Accenture Labs

Accenture Labs incubates and prototypes new concepts through applied R&D projects that are expected to have a significant impact on business and society. Our dedicated team of technologists and researchers work with leaders across the company and external partners to imagine and invent the future.

Accenture Labs is located in seven key research hubs around the world: San Francisco, CA; Sophia Antipolis, France; Washington, D.C.; Shenzhen, China; Bangalore, India; Herzliya, Israel and Dublin, Ireland; and 25 Nano Labs. The Labs collaborates extensively with Accenture’s network of nearly 400 innovation centers, studios and centers of excellence located in 92 cities and 35 countries globally to deliver cutting-edge research, insights and solutions to clients where they operate and live. For more information, please visit [www.accenture.com/labs](http://www.accenture.com/labs)

## About Accenture Research

Accenture Research shapes trends and creates data driven insights about the most pressing issues global organizations face. Combining the power of innovative research techniques with a deep understanding of our clients’ industries, our team of 300 researchers and analysts spans 20 countries and publishes hundreds of reports, articles and points of view every year. Our thought-provoking research—supported by proprietary data and partnerships with leading organizations, such as MIT and Harvard—guides our innovations and allows us to transform theories and fresh ideas into real-world solutions for our clients. For more information, visit [www.accenture.com/research](http://www.accenture.com/research)

Copyright © 2020 Accenture.  
All rights reserved.

Accenture and its logo are  
trademarks of Accenture.

This document makes descriptive reference to trademarks that may be owned by others. The use of such trademarks herein is not an assertion of ownership of such trademarks by Accenture and is not intended to represent or imply the existence of an association between Accenture and the lawful owners of such trademarks.