Accenture Technology Vision 2014

Every Business Is a Digital Business

From Digitally Disrupted to Digital Disrupter

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FOREWORD

When we declared "every business is a digital business" in the Accenture Technology Vision 2013, we didn't see it as a trend for last year or this year. We saw it as the future. The future of technology. The future of business. The future of our increasingly interconnected and interdependent world.

Last year, we saw the beginnings of business transformation based on a digital model. Organizations looking to reimagine themselves in a technology-driven world set forth on their journey to becoming digital businesses. Many organizations were experimenting, while others were making larger investments. But all were counting on technology to fuel their next waves of growth.

This year, we see a marked uptick in digital. The Accenture Technology Vision 2014 lays out bold trends that are becoming characteristic of larger enterprises, which have been perceived by some as lagging in converting to digital businesses. While social, mobile, analytics, and cloud still drive these trends, the focus now is on new ways that these technologies are being woven into the next generation of business strategies across every industry.

Enterprises are embracing technology in the way they do business and also as a catalyst to create something new—new markets, new products, and new areas of growth and revenues.

The change is revolutionary. Industrial companies are becoming customer service companies. Consumer products companies are becoming Internet companies. Energy companies are becoming information companies. And media and entertainment companies are becoming logistics companies.

For our clients and for any organization, the Accenture Technology Vision 2014 points toward an exciting time of new opportunities driven by the power of technology. We hope that you find the Accenture Technology Vision insightful as you continue on the journey to become a digital business.

Pierre Nanterme
Chairman & CEO

Paul Daugherty
Chief Technology Officer

INTRODUCTION

Every Business Is a Digital Business: From Digitally Disrupted to Digital Disrupter

Big companies are back in the digital game. Procter & Gamble, Tesco, Disney, GE—these are just a few of the global 2,000 that are now in a race to become digital. Those that get there first will be able to disrupt their existing markets and penetrate new ones. They will be in control of their new digital destinies.

This year's report represents the latest iteration of Accenture's Technology Vision, which declares that "every business is a digital business." In last year's report, we laid out the imperative for every business to reimagine itself in this digital world, and we charted the increasing appetite of leading enterprises for exploring the opportunities that emerging technologies provide.

Big is the next big thing

This year we see something more. We see the first wave of large traditional companies starting to use technology as a driving force—in some situations, *the* driving force—for how they grow strongly and effectively. If the last decade has been seen as the playground of the digital startups—overnight sensations such as Instagram and Twitter, Zipcar and YouTube, TripAdvisor and Airbnb—then the coming decade will see the emergence of the traditional companies as digital giants. Backed by their deep resources, enormous scale, and process discipline, these new digerati are about to rewrite much of the digital playbook.

For business leaders everywhere, the next three years will be about determining their organizations' pace in this digital race—and their place in the new world of digital. Large companies are making a push to transform themselves from followers to leaders in digital. The first contenders out of the gate are already poised to take advantage of the many recent technology advances in ways that promise to upend expectations of industry observers and consumers alike.

Tesco, GE, and Disney show how

Consider Tesco. In the last two years, the global supermarket chain not only has created interactive grocery stores in airports and subway stations but also has expanded into new industries. Tesco now offers movie streaming, e-books, and even its own seven-inch tablet priced as low as $91.[1] The grocery retailer is well on its way to becoming a truly digital business. More than 20 percent of Tesco's online sales now come through smartphones, and 10 percent of all orders from Tesco Direct come through its mobile website.[2]

In the manufacturing arena, GE is betting on the industrial Internet, building cloud-based services with intelligent analytics so that it can collect and combine vast amounts of industrial-machine data and equipment data, extracting unique insights that it can use to set new performance standards in major industries such as energy and aviation.

In the business-to-consumer realm, Disney is introducing a collection of tools including a wireless tracking wristband to create an entirely new personalized and enriched experience for visitors to its amusement parks. For visitors wearing the MagicBand, Disney offers a better guest experience with much less waiting. But the technology goes beyond just giving preferential places in queues: for example, it allows Disney park-goers to simply "touch to pay" for food and merchandise and to make and share plans with family and friends in a travel group. The technology is also transforming the dining experience, enabling patrons to preorder food, which is then prepared and served as they walk into a restaurant.[3] And of course, Disney captures a comprehensive digital record (or storybook) of its customers' activities.

Much more than an investor relations game

During their years of experimentation, industrial powerhouses such as GE, Disney, P&G, Tesco, Walmart, and Shell have learned by doing—steadily gaining the skills and the competencies to pull ahead of their competitors, blunting the startups' advantages, and proving to their stakeholders that they absolutely have what it takes to excel in the new digital economy.

Of course, the big players know it's far more than an investor relations game. They are acutely aware that digital expertise can confer exceptional strategic advantage. They realize that not only can they control their own markets, but they can actually disrupt and establish footholds in others, often creating new business and market models in the process. For example, General Motors is already raising anxiety in the car rental business by partnering with RelayRides, a startup whose use of mobile phones makes ride sharing easy. And AT&T is entering the home security market with its Digital Life service, allowing customers to remotely control everything in the home, from alarms to lights to door locks.

When boundaries blur

A huge shift is under way. Boundaries are blurring in many dimensions—not just between IT leaders and their business colleagues, but between digital assets and physical resources and between enterprises and their customers, suppliers, and other stakeholders. IT strategy and business strategy are no longer separate; they have become inseparable. It's this kind of mindset that we see across the digital spectrum.

In many ways, digital is unlocking a renaissance for large companies, allowing them to reconnect with what made them industry leaders in the first place. There is a vast variety of opportunity before them. Just as technology leveled the field for the newcomers of the last decade, so the incumbents can now leverage those same forces of digital democratization to charge back. Lower barriers to entry for one are lower barriers to entry for all. Many will use their new digital prowess as a potent differentiator—resetting the bar for consumer interactions, for instance, or providing unprecedented levels of supply chain effectiveness, or perhaps developing groundbreaking new pricing models.

Hallmarks of tomorrow's digital disrupters

The concept of the "fast follower" is becoming obsolete. In a world of nonstop change, there is no time to catch up. Instead, we expect the emerging digital leaders to be master orchestrators—uniquely able to strive for convergence on a huge scale as they capitalize on a wide array of technology breakthroughs to rapidly advance and innovate with their systems and strategies.

In turn, this new pace will force corporate leaders to think about new operating models that might yield further advantage. Here too, many experiments are under way—from new cross-functional roles for data scientists to chief digital officers whose influence extends beyond the four walls of the enterprise.

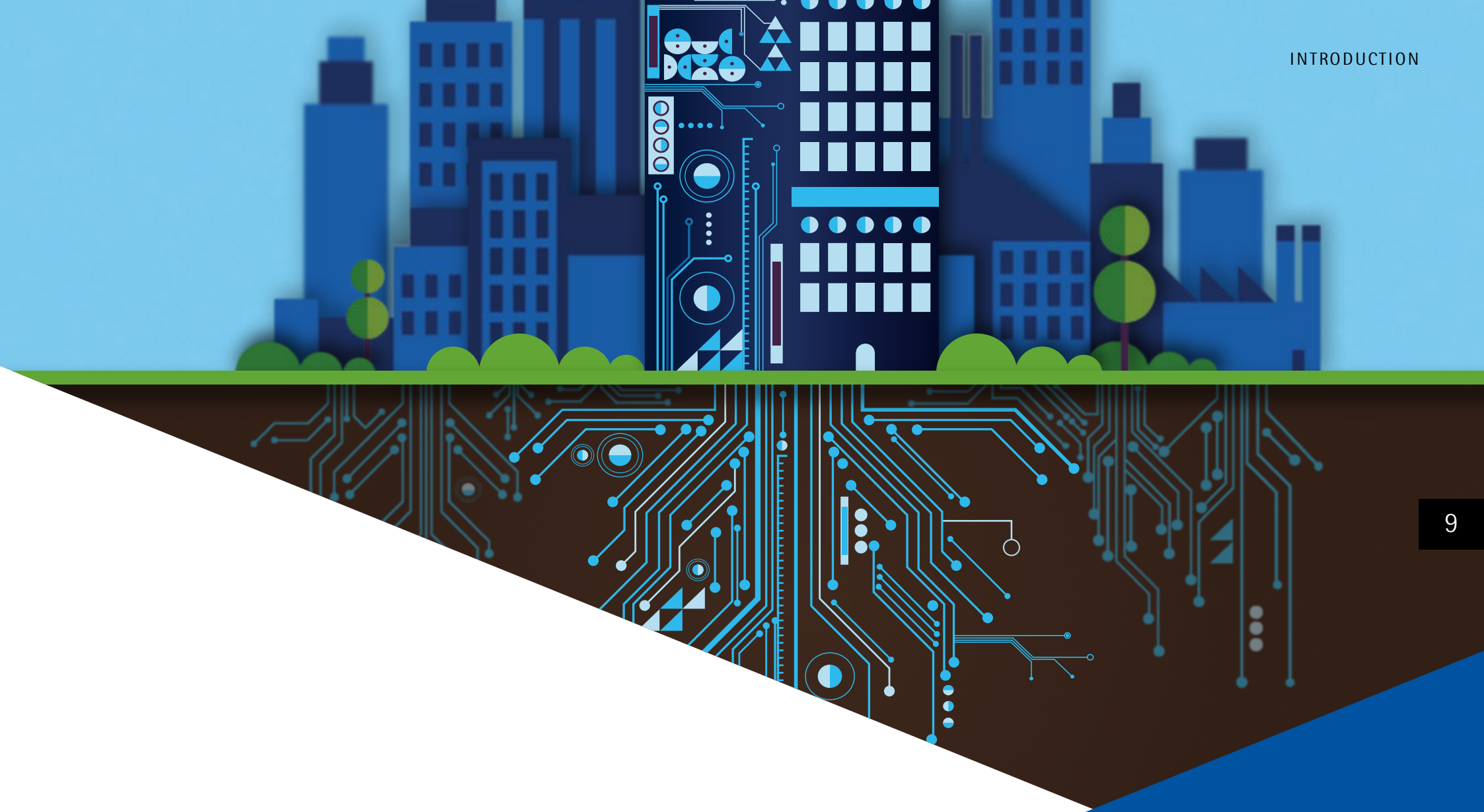
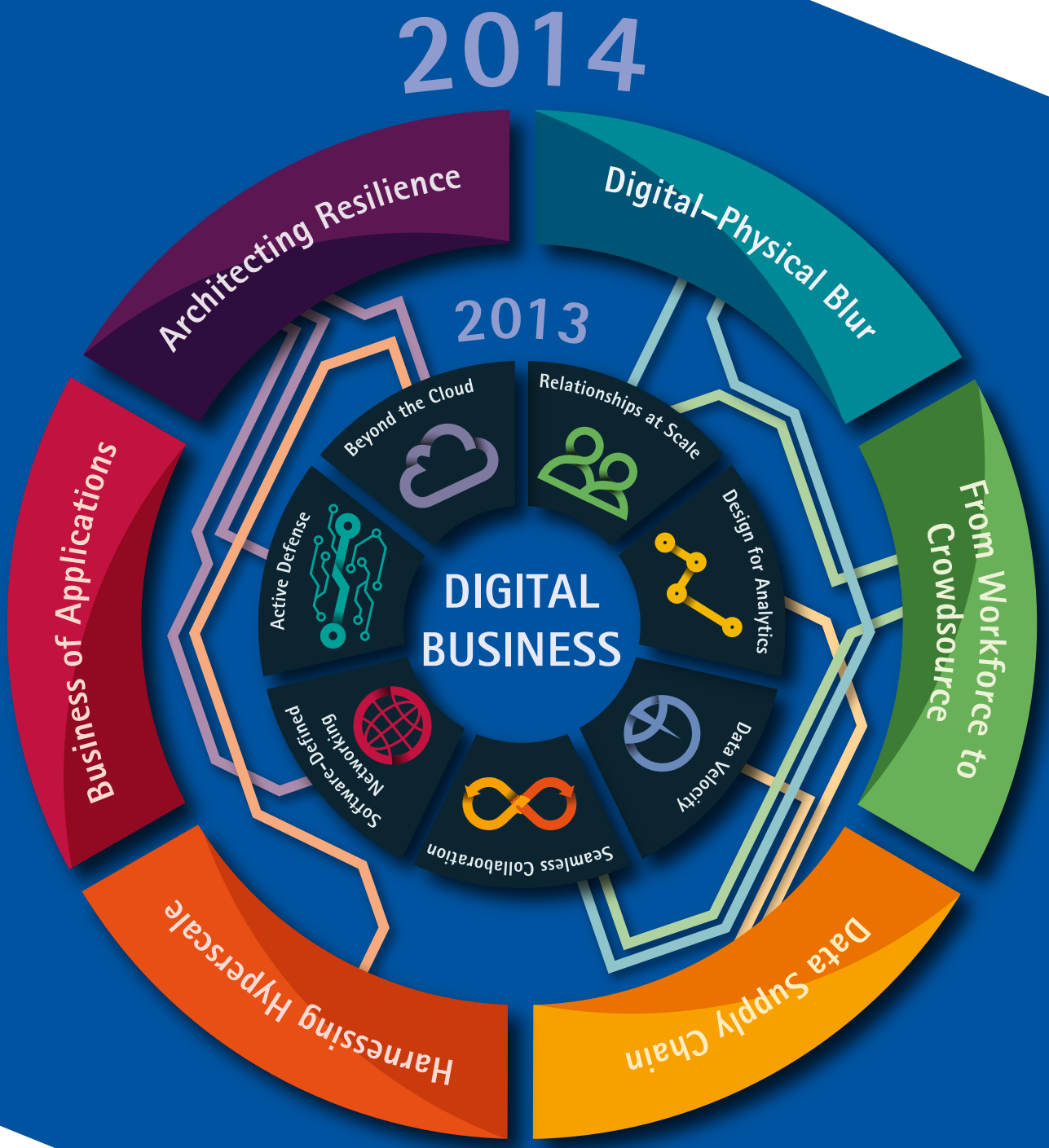


FIGURE 1:
Every Business Is a Digital Business: The Evolution



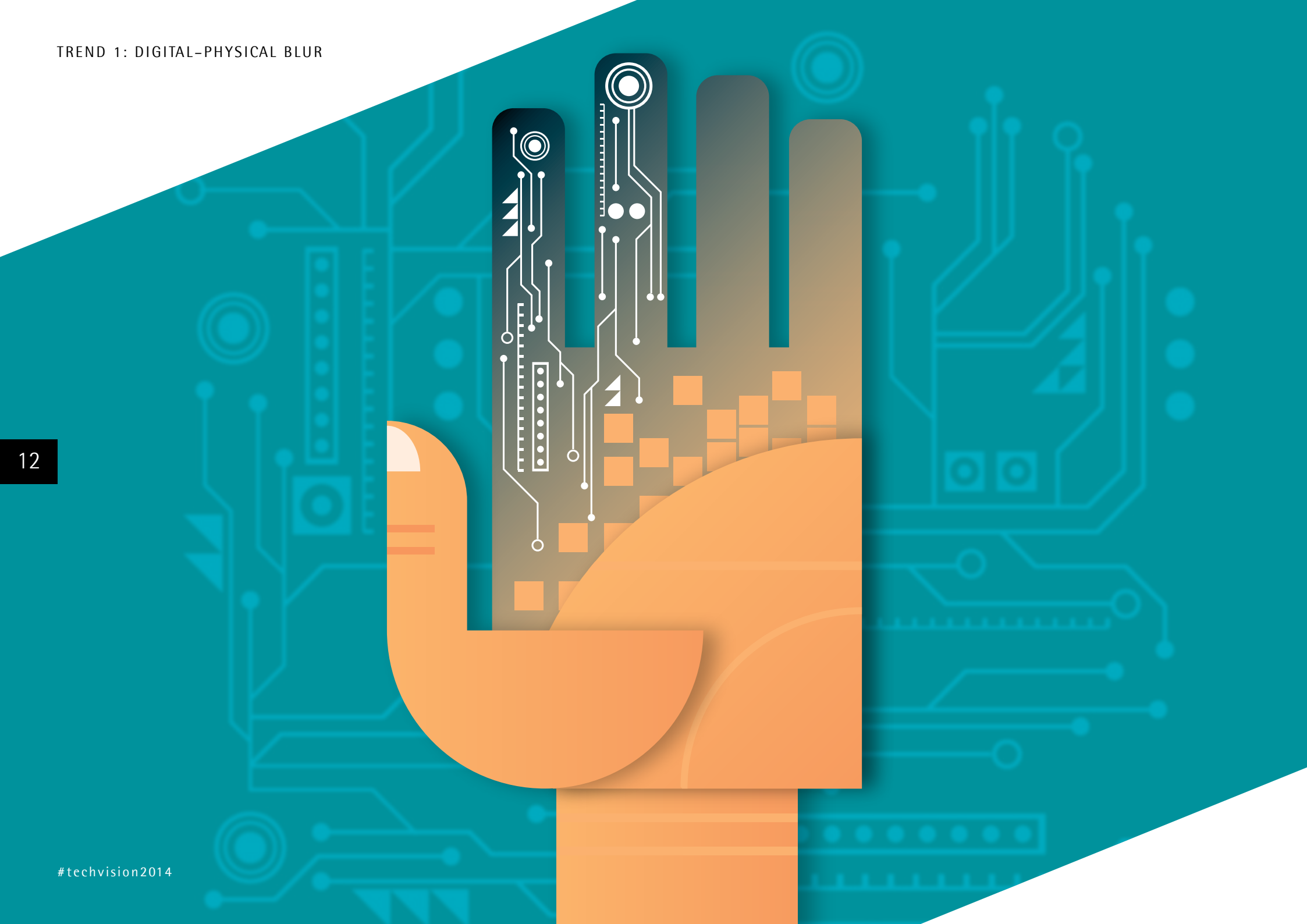
And throughout every organization, we anticipate a re-estimation of the skills that will be most valuable, at all levels.

This year's Technology Vision report highlights six emerging themes that reflect the shifts being seen now among the digital power brokers of tomorrow: large enterprises such as Tesco, GE, and Disney that recognize, as they leverage their scale to redefine digital in their industries, that *big is the next big thing*.

Collectively, these themes represent the newest expression of Accenture's stance that "every business is a digital business." They provide additional components to Accenture's multiyear perspective on technology's tectonic shifts and its impact on the strategies and operational priorities for organizations worldwide (see Figure 1).

Individually, each theme, from each year, highlights the evolution of a key technology, some of which are already central to the digital explorations of many leading enterprises. Viewed in aggregate, the themes represent a fundamental shift in the assumptions that companies now must make as they plan for success in the decades to come. They provide a richly detailed view from which business leaders in every industry can draw insight, inspiration, and, we hope, excitement about where digital technologies can take their organizations tomorrow.

Becoming a digital business is no longer simply about how we incorporate technology into our organizations; it's about how we use technology to reinvent those organizations to get out in front of the dramatic changes that technology is creating. For large enterprises especially, the opportunity to shift from disrupted to disrupter cannot be overstated. The question these businesses must now ask is how they will use the next three years to redefine their places in this new world.



TREND 1

Digital–physical blur: Extending intelligence to the edge

The physical world is coming online as objects, devices, and machines acquire more digital intelligence. What's emerging is more than just an "Internet of Things"; it's a new layer of connected intelligence that augments the actions of individuals, automates processes, and incorporates digitally empowered machines into our lives, increasing our insight into and control over the tangible world. There are benefits for consumers and businesses. Consumers become better informed and better equipped to influence the ways they experience everything around them. And businesses get real-time connections to the physical world that allow machines as well as employees to act and react faster—and more intelligently.

Why now?

Explosion of connected devices: The installed base of the Internet of Things is estimated to reach approximately 212 billion in 2020. This will include 30 billion "connected (autonomous) things" that same year.[1]

Increased bandwidth: Global IP traffic is expected to nearly double between 2013 and 2016, and broadband is expected to speed up more than twofold.[2]

Advanced robotics: From agriculture to oil fields, advances in robotics are empowering human-robot collaboration in industries beyond the factory floor. Several leading car manufacturers have committed to bringing autonomous car technologies to market by 2020.

Rise of real-time analytics: Data sources are growing at an unprecedented velocity, and the ability to loop insights immediately back into the decision process is supporting automating responsive actions like never before. By 2017, more than 50 percent of analytics implementations will make use of event data streams generated from instrumented machines, applications, and/or individuals.[3]

Wearing a smartwatch yet? Tracking your workouts with your phone? Noticed a driverless car in your neighborhood?

From wearable computers to autonomous drones, the ways in which we experience the world are changing fast. Intelligent interfaces are emerging that allow decisions to be made "on the edge"—at the point where digital and physical worlds converge—rather than in a centralized manner. These decisions can be made exactly when they're needed in informed, social, easy-to-use ways, allowing companies and governments to reimagine the possibilities for engaging with their customers and citizens.

Smartphones have turned their owners into digitally augmented versions of themselves—able to catalog and quantify actions throughout the day and access, create, and share an astonishing array of pertinent information that can enable faster, better decisions. Several car models can now self-park with ease—making "edge" decisions about available space, proximity to the curb, and more. Google and Nissan claim their driverless cars are just five to six years away.[4] And autonomous drones—once the sole province of the military—are being used by police precincts across the United States.

But what does the average smartphone subscriber have in common with the person riding in a driverless car? They are both using "edge devices"—devices whose edges border other devices in that they have unprecedented capabilities to connect with other devices. These "cyber physical" systems sense their environments and respond—appropriately—in real time, making possible better-informed decisions within windows of opportunity that can create competitive advantage. The pivotal point is that the sheer quantity of these edge devices is increasing as dramatically as their prices are dropping. At the same time, their ability to sense environmental variables, share data with other edge devices via the cloud, and have deep analytics performed by the cloud adds up to create rich user experiences that inform much more intelligent, real-time decision-making.

As the line between the digital and the physical continues to blur, a vast new window of opportunity is opening for the enterprise. By leveraging and enhancing their physical assets, traditional companies are looking at this opportunity as a way to leapfrog online competitors, create immersive real-world experiences for consumers, and gain market share. In addition, every company now has the opportunity not just to gather insight to make smart business decisions but to turn those decisions into actions, in real time, in the real world. The enormous expansion in intelligent capabilities is rapidly reshaping established operations, paving the way for industry disruption on a massive scale.

But to chase these new opportunities, business and technology leaders alike must rethink how they both engage customers and run their businesses in a digital-physical world. For industrial Internet leaders like GE, this means pushing sensing technologies outside of industrial applications and further to the edge of operations. For companies such as Cisco, which predicts that the industrial Internet market will be worth $14.4 trillion over the next decade, this means focusing on the "Internet of Everything"—or, as Cisco describes it, "bringing together people, process, data, and things to make networked connections more relevant and valuable than ever before."[5]

A world of new user experiences

The way people interact with the world around them is changing. Digital technologies offer new decision-making experiences—from selecting a restaurant in a new neighborhood to making a critical maintenance decision on a gas pipeline. The power of these decision spaces is that they give users real insights, not just information; by providing valuable insight, users are one step closer to taking action.

Technology has been evolving to enable this for the last decade. The ubiquity of network connectivity and the proliferation of smart devices (such as sensors, signs, phones, tablets, lights, and drones) have created platforms upon which every enterprise can innovate. In terms of creating new consumer experiences, this is perhaps most visible in the surging popularity of the "quantified self" movement. Consumer wearables such as Nike's FuelBand, Adidas's miCoach, and Fitbit track exercise and physical activity in ways that allow users to easily gain insight into their performance—often in real time—giving them the information necessary to make decisions about picking up the pace, going for another lap, or pushing for a personal best.

In the urban context, the Copenhagen Wheel, a replacement bicycle wheel, is able to augment the cycling experience by sensing the pressure and effort exerted on the bike's pedals and adding motorized help when the rider needs it; in doing so, it's able to quantify physical activity for the rider.

These quantified measurements are not isolated to athletes or individuals. Osakidetza, the public health system in the Basque region of Spain, is using Microsoft Kinect devices to enable telemedicine treatment of chronic patients. Using the Kinect devices, patients are given not only a more natural way to interface with technology but also new ways to experience medical care. Using insights from the Kinect devices, physical therapists get access to a wealth of granular data that can be used to offer remote consultations and to quantifiably gauge progress. In doing so, therapy sessions can be more frequent, more targeted, and shorter, thus reducing costs, improving outcomes, and reducing patients' recovery times.[6]

More and more, these experiences are expanding beyond a user's personal set of devices. Embedded intelligence isn't limited to smartphones and tablets. Everyday objects are becoming smart and expanding the definition of what it means to experience the real world. In London, British Airways has unveiled two digital billboards that actively track flights in real time, animate an image of a child pointing to the plane, and display the flight number and information about its destination or origin—inspiring onlookers to dream about where they could be escaping to on a British Airways flight.[7] In San Francisco, parking meters are smart and connected; drivers see a color-coded map denoting varying levels of parking difficulty. Once a car is parked, the system can alert the driver when his meter time has nearly expired and allow him to "feed the meter" virtually, from his smartphone. The technology doesn't allow drivers to reserve a parking spot, but it does give them an interface to make a decision on the edge.[8]

Similarly, Waze, a mobile phone app, allows drivers to make decisions at the point of action. It does this by enabling users to use their phones to share insights on current road conditions and offering suggestions about alternate routes around traffic obstacles. In short, Waze users share rich, unstructured insights that create actionable decision spaces.

These decision spaces are not the exclusive domain of digital companies. Brick-and-mortar retailers can differentiate themselves from their online-only counterparts by mastering the digital–physical blur. Retailers such as Tesco, Neiman Marcus, and Staples are continually experimenting with new ways to deliver unique and meaningful consumer experiences. Tesco and Staples are transforming their in-store technology and service offerings to better align with consumer lifestyles: Tesco is rolling out face scanning digital signage at all 450 of its UK petrol stations to tailor engaging and on-screen content to the audience of five million-plus adults who pass through its stations each week; Staples is piloting stores with less merchandise, more kiosks (with free next-day delivery), and meeting spaces for busy small-business owners.[9] For its part, Neiman Marcus has piloted digital-physical solutions that provide both sales associates and customers with actionable intelligence—in the form of store events, product arrivals,

and even personal touches such as the knowledge of when a favorite sales associate is working.[10] With Apple's introduction of iBeacon indoor positioning technology and competitors such as Estimote, brick-and-mortar retailers will find abundant opportunities to incorporate digital transformations on the retail floor that cascade throughout their operations.

What all of these examples have in common are the ways they enhance users' experiences of the world, improving their ability to share insights and take action. There's a powerful secondary effect at work here too: the more that users have access to such amplifying technology, the more they want access to real-time analytics to inform their next experiences, everywhere.

Capabilities at the edge refresh traditional industries

Having access to instantly actionable decisions has served the industrial world well. Over the last two decades, industrial companies have enjoyed radical efficiency improvements by integrating digital technologies throughout their operations—from RFID tags in supply chains to robotics and remote monitoring and control in oilfield and pipeline operations.

What's changing to put digital-physical systems on boardroom agendas today is their infiltration into more industries and their ability to disrupt so many sectors of global economies. The same improvements that manufacturers have made to drastically improve safety and operational efficiency and, in some instances, to augment the ability to scale are now expanding to every industry. Today's digital-physical systems range from chef robots that can serve a custom gourmet burger every 10 seconds to smart grid technologies that are able to identify individual appliances and their discrete energy consumption—by simply installing a single device on a smart meter that can read, analyze, and decipher complex electrical frequencies.[11]

Building owners, property managers, and industrial equipment vendors are benefiting from the reduced cost and increased capabilities of digital-physical systems to drive new experiences with building operations. They are adopting integrated solutions such as continuous

commissioning systems that make use of sensors throughout a building's workspaces and mechanical equipment to collect data with millisecond resolution on building performance. Four years ago, Microsoft relied on a team of reactive operations staff traversing the enormous corporate campus in trucks responding to hot and cold calls. Today, the company uses a software overlay which visualizes the existing 500 million data transactions every 24 hours and is managed by a staff of highly skilled engineers who is harnessing big data and using it to improve Microsoft employees' experience and drive down energy costs.[12] Schneider Electric is going one step further by incorporating some of the world's most advanced weather modeling data into its building automation systems, allowing facilities managers to factor external climate conditions into their decisions and making it easier to automate many of those decisions.[13]

Industries from warehousing to agriculture are seeing similar advances. With robotic systems for order fulfillment enabling big reductions in shipment times, warehouses can process more orders in less time with fewer employees. Taking robots to the skies, the use cases for autonomous drones are abundant and are disrupting

"The more that users have access to amplifying technology, the more they want access to real-time analytics to inform their next experiences, everywhere."

a diverse group of industries. Agricultural applications use infrared cameras to pinpoint crops that are receiving too much or too little water, first responders use drones to detect survivors of accidents and natural disasters and to deliver supplies to those emergency zones, and road surfaces and traffic congestion are monitored by drones. The EU has identified robotics as a high-growth industry and is committing resources to ensure a strategic leadership position. Together with a consortium of ten European companies led by Shell, the European Commission has committed €3.7 million to a €6.2 million project to develop robots which can replace humans in inspections of pressure vessels and storage tanks used extensively in the oil, gas, and petrochemical industries. When deployed, these robots will increase worker safety, reduce exposure to hazardous conditions, and increase economic development by creating new jobs and opening new markets for the European robotics industry.[14]

Individuals are seeing the benefits of augmentation as well. Philips is piloting the use of Google Glass to allow physicians wearing the display to simultaneously monitor a patient's vital signs and react to surgical procedural developments without having to turn away from the patient or procedure.[15] Gartner predicts that the field service industry alone stands to save $1 billion annually by 2017 by using smartglasses—the field now being pioneered by Google Glass. The research firm notes that smartglasses will enable field service technicians to "diagnose and fix problems more quickly and without needing to bring additional experts to remote sites."[16]

Disruptions ahead

Supported by their abundant resources and their ability to scale, large companies can now use digital-physical systems to disrupt their industries—and other industries too. To act disruptively, they must not simply use digital-physical systems to improve today's processes and services; they have to re-imagine the end-to-end delivery and experience of those processes and services. In doing so, there's ample opportunity not only to disrupt existing industries but to define new markets.

Etihad Airways has reimagined what it means to operate an airline in a digital world. Working with Taleris, a provider of intelligent operations services, Etihad Airways will tap the industrial Internet and use sophisticated software to harvest and analyze data generated by

hundreds of sensors working inside its planes. The tools will allow Etihad to monitor planes in real time, reduce fuel costs, manage plane maintenance, and even spot problems before they happen.[17]

Enabling many of these advances is the concept that data can be acquired, analyzed, and acted upon in real time. The underlying concept is hardly novel: it applied to the earliest anti-lock brake systems on cars, and it's true of many more complex systems today. The difference, however, is that today's digital-physical systems often have orders of magnitude more data to help make more informed decisions within a window of opportunity that matters.

This "iteration capital" is a force multiplier at Ford Motor, where 3-D printers radically reduce iteration cycles in the design process, saving an average of one month of production time for new engine parts, for instance.[18] At motorcycle maker Ducati, design cycle time has been halved by leveraging 3-D printing.[19] And the U.S. Army is experimenting with 3-D printers to eliminate the need to carry so many spare parts. The precision enabled by today's additive manufacturing technologies is leveraged by GE to make parts that were simply not possible with previous manufacturing technologies.[20] In all of these examples, companies are pushing decisions to the edge in ways that were never before possible.

The entire transportation ecosystem is ripe for disruption by digital-physical systems. When driverless cars become common, not only will they change commuters' experiences, they are expected to reduce the incidence of traffic accidents, improve the density of road use, smooth subsequent planning for maintenance and new road construction, ease long-term planning for other transportation systems such as light rail, and much more. Overall, driverless cars will radically disrupt the shipping and logistics industries, fleet services, public transportation, taxicabs, rental cars, agriculture, and mining industries. What's more, insurance liability markets will likely undergo dramatic changes as car manufacturers move to self-insure, offsetting their distributed risk via reinsurance markets.

In case there is any doubt that such technologies are in our future, public policy—often the biggest laggard in innovation economies—is keeping pace. In the U.S., California, Nevada, Michigan, and Florida have already passed legislation allowing driverless cars on the roads.[21]

"Organizations that understand the potential of behavior shaping and respect its privacy implications will enjoy consumer loyalty and employee engagement."

The U.S. federal government has instructed its Federal Aviation Administration to publish rules that will permit drones to use public airspace by September 2015. Nearly a dozen EU member states have no laws preventing small drones from flying below 150 meters.[22]

Decisions on the edge are powering innovations for consumers and businesses alike. To lead, companies need to identify the decisions they would like to shape and the places where they can build decision spaces to inform those decisions. From there, companies will have new opportunities to shape behaviors in new ways.

Shaping consumer behavior

What's perhaps most intriguing about digital's amplification effect is that it's directly allowing businesses and the enterprise to identify and replicate productive behaviors. Furthermore, it's creating the expectation that every experience can and should be optimized. There is significant potential to shift employee behaviors away from preparing for every permutation of

an experience and toward developing new and simpler experiences altogether. These experiences prove to be better for the end user and to be more cost-efficient for the enterprise to implement.

Royal Caribbean International cruise line has shown its grasp of technology's ability to empower travelers and optimize customer experiences. Eager to ease long lines for shipboard restaurants—a perennial complaint from passengers—Royal Caribbean uses sensors to relay to passengers the real-time seating availability at each of the restaurants on its ships. In other words, Royal Caribbean moved dining decisions to the edge by giving its passengers the data they need to decide where and when to have a meal. Passengers are happier and the cruise line was able to discard cumbersome scheduling processes, making it a win-win situation for everyone.[23]

This behavior-shaping capacity can be tuned by the ways in which information is presented to a user. For example, if a city wants to reduce its collective carbon emissions, it might offer a transit planning app that provides route planning guidance on the least carbon-intense mode or route in addition to the quickest.

Organizations that understand the potential of behavior shaping and respect its privacy implications will enjoy consumer loyalty and employee engagement. The key is to notify individuals about how their activities are being monitored, give them the choice of opting in, and explicitly share with them the choices of actionable information at the decision point.

These aspects are crucial. Privacy issues are likely to keep making headlines as privacy watchdogs jump in to defend against unauthorized tracking of citizens and consumers. The company that can build a reputation for providing valuable services while using consumers' personal data in trustworthy ways will have big advantages over competitors. Its brand will be more valuable, it will have more opportunities to attract and retain lifetime customers, and it can become a preferred partner in a larger value chain of goods and services.

Next steps for businesses

Are consumers already buying smartwatches? They are. Is there a long waiting list for Google Glass? You bet. It's fair to say that there will always be individuals who are eager to acquire technology to become better informed and to be able to enjoy different and hopefully better user experiences.

Businesses are likely to be more circumspect about the migration of decisions to the edge. Accenture expects that business-to-consumer organizations will be quite quick to respond to consumers' eagerness for and openness to new experiences, offering everything from new mobile couponing opportunities to new ways to monitor and improve their health.

In the broader business world, there are enormous opportunities to move employees' decisions closer to where they can take action. That much is apparent when so many employees keep their mobile phones close to them in the workplace. But businesses' embrace of the next generation of automation will be cautious.

Accenture anticipates three phases of uptake. The first impact will be on making current ways of doing things much more efficient. The second phase will see digital-physical systems start to create industry disruptions. Disruption will begin as it always does—by changing users' expectations of what is acceptable, normal. The businesses that proactively alter users' experiences will be the disrupters. The third phase will be in how organizations respond. They will need to ask questions about how truly intelligent automation will change interactions with and expectations of their customers and other stakeholders. Will it open up new business opportunities? Will it change the productivity equation in the workplace? Will it materially change how we plan our use of resources? Will it simplify our organization's structure?

The businesses that arrive at the best answers—and that can properly leverage the strengths of machines (precision and scale) alongside the strengths of people (insight and decisions)—will be setting themselves up with market-leading advantages.

Your 100-day plan

In 100 days, promote decisions at the edge by completing the following:

- Take an inventory of devices at the edge of your network; segregate them by those used by humans and those that act on their own, such as sensors and embedded intelligence.
- Catalog how data is currently being collected in your organization to drive business decisions. Understand how having more data about daily operations could improve business outcomes.
- Define and prioritize both the ways in which consumers engage with your products or services and the locations where they engage. Brainstorm ways to deliver compelling user experiences that offer new insights into their decision making.
- Consider how you can influence behaviors or decision making to help consumers arrive at a favorable outcome for your mission or business.
- Look to early adopters to learn what businesses in different industries are doing to enhance consumer experiences, enable field workers, and embed intelligence into their physical assets.
- Organize a cross-functional mobility team between your IT and business organizations. Their objective will be to pilot relevant hardware innovations and test new consumer and employee digital-physical experiences.
- Collaborate with your customer-facing business units to capture the types of edge decisions they often make. Determine how they will benefit by adding data with real time analytics at the point of action and create a strategy to deliver that solution.
- Reevaluate your corporate privacy policy to address the new digital-physical interactions for your business. Data collection, usage, transparency, and user control (opt in/opt out) guidelines should be clearly addressed.
- Uncover the types of decisions that can alleviate oversight obligations from middle management and start to build decision spaces for front-line workers to take autonomous actions.

This time next year

In 365 days, you should step up your business agility by pushing decisions to the edge:

- Develop a portfolio of pilots to deliver actionable insights to employees and customers and that considers hardware and software solutions. Aim for increased data resolution over what is provided today. Monitor outcomes related to those decisions, and consumer experiences.
- Extend your infrastructure to support enterprise mobility for core business functions.
- Develop a real-time data analytics infrastructure to support the data velocity and insight needs of digital–physical projects.
- Develop a governance strategy to act on real time feedback loops to enhance decisions at the edge.
- Proactively address potential data privacy issues as new pilots and projects are developed. Urge leaders to go beyond compliance, giving end users transparency and control in an effort to mitigate corporate risk and liability.
- Start planning for known technology disruptions coming down the pipeline. Example: your business will make use of autonomous vehicles and aerial drones. Be disruptive. Plan on aerial drones being available for use in late 2015 and driverless cars in 2020.

SIDEBAR

Digital augmentation makes every worker an information worker

To-date, corporate technology investments have focused on improving the efficiency of only certain staff: high-cost knowledge workers. That is changing. Intelligent devices are now sufficiently abundant, inexpensive, and connected, empowering workers at every level to perform their jobs with greater efficiency, productivity, and safety. Front-line workers are becoming information workers with some of the same augmentation technologies that improve the performance of knowledge workers.

These new information workers are able to make informed decisions in real time, acting in the tangible world with the right information at the right time—often using their own mobile devices rather than technology supplied by the organization, yet interacting with the organization's back-end IT systems.

For example, paramedics in Champaign, Illinois, and Grand Rapids, Michigan, are using their own smartphones and tablets to increase access to medical information, find drug dosages and interactions, and share insights

with the destination hospital while a patient is in transit. In the past, if this research happened at all, it would happen when the paramedics arrived at the hospital or returned to their depots. Now, the research can happen in near real-time and have meaningful impact on the course of treatment.[24] The paramedics are newly enabled by information that provides critical insights within a narrow window of opportunity; those insights can spur a decision "on the edge" that can possibly save a life.

In similar ways, developments with wearable technology, such as Google Glass, may provide field-service professionals in the oil and gas industry with access to real-time information and deep expertise—improving their effectiveness at fixing remote pipelines and maintaining highly sensitive infrastructure.

As front-line workers have their capabilities augmented by digital technologies, they are emboldened to make more informed, real-time decisions and encouraged to become more engaged with the organization. This drives operating efficiency and revenue growth. Studies have shown that companies with high employee engagement frequently demonstrate higher levels of operating income and growth in earnings per share than those found to have low levels of employee engagement.

The implications of digital workforce transformations go beyond updating bring-your-own-device (BYOD) policies. Realizing the efficiencies from digitally augmented workforces will require business leaders to fundamentally rethink how employees do their jobs and reassess the back-end systems that support them. Leaders will also need to be comfortable with decentralized decision-making as business decisions get pushed closer to the edges of their business. Chief information officers (CIOs) will need to be more cognizant of potential risks associated with data privacy and security. Real-time information systems will become a higher priority. Getting information to workers as they need it will allow businesses to uncover a workforce that is more productive, eager for new challenges, and more effective and efficient at making and sharing decisions by collaborating with others. The benefits can rise above quantity and quality of work output by contributing to the flattening of organizations—meaning that a smaller number of supervisors and middle managers can manage larger and more dispersed teams.

TREND 2

From workforce to crowdsource: The rise of the borderless enterprise

Picture a workforce that extends beyond your employees: one that consists of any user connected to the Internet. Cloud, social, and collaboration technologies now allow organizations to tap into vast pools of resources across the world, many of whom are motivated to help. Channeling these efforts to drive business goals is a challenge, but the opportunity is enormous: it can give every business access to an immense, agile workforce that is not only better suited to solving some of the problems that organizations struggle with today but in many cases will do it for free.

Why now?

Accelerated pace of IT change: The increasing pressure to rapidly deploy new technology is accentuating some of an enterprise's biggest pain points: market insight, innovation, and a need for highly specialized skills. These are areas for which crowdsourcing solutions are well suited.

Maturation of crowdsourcing platforms: Communities of shared interest have organically formed or are forming around almost every product, service, and idea that can be imagined. Crowdflower, Spigit, and Mechanical Turk are just a few of the collaboration platforms that are rapidly evolving to enable and orchestrate efficient solutions.

Strong case studies from early adopters: Some of the biggest market disrupters, such as Facebook and large enterprises including GE, are currently using crowdsourcing services to solve their most complex problems, and everyone is taking notice.

Where do leading companies like GE, MasterCard, and Facebook go to solve their toughest data science problems?

They don't always turn to the professionals on their own payrolls. Rather, they are beginning to turn to companies like Kaggle—a global network of computer scientists, mathematicians, and data scientists who compete to solve problems ranging from airline flight optimization to retail-store location optimization. This is just one glimpse of how the concept of the corporate workforce is changing.

Over the last decade, organizations have been using increasingly advanced tools and processes to boost collaboration among their employees. Videoconferencing, instant messaging, blogs, wikis, and activity streams have all become the norm as large companies push to connect their employees across groups, skills, and geographic boundaries. Outside of the enterprise, these patterns are even more pronounced: tools such as Twitter and Yelp and Wikipedia connect huge swaths of the population to discuss and collaborate on everything from new-car reviews to health care.

Given that so much collaboration happens through digital channels, there is the potential for almost limitless collaboration with everyone else who is connected to the Internet—regardless of whether they are "our" employee or not. Which raises a crucial question for business and IT leaders: "Are we missing out by *not* connecting to this 'expanded workforce,' everywhere and in all directions?" The short answer is "yes."

Digital connection platforms

More and more digital platforms are available that make it easier to connect to what Accenture calls the expanded workforce. Kaggle is just one of these; others include Amazon's Mechanical Turk, along with services such as Elance and oDesk. All of these can be considered online labor markets. They help companies that have tasks that need to be accomplished connect with resources that have the right experience, ability, and time.

Although many organizations are experiencing the benefits of digitally enabled forums such as innovation exchanges and crowdsourcing platforms, few executives yet fully grasp the idea of being able to access a truly liquid workforce—pools of premier talent gathered in virtual communities and coalescing around specific business problems. This expanded workforce likely offers not only expertise that is not immediately available in-house but also real scale. It can be leveraged to solve problems that may be too large or too expensive to solve internally.

Name almost any challenge—early detection of driver drowsiness or the predictability of drug targets or electric-only updates to hybrid cars—and there are often already communities of experts that companies can leverage to competently address it. The individuals involved may be around the corner or on the other side of the world; what they have in common is not only the experience and expertise to solve the problem but the motivation—in many cases the passion—to do so.

The tasks involved may be as simple as data entry or as complex as industrial design. The individuals—the problem solvers—may work on a project or just part of a project. They may be paid; they may compete for prizes. But whatever their incentives and their spheres of interest, the unifying feature is that their contributions are made possible with digital tools.

The expanded workforce in action

Take the automotive startup Local Motors for example. Its Rally Fighter car can't easily be called beautiful, with its scrawny jellybean body perched high above gangly struts and monstrous off-road wheels. Its real beauty is in how it came to be—not how it looks.

A harbinger of the future, Local Motors created a global community of car enthusiasts that included engineers, mechanics, and industrial designers and broke down the creation of the vehicle into a set of tasks that were widely distributed, via the cloud, to this eclectic workforce. In just 18 months, those individuals—working closely with the company's employees—designed, manufactured, and delivered a car that this user community loves.[1]

Local Motors provides a provocative example of leveraging an unconventional workforce to accomplish something previously thought impossible. So intriguing is Local Motors' social-plus-collaborative take on car making that it has attracted some blue-chip partners, such as BMW. BMW hopes to use the startup's expanded workforce model to move beyond typical focus groups and inference, developing and testing new automobile interiors that reflect users' true desires rather than incomplete and veiled answers.[2]

Local Motors' real innovation is conceptual. Its leaders imagine and leverage limitless talent instead of being boxed in by what has traditionally been a predetermined workforce. They see talent that may already be waiting to solve some of the challenges the organization has yet to confront. "There are two ways to build things," Local Motors' co-founder and chief executive Jay Rogers told an industry publication. "You can hire the relevant people to solve a problem—or you can organize in the cloud to get better ideas faster."[3]

A crucial point to make is that the use of the expanded workforce is not another form of labor arbitrage. It is not to be confused with employing contractors or temporary labor or moving to an outsourcing arrangement. The channels, structures, and transactions are entirely different—far more fluid and versatile than any familiar forms of accessing human resources.

It will be essential that borderless enterprises work to harness the energies and enthusiasm of the expanded workforce. The current workforce is not going away, of course; not every problem will be well suited to crowdsourced solutions. However, it is no longer enough to rely only on groups of in-house individuals to drive market research, innovation, and product-development activities. Digital technology has brought a global voice to those functions. It is pushing out the boundaries that previously defined the enterprise workforce. It's not an overstatement to say that business leaders now need new perspectives on the nature of work itself.

Let's walk through a few of the ways in which leading businesses are starting to harness the expanded workforce.

Marketing moves toward perfect information

The expanded workforce is already changing the way companies market their products and services. Technology platforms that promote comments, user interaction, and even consumer investment are giving consumers a direct voice with which to communicate with the marketing department. In doing so, these platforms create a porous membrane between paid employees and the expanded workforce. Consumers are providing richly detailed information, giving companies an unprecedented level of insight into their products, how they're used, and the consumers that buy them.

With the right digital tools in place, producers can predict better than ever how the market will react to their products and who will buy them. They can segment markets more discretely and test premium feature sets to see who will pay for them. The new approach trades abstract market projections for data-driven market decisions; consider the difference in outcomes between

running small focus groups city-by-city and running a crowdsourcing contest to solicit customer input. Responses from 125,000 real-world consumers certainly are more statistically sound—and arguably more honest—than responses from 125 focus-group attendees.

The benefits of expanded-workforce input go further still. Direct consumer feedback can furnish data on pre-order sales that enables not only sales projections but also raising of working capital that can be used to begin manufacture of the actual product. In this way, the expanded workforce becomes an invaluable tool for reducing product inventory risks. This is market insight that is not confined by four walls or hidden behind artificial representations of consumers' wishes.

A few examples stand out. Walmart Labs, the digital technology division of the world's largest retailer, is embracing the power of the crowd to determine which items the company should stock in its stores and on its website. Using a contest titled "Get on the Shelf," which was heavily promoted on Facebook, Google+, and Twitter, the company offered a way to democratize the job of the store buyer and bring shelf selections in line with shoppers' expectations—and wants. The effort was intended only as a "fun experiment"—which it was, but it also provided Walmart with a clear view of the demand for products not currently on its shelves. Consumers voted online for the products they wanted to see sold at Walmart; winning entries for new products won prizes and a grand-prize winner was chosen from the top three contestants.[4]

Similarly, snack maker Lay's has used consumers' creativity to launch new flavors. The company has run flavor naming and defining contests in more than 15 countries since 2008. One recent U.S. initiative that used the slogan "Do us a flavor" drew nearly 4 million proposals. The winning flavor—"cheesy garlic bread"—was chosen from the votes of the company's fans and by a panel of experts who included a popular TV actress and several top chefs. The new flavor is now widely available for sale.[5]

Of course, there is no stronger indicator of market interest than customers' willingness to part with their money. These days, more and more businesses are using "crowdfunding" platforms such as Kickstarter to help validate product development. Kickstarter is the granddaddy of crowdfunding sites—new businesses that use Web-based collaboration, social media, and microfinancing techniques to raise money for everything from new film

projects to seed funding for small businesses. Since Kickstarter launched, in 2009, over 5 million people have used the platform to pledge more than $900 million, funding more than 50,000 creative projects.[6]

Companies are using Kickstarter and similar platforms not just for fundraising but to provide market insight and product viability assessments for a fraction of what those services typically cost. By determining what people will actually pay for, the process influences and validates products and pricing strategies and sometimes leads to initial consumption and to product advocates. Accenture has developed initial models that show that crowdsourcing, when used correctly, leads to higher profits for producers.

Tesla Motors is an example of a company that has taken this idea to the next level. The maker of electric cars has asked for advance reservation fees from customers—$5,000 per car—not only confirming the extent of demand but providing Tesla with working capital to the tune of $130 million. These "funds" are willingly provided by eager buyers for zero percent interest. Otherwise, Tesla might have to pay 10 to 15 percent to a bank.[7]

"With the right digital tools in place, producers can predict better than ever how the market will react to their products and who will buy them."

Taking innovation off its leash

Innovation is now at or near the top of the C-suite agenda in every organization. But it remains difficult to execute—difficult to scale up and to ramp up fast, and hard to ensure that the results are of the quality expected. Yet innovation is happening organically everywhere, whether business leaders are aware of it or not; communities of shared interest have formed or are forming around almost every product, service, or idea that can be imagined.

There are new platforms, such as Spigit, that can help to propel the innovation process quickly and effectively. Another example is TopCoder, a mechanism for running computer-programming competitions. Such platforms capitalize on the very human urges to create, solve problems, and pursue knowledge. Many people are powerfully energized by the idea of developing innovations that solve big, intractable problems. The zeal of those working on the Human Genome Project, an ambitious undertaking to fully map the human genome, is ample evidence of that.

Organizations can't depend solely on existing or emerging innovation solutions. They should be willing to create comparable platforms and communities. Roughly a decade ago, pharmaceutical company Eli Lilly spun off InnoCentive, an innovation exchange that now has more than 300,000 registered problem solvers from 200 countries. Essentially, the company marries this expanded workforce to cloud-based technology to solve problems posed by customers. Winners receive substantial cash prizes. To date, more than 1,500 awards have been given, with the size of the award ranging from $5,000 to more than $1 million, based on the complexity of the problem and nature of the challenge.[8]

Similarly, companies such as Facebook and Twitter are leveraging the intellect and energy of the crowdsource by using application-programming interfaces to open up their platforms to the development community at large. This open approach encourages individual developers and companies to innovate and create products that solve problems and issues that might never surface in the interactions of those companies' conventional workforces. The open approach not only motivates the users of the platforms; it creates substantial additional value for the platform and subsequently for the platform owner itself.

Fast-tracking product development

The open-source community is the original expanded workforce—the trailblazers, united by ideas and interests, who helped write the rules and define the tools for freeform ways of developing software. Collectively, these impassioned individuals make up a global army of developers who are creating and improving free software, bringing worldwide benefits server by server, device by device, for free.

This expanded workforce has touched every organization in some way. Witness the widespread use of two outputs of open-source projects: Hadoop and Linux. The first is the engine that is powering the Big Data era; the second is the kernel operating system embedded in 23 percent of installed enterprise servers, over 80 percent of smartphones shipped, and countless other systems ranging from embedded sensors to supercomputers.[9]

It can be argued that the open-source movement has changed the face of software development just as much as the move from punch cards to hard disks did. Open-source initiatives are foundational for companies such as Yahoo and Google. Android is based on Linux; it is projected to constitute nearly half of all mobile operating systems (smartphones and tablets) by 2017.[10]

Nowadays, the largest technology players all have significant roles in open-source development. Companies including IBM, Microsoft, and Oracle—once strongly opposed to all things open-source—are official, vital, and prolific contributors to the open-source community. The open-source paradigm has now moved to hardware development, as seen with Facebook's Open Compute Project and Hewlett-Packard's Pathfinder Innovation Ecosystem Solutions initiatives. But it shouldn't be limited to just tech companies. Businesses of all kinds should engage in these open-source communities. By contributing ideas, time, and code, companies help set the overall direction of product development, allowing them to leverage not just software that is free but software that targets their specific needs and problems.

Software is also just one example of using the expanded workforce for product development. From smart watches to smart vehicles, the expanded workforce is being employed by bold companies to energize their product

development. The expanded workforce is becoming an invaluable filter for reducing product development risks, improving time to market, and determining receptivity to new-product introductions. For example, the Pebble watch Kickstarter campaign not only raised more than $10 million in 2012 but allowed the company to gather valuable product intelligence about pricing and product demand. By interacting directly with its target customer base, Pebble was able to determine that consumers were willing pay $150 for one of its watches and that 85,000 watches, once funded, would be mailed in the first month.[11]

Using the crowd—and its assets

Innovating, marketing, and developing products are by no means the limit of what the expanded workforce can help with. The concept is expanding to include people's assets as well as their time. Just one snapshot: Local Motors quite literally uses its customers as free labor, and the buyers of its Rally Fighter car actually pay for the experience of participating in the car's assembly.

In fact, the use of the crowd's assets can launch new businesses that are well positioned to attack long-established sectors. Airbnb is a classic example. Billed as a trusted community marketplace where people can list, discover, and book unique accommodations around the world, Airbnb uses the crowd as the untapped source of places for travelers to stay. In effect, everyone can offer their own home or apartment as a kind of hotel. Airbnb is possible because digital tools—particularly mobile phones—make it very easy to find, select, and obtain accommodation. Not surprisingly, the startup—it was founded in 2008—is seen as a significant threat by the hotel industry.

Similarly, Uber crowdsources assets (in this case, cars) by connecting drivers with people needing a ride, a model that the taxicab trade views with alarm. And RelayRides—through which car owners rent out their own vehicles—presents competition to the established rental-car business.

Current markets are being disrupted and new markets are being discovered by companies that are employing latent talents or assets made available through digital technology. Businesses can no longer be on the sidelines

watching and waiting to see what will happen next and hoping to grab the coattails of the next big idea. The enterprise needs to be out there experimenting, discovering, and creating the next big idea.

From doing to orchestrating

So, there is no shortage of people willing to participate in online experiments, contests, challenges, and more. Individuals are surprisingly ready to work for little or no money if they get other rewards: prizes, recognition, fame, the sense of pride in getting to create something. But how do business leaders then effectively manage the flow of talent and ideas? How do they effectively keep control when their workforce moves from hundreds or thousands to tens of thousands?

Given the relative immaturity of these crowd-based services and platforms, there's still much to be learned. The strengths of these services can also be their limitations. However, although there are no clear lines or absolutes when employing the expanded workforce, there are already some useful guiding principles for planning and implementing platforms for crowdsourcing.

The use of the expanded workforce demands very diligent planning. There must be clear, shared objectives for the crowdsourced exercise, whether the requirement is for new solutions to tough engineering challenges or for funds for new-product development. And complex tasks must be clearly and logically broken down into a series of independent subtasks that can be parceled out to the crowd in a way that allows the crowdsourced efforts to be reintegrated into the overall product or project. In the case of labor market exchanges, there can be no subtlety in the work description; amplified across hundreds or perhaps even thousands of "workers" in the expanded workforce, inexactness will produce meaningless results or work that cannot be re-aggregated.

This need for structure requires more than just planning; typically, it will also require a technology solution to drive users through the process. A superb example of this is the DARPA Language Challenge, which leveraged Amazon's Mechanical Turk platform. The challenge was to translate, from Arabic to English, messages that were communicated on social platforms, where traditional grammar rules are not used and context is paramount. Using the correct platform, precise planning, and the expanded workforce,

DARPA was able to translate more than 200,000 words per week from Arabic to English. This project required partitioning the work up meticulously, with explicit quality-assurance steps, and ranked incentives for those who provided higher-quality translations. By using a crowdsourced model, DARPA was able to shift its effort from finding, recruiting and hiring the correct resources to where it will do the most good, innovation around developing the project, planning and incentives.[12]

It is also crucial to properly engage the expanded workforce. With crowdsourcing, adoption is paramount; lacking a properly motivated and incented community, nothing gets done. InnoCentive provides a great example. The knowledge exchange has not become a powerful platform for innovation without paying close attention to every aspect of its operations—from setting the size of prizes for "solvers" to how it communicates the challenges. One more snapshot: Quirky, a co-creation company whose crowdsourced product innovations are sold through mainstream retailers such as Target, has a disciplined weekly voting process—online as well as on-premise—to select the product ideas that it will put into production.

It's still early days for the use of an expanded workforce, and being a borderless enterprise brings its own challenges. For instance, the inherent transience and anonymity of the expanded workforce places sharp limits on traditional human resources activities such as job training. And it raises many thorny questions about the security of intellectual property.

Despite these challenges, the opportunity is immense for enterprises that are willing to step up. The companies that get it right will find themselves with better insight into their customers, more-innovative products and services, and an increased agility to retool themselves with the skills necessary to respond to the changing technology landscape. The question is this: how are you going to position your enterprise to reap the rewards?

Your 100-day plan

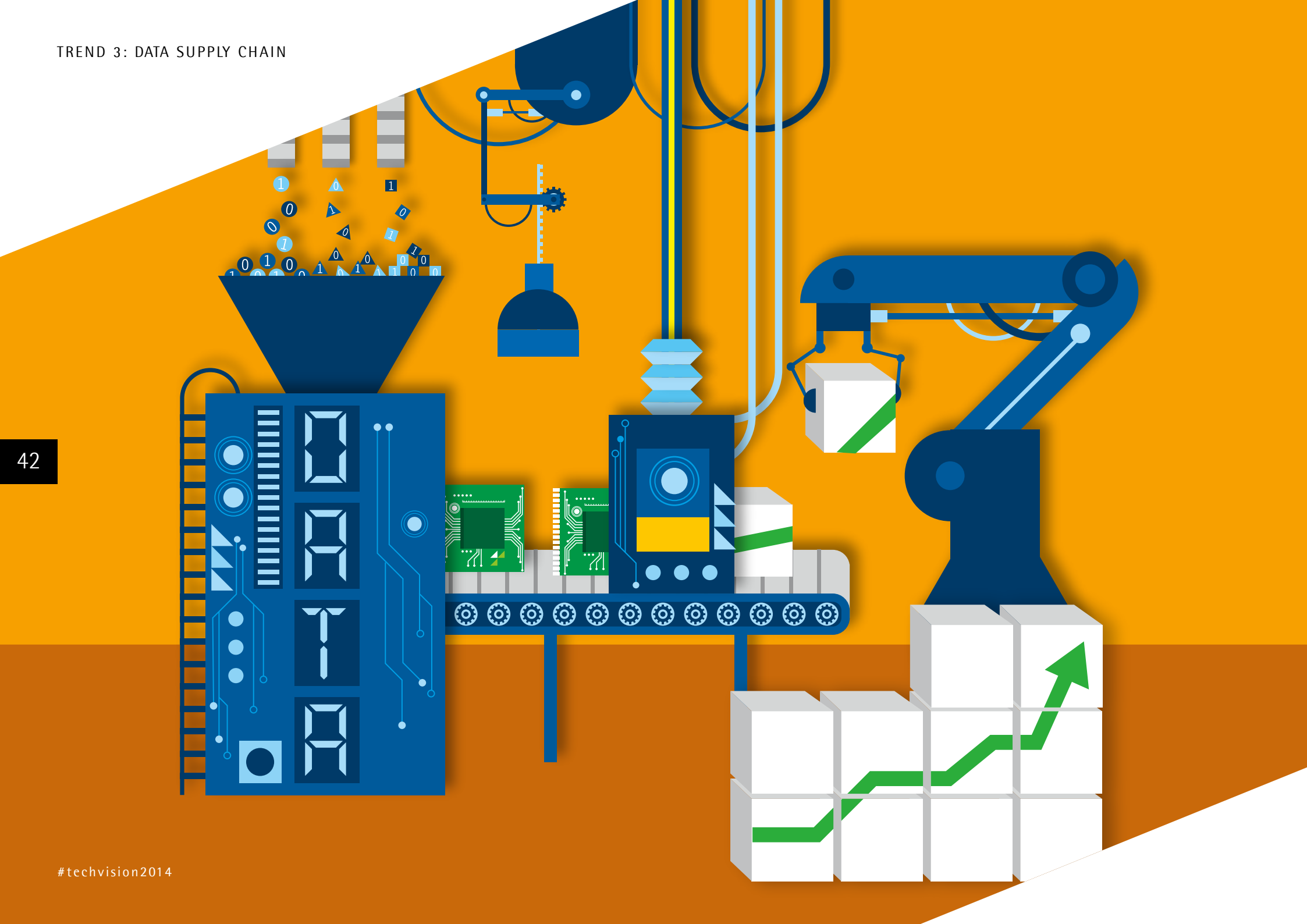
In 100 days, learn about the variety of options that contribute to the borderless enterprise and begin to create a strategy for how you can harness the crowd moving forward.

- Identify any existing enterprise connections to established expanded workforce platforms.
- Determine how your competitors are using crowdsourcing.
- Evaluate the benefits your market research, product development and innovation functions could reap from using expanded workforce platforms.
- Develop an initial strategy to engage existing online communities in support of your core functions. Where it aligns with your core business, create a catalog of existing online communities that are specific to market-research and product-development functions.
- Consider assets from the open-source software community that are usable for your core IT functions and begin planning how to integrate them.
- Design and implement a pilot to leverage the established expanded workforce that most aligns with the nature of your business.

This time next year

In 365 days, you should be familiar with the various types of crowdsourcing platforms that apply to your business and have started an integration strategy.

- Identify which tasks are most easily broken into smaller independent tasks and conduct pilots with existing or custom-built expanded workforce platforms to resolve them.
- For market-research and product-development functions, start to figure out how to engage consumer communities. Where communities are not yet mature or specific enough, develop a strategy to build them.
- After completing a few pilots, test your orchestration strategies. Aim to seamlessly bring solutions, no matter how small, back into the enterprise.
- Create and implement governance and cost-control strategies to respond to and manage infinite capacity.
- Understand the types of specialized skills that cause surges in demand for your organization. Determine whether adoption of expanded workforces can resolve these surges and reevaluate your hiring structure in response.
- Develop an authorized and trusted talent cloud with an established expanded workforce community.



TREND 3

Data supply chain: Putting information into circulation

Yes, data technologies are evolving rapidly, but most have been adopted in piecemeal fashion. As a result, enterprise data is vastly underutilized. Data ecosystems are complex and littered with data silos, limiting the value that organizations can get out of their own data by making it difficult to access. To truly unlock that value, companies must start treating data more as a supply chain, enabling it to flow easily and usefully through the entire organization—and eventually throughout each company's ecosystem of partners too.

Why now?

Corporate data silos: Data is the lifeblood of every digital organization, but businesses are struggling to access, share, and analyze much of the data they already have. Through 2015, 85 percent of *Fortune* 500 organizations will be unable to exploit big data for competitive advantage.[1]

Rising data volumes: In addition to the data that organizations already collect, new external data sources are available, providing new opportunities for data insights. The digital universe is doubling every two years and is expected to grow to 40 trillion gigabytes (more than 5,200 gigabytes for every man, woman, and child in 2020).[2]

Maturing data technology: The tools and technology required to build a data platform, ensuring data access and velocity, are available and in use. For example, a reported 20 percent of enterprises are already using NoSQL.[3] With the foundation of these technologies, the integrated, end-to-end data supply chain is possible.

For years now, data has been talked about as the premier strategic IT asset. Today, it's so much more than that.

Business leaders now view data as among their most valuable assets too—some even call it the lifeblood of their organization. That's why they're implementing the newest big data tools, investing in advanced analytics applications, and purchasing the latest data visualization software.

Yet the reality is that these easily become one-off data fixes that contribute to data silos rather than provide an end-to-end data solution. Few companies have mastered the concepts at the foundation of modern data management—ideas such as the mobility and portability of data, its structure and velocity, data as a "saleable" product, and its valuation in open data exchanges.

Fewer still are comfortable with these concepts at scale. Most efforts to properly manage data are ad hoc at best. No wonder half of all companies are concerned about the accuracy of their data and a majority of executives are unclear about their analytics programs' business outcomes.[4]

According to research by Gartner, 85 percent of *Fortune* 500 organizations will be unable to exploit big data for competitive advantage through 2015.[5]

The high performers, however, will embark on a journey to ROI; they will liberate their data, generate value from it, and operationalize insights to drive strategic decisions through the organization. Key to their success will be managing their data like any core product—in the context of a supply chain. The supply chain begins when data is created, imported, or combined with other data. The data then moves, flows, and transforms through the supply chain, incrementally acquiring value. And while there may be diversions along the way, such as when a data "product" is removed for repairs (in other words, data cleansing), the supply chain ends with a valuable insight as its output. Guiding this movement is a data services platform. Analogous to the blueprint of a factory floor, this platform provides the structure for the intelligent transportation of data throughout the organization. It enables the effective supply chain—fit to strategy and designed to drive outcomes.

This means that business leaders now need to develop an end-to-end view of data in order to achieve their business goals. Accenture's earlier Technology Vision reports have dived deeply into the keystone data topics, highlighting the value of data platforms, the importance of industrializing data services, and the need to think in terms of the velocity of data as well as its variety and volume. Now, all of those themes must come together in an end-to-end "supply chain" perspective that can help break down the data silos—usually built and "owned" by a single department—and enable data to flow freely for the benefit of the whole organization.

Working in this way, however, will change how the enterprise works with data at each stage. New sources of data can be leveraged. How data is managed and analyzed will evolve. And companies will begin to explore new ways to monetize their data. Understanding the implications at each of these stages will be critical for business leaders if they are to capitalize on the value of their data now and in the future and, importantly, at scale.

Enabling the data supply chain with a data services platform

The data supply chain must enable data movement. And in order for data to move, it must be made visible and accessible to those who need it when they need it. As such, the first step is to create a data services platform or federated data access layer, which provides a standard method of access to an organization's curated and trusted (albeit varied and siloed) data in a time-relevant manner. Currently, only one out of five organizations integrates data across the enterprise.[6] But those few are realizing great benefits. For instance, a major bank has been able to use Palantir's Capital Markets solution to integrate 15 data sources into a single point of access. This has allowed hundreds of analysts and less-technical business users to do a variety of tasks, including performing regression analysis, developing hedges, and assessing investment risks.[7]

In order to realize their data platforms, organizations must first make their disparate data sources accessible through data services—ranging from Lightweight Directory Access Protocol (LDAP) to Web services or application-programming interfaces (APIs). Regardless of the specific type, the power of these data services is in their ability to mask back-end complexity and expose data in defined ways. Once all of the data sources have been opened up, one common solution is to make them accessible through a virtualized data layer, which unifies everything into a single view. Then, users can interact with this abstracted data platform in a standardized way. (Behind the scenes, they are actually being rerouted to the data sources.)

Many newer data platform strategies now depend on opening up each data source separately, but through a common standard access protocol. Increasingly, companies are turning to APIs to achieve this, and they're often aided by API management platforms. Walgreens, for example, has opened up its prescription API to enable third-party developers to incorporate the technology to scan barcodes on prescription bottles, in order to make it easier for customers to refill their prescriptions.[8]

These are just two of many data platform solutions in a market of vendors offering a wide variety of methods to create this federated access layer. Traditional middleware providers such as Tibco Software and Red Hat have evolved their messaging solutions to provide that abstraction layer. Companies such as Apigee are touting their API management software as the solution. Additionally, Platform-as-a-Service (PaaS) providers such as Amazon and Windows Azure are offering readymade solutions already built into their clouds. And large database vendors—such as Oracle and Microsoft—are creating access layers to allow connections to data silos in order to better manage the flow of information throughout an organization.

In the end, there's no one-size-fits-all solution; most enterprises will end up with a hybrid set combining many of these tools. But no matter what the solution, it's important to understand that data access and data acceleration make the data services platform both possible and necessary—and thus help to realize the data supply chain at scale.

Accelerating data through the supply chain

Data access on its own isn't enough—velocity is needed. Importantly, this does not mean that all data needs to move at top speeds at all times but rather that data needs to be prioritized on the data services platform—such that important, time-critical data is accelerated through the supply chain, while stale, less relevant data moves more slowly but still meets the demands of the business. Quick access to valuable data means that analyses can be performed, insights can be gained, and actions can be taken in the sometimes very small window of opportunity available to businesses. Historically, IT professionals have addressed this problem by giving precedence to "hot" data—data that is accessed frequently and saved onto high-performance systems that can store and retrieve it very quickly. For its counterpart "cold" data—tax records, say—they have used slower disk hardware or even tape backups in legacy systems.

While these strategies have worked, newer prioritization practices improve data acceleration by adding many more gradations of "data temperature"—or data tiers. This makes sense when businesses consider the wide range of how, when, and how fast users need to consume data. The next step is to enable dynamic movement of data through these tiers, meaning they can be "heated up" or "cooled down" at any time. The ability to seamlessly change priority over time based on business need improves data velocity—but it's also an efficient and cost-effective capability.

Facebook shows how. Not long ago, the social network discovered that 8 percent of all Facebook photos accounted for 82 percent of its network traffic. It turns out that there is a marked drop-off in accessing photos as they age, meaning that the photos' data may be top priority at some point but not always. This led to Facebook's development of its own three-tiered data storage solution. Its software categorizes photos and stores them in the appropriate tier, which has dedicated hardware to increase savings—the lower tiers (for colder data) can store more photos and use less energy.

While the hot, tier-one data can be accessed almost instantaneously, one of the unique aspects of Facebook's solution is that even cold data can be retrieved quickly (most solutions require several hours) to better meet users' expectations. In this way, Facebook is both increasing its photos' velocity and saving on storage costs.[9]

Tiered data solutions allow for time-critical and commonly accessed data to be stored in data-centric caching structures, optimized for quick transport through the supply chain. But in all likelihood, most data will eventually end up in the "data lake"—used to store the vast quantities of an organization's data that are less time-sensitive or used less frequently. Although historically the "data lake" was tape, technologies such as Apache Hadoop and Amazon Redshift have been able to keep costs low while maintaining data accessibility. With a greater number of data tiers, more data can be stored longer and at a lower cost, without interfering with access to important, time-relevant data.

More uses for more data sources

The supply chain process starts with ingesting data. These days, companies can use a wide variety of new data sources—including, notably, data that they do not control or own. For example, if a regional grocery chain wants to analyze its daily transactions over the past month, it should look beyond the data in its database to supplement its findings. Many companies are already tracking sentiment on social media sites; data can also be analyzed in the context of weather, characteristics of shoppers, events in the news, or virtually any new data dimension imaginable—if the relevant data can be located. Whether this "external" data is to be obtained from partners, Data-as-a-Service providers, or open data sources (free for anyone to use in any way they want), companies should capitalize on the business value that these new sources provide.

Collaborate.org is one example of an open data source, containing 5 petabytes-plus of data.[10] It is a global collaboration platform (meaning that users are encouraged to contribute data back to the platform) that allows users to view data geospatially—such as satellite imagery and air quality. The U.S. state of Hawaii is using Collaborate.org to share data across organizations, and it is the platform for the Exemplary State Initiative, which monitors environmental efforts and enables early identification of natural disasters.[11]

In similar ways, Beiersdorf, a global provider of skin care products, is using their own internal data along with syndicated data from research companies such as Nielsen to provide board members with market share development information across a variety of products, brands, and countries. Using SAP Demand Signal Management powered by HANA, Beiersdorf plans to automate its data integration process, leading to more accurate and accelerated market share insights.[12] These examples demonstrate the new opportunity that businesses have to look beyond their four walls for data that will grant more informed data insights and, ultimately, more value.

Advancing data discovery

The process of discovering new insights to answer business questions is changing fundamentally as users get faster access to more data. Now, when data is manipulated as it moves through the supply chain, value can be added to and obtained from it in ways that were previously impossible. This is because data discovery allows businesses to discover answers to questions that they might never have known to ask in the first place. Previously, traditional business intelligence (BI) methods were the only way to answer prescribed business questions; they require multiple lengthy steps before a solution is possible. Now, however, data discovery helps discern the very questions that companies should be asking by uncovering insights in a visually interactive and rapidly iterative manner. Effectively, data discovery empowers users to "communicate" with data at close to the speed of thought—accelerating businesses' time to insight. Companies can and should be investing in this practice today.

So that businesses can better "communicate" with and analyze data, analytics are being embedded in data discovery tools (as they are in applications)—effectively enabling data scientists and less-technical business users alike to do data discovery more easily and intuitively. As an example, the Teradata Aster Discovery Platform enables data scientists to do data discovery and advanced analytics themselves, but it also allows them to extend those capabilities to business users by leveraging analytic functions exposed through BI or other tools. When business users, and even business leaders, are able to discover and answer their own business questions in a matter of minutes, intelligent insights quickly lead to intelligent actions.

For instance, Texas Medical Center (TMC) understands the importance of health care data to advance patient care. However, this data can also be extremely complex and difficult for anyone—from medical experts to data scientists—to analyze. Therefore, TMC is using Ayasdi's technology—one that specializes in the analysis of high-volume, high-dimensional datasets—to empower users to find insights in their data. Using a visual representation of the data and built-in statistical tools, users can more

easily perform "semi-supervised analysis" of the data. The ability to interact with data in this quick and iterative way allows users to identify emerging patterns and accelerate their time to insight. This approach first proved its power when analyzing a breast cancer dataset (one that had been analyzed many times already); within just a few minutes, a new subset of survivors was identified.[13]

TMC plans to use Ayasdi for a variety of applications, from analyzing clinical and genomic data to drug repurposing.[14] The truth is, every organization has unexpected insights waiting to be unearthed by data discovery methods. Now, it's a matter of determining those insights and accelerating their time to insight.

The next step: cognitive computing

As the volume and variety of data grow, so too do the scale and complexity of the data supply chain, making it increasingly difficult to add to and get value from data as it is manipulated. Imagine it this way, on a standard supply chain: everyday, more and more raw goods (some of them new) are being delivered. Initially, this might sound great—more supplies mean more products—but it's not what the machines were designed to handle, and workers can't keep up with the maintenance required. The supply chain becomes clogged, hindering the creation of valuable products. But what if, instead, machines could be taught to leverage data, learn from it, and, with a little guidance, figure out what to do with it? That's the power of machine learning—which is a major building block of the ultimate long-term solution: cognitive computing. Rather than being programmed for specific tasks, machine learning systems gain knowledge from data as "experience" and then generalize what they've learned in upcoming situations. Cognitive computing technology builds on that by incorporating components of artificial intelligence to convey insights in seamless, natural ways to help humans or machines accomplish what they could not on their own. At its most advanced, cognitive computing will be the truly intelligent data supply chain—one that masks complexity by harnessing the power of data to help business users ask and answer strategic questions in a data-driven way.

Although complex, large-scale cognitive computing may be beyond the reach of most companies, there are some cognitive computing capabilities that can be put to work in practical and affordable ways. Companies should focus on tackling well-defined problems on a smaller scale—where machine learning techniques can be leveraged to accomplish practical cognitive computing goals. For example, Tempo, the calendar application found on iPhones, uses data contained on the phone—from social media to email, location, and more—to "learn" about events and display relevant information to the user when requested. This smart personal assistant application masks the complexity behind the data supply chain as raw data is aggregated, analyzed, and turned into an actual event with value. Only then does the user naturally interact with the calendar through the phone's interface.

One interesting cognitive computing example comes from U.S. food company McCormick. Machines are now starting to use data to "sense" the world as humans do, and this extends to taste—with obvious benefits for the food industry. Using Enterra Solution's Cognitive Reasoning Platform, McCormick's FlavorPrint site asks customers to rate a variety of flavors in order to learn taste and, from that, creates unique taste preference profiles—or what it calls FlavorPrints. If customers provide additional information, such as cooking preferences, equipment, and typical pantry items, they can receive better personal product and recipe recommendations. As far as these customers can tell, they're providing just a few raw facts in return for a great deal of personalized value about taste—something almost everyone feels strongly about yet finds hard to quantify or specify. From McCormick's point of view, learning customers' taste preferences leads to better insights, product decisions, and, ultimately, ability to serve its customers.[15]

Cognitive computing can, and will, bring benefits to many industries, and it will fundamentally change the ways in which many businesses operate. It flips the problem of data volume and variety on its head and instead leverages it to enable the smart, interactive data supply chain. The ultimate goal is for any business user—from a CEO to a field worker—to be able to ask any business question and immediately get a data-driven answer from the masked data supply chain.

Although this technology may seem far off, there are already cases that prove its relevance. And by its very definition, with more data over time, cognitive computing technology will only learn more, adapt quicker, and improve. It's important for business leaders to familiarize themselves with this technology now.

Realizing data value

By the final stages of the supply chain, a significant investment has been made in the ingestion, transformation, and analysis of data—and now that data is both accessible and sharable, companies have new opportunities to capitalize on its value. Of course, data is important internally, but companies must now realize that the value of data extends outside the organization as well. From forging new partnerships to creating new revenue streams, or even entering new markets, businesses now have more potential than ever to realize the true value latent in their data.

When companies open up their data for external access, they can profit by leveraging external developer talent to extend their platforms. It's a win for developers, too; they can use these platforms to add value to their products much more easily and at a higher quality than if they had attempted to do so on their own. For example, one of the reasons Google Maps is so widely known and successful is that more than 800,000 websites use its data, accessed through its API.[16]

Now, companies can take advantage of the opportunities for data monetization—to sell data insights directly, share them through partnerships, or develop entire ecosystems around them (see the chapter "From Workforce to Crowdsource"). There are risks and rewards for each, of course, and some methods will be better suited for certain companies and industries than others, but they are all important strategies to consider. Kabbage, for instance, was able to find a unique use case for data from UPS. As a partner, UPS provides transactional shipping data to inform Kabbage's health assessment of the companies it finances—determining those companies' access to capital.[17]

Just as companies are finding new reasons for ingesting external data sources, there have to be companies out there to provide them. It's not just about selling data; it's also about strengthening partnerships and developing ecosystems around data to monetize it. Companies now have the opportunity to think outside of the box for new ways to realize and take advantage of the true value in their data.

Adding one data supply chain, and then another

Every day, as the amount of data grows, so too does the seemingly impossible task of realizing the data services platform and, ultimately, the data supply chain. Unfortunately, there are no shortcuts. The path is incredibly difficult and exceptionally long—in fact, it never quite ends. But it is also one of the most rewarding journeys that companies can make in their transformation to become truly data driven.

Progress becomes possible when the transformation process is viewed as a matter of small steps rather than one giant leap. So, we expect that leading organizations will start by establishing a data services platform, followed by implementing a single data supply chain for a specific outcome. Once that's done, they will incorporate another—and another. It may not be easy, but it's doable.

The implications of enabling the data supply chain are huge. In the first stage, organizations now have the opportunity to ingest new sources of data. In the second, the manipulation of data through new methods of data discovery adds significant value. The future of this phase is to mask its complexity and truly embed this value through cognitive computing technologies. And finally, businesses can now look externally to realize value from data in new ways.

It's time for business leaders to start thinking about the entirety of the data supply chain—as an end-to-end process that is outcome driven and fit to strategy. Today, data should be more than just a premier IT asset; it should be a premier business asset. Let's start treating it that way.

Your 100-day plan

In 100 days, begin to develop a comprehensive strategy around laying the foundation for your data supply chain.

- Start to build an inventory of your data, beginning with your most frequently accessed and time-relevant data—which will be given first access to your data platform and accelerated on it.
- Identify any manual, time-consuming data curation processes (e.g., tagging, cleansing) for potential replacement with machine learning algorithms.
- Identify data silos within your organization (e.g., HR, finance, engineering), along with corresponding data needs that are currently unmet across the business.
- Begin to simplify/federate access to trusted data. Create a strategy for standardizing data access via the data platform. Solutions may be hybrid, utilizing a combination of traditional middleware and API management, or even a PaaS offering.
- Prioritize your individual data supply chains to develop a road map for implementing the data supply chain at scale.
- While building your platform, start looking outside your company for external data sources that can be incorporated to complement existing data and help lead to more complete insights.

This time next year

In 365 days, begin the journey to ROI by building a supply chain that is designed to drive outcomes.

- Pilot an initial data supply chain targeting a single business function. Once proven, each subsequent data supply chain will build upon this initial framework.
- Accelerate data on your data platform to enable the practice of data discovery across your organization. Uncover value in your data by quickly asking questions, failing fast, and iterating to solutions.
- Empower your business users to be value creators in the data supply chain by giving them data discovery tools and training them to deliver insights.
- Reduce the manual effort of curating data by using machine learning algorithms to automate the repetitive processes in your supply chain.
- Find a specific use case that can be addressed by cognitive-computing techniques. Use this focused issue as a chance to experiment with and learn the ways in which cognitive computing can be applied to your organization.
- Investigate opportunities to monetize your data. These should include developing new partnerships or ecosystems around data insights, in addition to directly selling them.

TREND 4

Harnessing hyperscale: Hardware is back (and never really went away)

Eclipsed by more than a decade of innovation in software, the hardware world is again a hotbed of new development as demand soars for bigger, faster, lower-cost data centers. Does your IT organization understand the new developments allowing companies to realize the benefits of "hyperscale" systems? In this new world, hardware matters more than ever in transforming enterprises into digital businesses with access to unlimited computing power that can be turned on and off as needed.

Why now?

Rising demand for scale: Across industries, demand for processing at scale is surging. Businesses need reliable hardware to support the immense amounts of data processed for predictive analytics and real-time insights.

Hardware and server architecture innovation surge: From advances in storage to power consumption to processors to server architecture, infrastructure innovations such as nonvolatile memory are paving the way for faster, cheaper, and bigger hyperscale systems.

Open source: Facebook's Open Compute Project is accelerating the adoption of infrastructure innovations by sharing those breakthroughs freely. Founded in 2011, the Open Compute Project has already grown to more than 60 official members and thousands of participants.[1]

Who said that everything old is new again? He may have had a point—especially where computing hardware is concerned.

Not so long ago, every announcement of a new, multicore microprocessor or personal computer met with fanfare—lots of buzz about clock rates and cache memory capacity. But in recent years, the prevailing sentiment has been that hardware no longer matters—that x86 servers are nothing more than off-the-shelf commodities and all the important advances now happen in software.

Fast forward to today and looking to the future, it is becoming clear that "hardware as an afterthought" is a blinkered view. In fact, it is now a harmful view because it will make it more difficult for enterprises to evolve into digital businesses.

Every industry will be touched by the technologies being developed for the era of "hyperscale" computing systems—the supersized, super-scalable, and resilient data centers pioneered by heavily data-dependent companies like Google and Facebook. Innovations in technologies

such as low-power CPUs, solid-state data storage, and in-memory computing will benefit the performance of all enterprises' servers and data centers, enabling their next generation of infrastructure to support the digital transformation of their business.

Unilever, a consumer goods company; Pirelli, a tire manufacturer; and the NBA, a professional basketball league, are not companies that would typically be associated with one another, let alone be considered in the same context as Amazon and Google. And yet, similar to those technology giants, these and other traditional companies like them are faced with challenges that hyperscale computing can help to solve: immense amounts of data that need to be processed at speed. However, these companies had neither the scale nor the computing hardware to solve these challenges in-house. So they looked to hyperscale hardware appliances to help them perform at the speed of their nonstop businesses. For example, Unilever, Pirelli, and the NBA are all using SAP HANA to perform real-time analytics on huge datasets to gain insight and competitive advantage.[2] HANA gives them the capabilities of hyperscale that Amazon and Google enjoy in a single appliance instead of an entire data center. Others are using solutions from Oracle, IBM, and Teradata.

These data challenges exist across every industry and for companies of all sizes. This is why every CIO will again be tasked with understanding the advantages and trade-offs of hyperscale systems and big data appliances, as well as the opportunities and risks behind choosing which hardware will be used to inform and optimize their digital business.

Inside hyperscale

Before we examine the hardware innovation that is being propelled by hyperscale developments, it is important to explain what the word *hyperscale* means. Accenture uses the term to describe not just the physical infrastructure of giant and distributed systems that support the data centers and provide companies such as Google, Amazon, and Facebook with the computing power to deal with vast volumes, variety, and velocity of data, but also the ability to scale computing tasks to achieve performance that is orders of magnitude better than the status quo. Hyperscale data centers consume storage, bandwidth, memory, and computing cycles on a scale unimaginable to most. They make pragmatic use of the latest hardware innovations, but never at the expense of scalability.

What does this scale actually mean? In the world of hyperscale data centers, there are very few players. Google is the largest with well over a million servers; Microsoft also has more than a million. Then comes Amazon with about half a million, and Facebook and Yahoo with a couple hundred thousand each.[3] In terms of power consumption, Google's global operations continuously draw 260 million megawatts of power—roughly a quarter of the energy generated by a nuclear power plant.[4]

Not only are these companies operating on a scale that defies most people's imaginations, but the services provided by these hyperscale data centers are expected to be up 100 percent of the time—not just 99.99999 percent of the time. This is the era of "always on." As a case in point, note that companies such as Amazon, Facebook, and Google are not just responsible for their own bottom lines—they are increasingly responsible for numerous other businesses' survivability as well. Today, hyperscale data centers are pivotal to an enormous ecosystem of companies and organizations that rely on hyperscale platforms as a necessary component of their business models.

But the demands on hyperscale computing do not stop with the need to be always on. It is equally critical to be "always optimized"—application-specific computing technologies are available to solve increasingly specialized tasks. For example, hyperscale data centers with the ability to horizontally scale worldwide with commodity servers are appropriate for a website. But complex calculations for applications such as 3D rendering, DNA sequencing, and cryptography are more effectively and efficiently handled by a system of servers with advanced graphics processing units (GPUs)—specialized processors optimized for parallel processing of very large floating-point number calculations. GPUs are so effective at these tasks that application-specific integrated circuits (ASICs) are starting to become available that offer orders of magnitude more processing capability than server farms full of advanced GPUs with dramatically less energy consumption and a smaller physical footprint.

There are two main reasons why this hyperscale trend is important to the enterprise. First, hyperscale is driving significant hardware innovation that will put businesses at a nexus where decisions on public or private cloud, as

well as commodity versus specialized hardware, become significant differentiators. Second, these hyperscale systems are no longer limited to large Internet companies.

Utilities, oil and gas, and automotive are only a few examples of industries that are quickly approaching the hyperscale level of interconnected devices, sensors, and data centers. Utilities now have networks of integrated sensors and smart meters that rival those of communication companies. Ford, GM, and Toyota are building vehicles with hundreds of sensors, telematics, and real-time connectivity. As all of this information begins to be collected every day, every hour, and, in extreme cases, multiple times per second, the systems required to store and analyze this data at speed will soon demand hyperscale solutions. Take gas turbines at power plants, for example. "We're almost putting a data center on a gas turbine," GE said recently in reference to the hundreds of sensors the company is placing on those machines to capture data. If those sensors, combined with robust data analysis, are able to improve efficiency by just 1 percent, that could save nearly $6 billion a year.[5]

"Not only are these companies operating on a scale that defies most people's imaginations, but the services providzed by these hyperscale data centers are expected to be up 100 percent of the time—not just 99.99999 percent of the time. This is the era of 'always on.'"

The innovation behind the hyperscale push

The rapid growth of hyperscale systems has sparked a renaissance in hardware innovation from which all businesses stand to benefit. While the tech-savvy reader can jump into a bit more depth around the technology in the "Driving innovation in hardware" sidebar in this chapter, everyone should understand that innovations around processors, storage, and specialized hardware are proving to be opportunities for tangible benefits for the business.

Putting limits on design specifications, such as energy consumption, has driven innovation. Hewlett-Packard (HP) drew inspiration from mobile processors for its Moonshot servers, which operate with up to 89 percent less energy than traditional servers.[6] In a similar focus on energy efficiency, Facebook reduced energy consumption by 38 percent in its Prineville, Oregon, data center compared with existing facilities by using technologies developed as part of the Open Compute Project.[7]

Storage advances are providing enterprises with fresh ways to access and manipulate data faster. Flash storage arrays are becoming the norm for e-commerce sites and financial services firms with trading platforms.[8] E*Trade uses EMC's XtremIO storage array to maintain exceptional performance for customers while performing data maintenance tasks in parallel with no performance degradation, giving E*Trade the ability to scale operations and support new features for users.[9]

And innovations in server architectures are offering more options to match specialized infrastructure to the applications being run, helping CIOs identify the important requirements of each application, whether that be performance, scale, or cost. Illustrating the advantages that specialized hardware can provide, SAP has 28 customers that now run analytics jobs in HANA 10,000 times faster than they did previously. Three of these customers have experienced 100,000 times improvement. One of those three, Yodobashi, a Japanese electronics retailer, took a three-day batch process to analyze loyalty customers down to two seconds, enabling real-time couponing at the point of sale.[10]

Although the details of these innovations may not need to be completely understood outside of the IT department, it is important to recognize their potential to transform business processes and strategies. In doing so, it's paramount for companies to understand the advantages and trade-offs of these new tools as they look to procure, build, and use their next generation of IT systems.

Adopting an open-source view of hardware

Facebook's Open Compute Project is another development that is causing significant discussion within CIO and other technology circles. The initiative involves openly sharing hardware innovations, following the model associated with open-source software projects. Members participating in this exchange of technology innovations include Goldman Sachs and Fidelity, which, in conjunction with AMD and Intel, have been reviewing new motherboard designs to incorporate in their own data centers.[11] The payoff for enterprises can be significant. For instance, Facebook designed and built its own servers and software, claiming that it can build its data centers at one-fifth of the cost of a traditional data center.[12]

Asking hard questions about hardware

The relationship between hardware innovation and rising demand for cloud services is raising some new questions for IT leaders. First and foremost, over the next five years, every IT department will consistently be faced with the choice between leveraging external clouds and building computing infrastructure on premise. To make matters more complex, on-premise choices are capital intensive and increasingly specialized. There are computing appliances that give hyperscale capabilities from a bevy of manufacturers—SAP HANA, Oracle Exadata (now enhanced with Exalytics), IBM PureData Systems (an evolution from Netezza), and Teradata are all top-tier options. Choosing the cloud does not remove this complexity either. Not all clouds are equal; there are many varieties from which to choose. How CIOs make this choice will depend significantly on the systems they are looking to build and their demands.

One company may need highly resilient services that fluctuate little during the workday, but it may demand more of those services at the end of every month. Another may require real-time decisions on vast quantities of data.

The array of decisions now required is reflected in the sheer number of choices to be made when configuring an instance on Amazon Web Services (AWS). Amazon provides a wide range of configuration options to suit all sorts of business needs—ranging from "compute optimized" (with a high ratio of CPU to memory and lowest cost per virtual CPU of all Amazon's instance types) to "storage optimized" (suited to applications with specific input/output and storage capacity requirements).

So the decisions that IT leaders make about their data centers and cloud services must consider the underlying hardware. How will this provider's use of low-power CPUs in its data centers affect operational costs over the contract term? Can our applications run on low-power CPUs, or would GPUs be more efficient for computation? Does the code for our critical business insights need to be rewritten to take advantage of these new technologies?

To what extent can the data center scale up for a pharmaceutical client, say, if the client starts putting most of its clinical trial simulations in the cloud? Do our business requirements mean that we are better off with flash, in-memory, or hard-disk storage? The choice of hardware depends very much on what the specific application needs are, and what the usage patterns will look like.

On this digital journey, solutions must be tailored for individual use cases. Every organization is going to face a set of heterogeneous requirements that will be best served using the correct recipe of commodity versus specialized hardware and private versus public cloud architecture. This means that for the foreseeable future, enterprise infrastructures will be, by necessity, hybrid solutions—weaving hyperscale cloud, on premise, specialized hardware, and an enterprise's existing systems into a computing fabric that serves more parts of the business in more demanding, reliable, and scalable ways than before.

Adopting hyperscale

In a dramatic shift of IT strategy, companies are leveraging hardware innovation on a piecemeal basis, with some companies going so far as to build their own hyperscale systems as a competitive differentiator. GM is one such company that is embracing the hyperscale concept and building out its own mega data centers. This is not just another private cloud, according to GM: "IT isn't here to manage daily operations. It's a strategic tool to drive business forward."[13]

With that in mind, the automaker is setting up its own hyperscale environment starting with the first of two data centers located in Michigan. Moreover, GM has cancelled its multibillion-dollar outsourcing agreements, believing that it needed to bring these strategic capabilities in-house to be closer to the business decisions needing to be made in a rapidly changing industry.[14]

GM's goal is to accelerate new product introductions, especially when it comes to keeping up with the growth of on-board vehicle electronics. Imagine fleets of vehicles with thousands of sensors sending gigabytes of data back to the data centers every second of every day from every corner of the world—all while maintaining high reliability levels in its data centers. Downtime at one of its factories can cost GM $1 million per minute, given current just-in-time inventory practices.[15]

And GM is not alone. By 2018, some 10 million BMWs will be connected, asking for, and receiving more than 1 terabyte of data every day.[16] More large organizations are interested in building their own high-efficiency data centers. Gartner estimates "large data centers"—those with more than 500 racks—will account for 29 percent of all data hardware revenue by 2017, up from 22 percent in 2011.[17]

Even if CIOs do not have an appetite for building their own infrastructure, companies still need to examine their path to becoming digital enterprises and determine whether they have the infrastructure and skills needed to support it. There is no set path on how to grow to meet the hyperscale challenges that businesses are going to face. But forward-looking companies are seeing the advantages of hyperscale technology.

At a minimum, they are seeing an opportunity to drive down the operational cost of running their data centers. As such, high-performance companies are increasingly recognizing that hyperscale systems are a vital part of becoming a digital business. To get started, technology leaders need to ask themselves, "What could our business do with unlimited compute power that can be turned on and off as needed?"

Your 100-day plan

In 100 days, make sure your organization is informed about the available hyperscale technology options.

- Ensure that your IT organization is aware of consortiums and/or is testing the benefits of the latest hardware innovations. Identify those that are most important to your business.
- Identify your data storage needs and the magnitude of devices producing data in your network (including sensors, smart meters, devices, and data centers). Forecast their expected usage based on one-year and three-year business growth strategies.
- Create a plan that allows key data assets to be portable across architectures.
- Explore participation in open-source communities such as the Open Compute Project to leverage emerging hardware innovations.

This time next year

In 365 days, be prepared to have your IT road map include hyperscale technologies. Have the knowledge to make the right investments and act.

- Update models of your digital business's most demanding compute processes to understand the advantages, tradeoffs, opportunities, and risks of hyperscale hardware choices.
- Create a hyperscale task force. Have it include hyperscale hardware during infrastructure planning.
- Build the reference architectures for hyperscale workloads and evaluate the applications that are deployed to hyperscale. Maintain hybrid hyperscale deployment strategies that account for improvements in offerings across SaaS, PaaS, and hardware to support varying enterprise activities.
- Investigate how edge-device computing can make applications more efficient and provide a vehicle for machine-to-machine interaction.

SIDEBAR

Driving innovation in hardware

Innovation in three corners of the hardware world is driving hyperscale:

Processors

Historically, complex instruction set computing (CISC)–based servers ran on high-performance x86 processors. This helped to rein in costs and maximize compatibility for mass-market applications. Over the last decade, however, the massive consumer demand for mobile phones has driven radical progress in the capabilities of low-power processors—largely to the credit, and benefit, of ARM Holdings. Low-power processors give data center designers an opportunity to address data center power costs which, in many cases, have risen to be 30 percent or more of operational expenditures. Calculations show that the cost of power to run a server over its lifetime will very often eclipse the cost of the server itself.[18]

Innovation is not limited to power consumption. ARM licenses its chip designs, creating a rich ecosystem of chip manufacturers and software developers able to pursue niche opportunities. Benefiting from this ecosystem, HP recently announced that an upcoming module for its Moonshot server line will use a new version of Calxeda's ARM-based EnergyCore chips. HP claims that this new module will offer nearly double the performance and four times the amount of memory per module compared with the previous generation of low-power processors.[19]

Complementing these low-power CPUs, the massively parallel architectures of graphics processing units (GPUs) are ideal for big data analytics. As a consequence, x86 servers are being replaced by servers with low-power ARM processors, using GPUs as accelerators or coprocessors. This allows massively parallel database (MapD) technology to realize tremendous speed gains by storing the data in the onboard memory of GPUs instead of CPUs, as is typical. Use of a single high-performance GPU can make data processing as much as 70 times faster than a conventional CPU.[20] That is why 53 of the top 500 supercomputers now use GPU accelerators or coprocessors.[21]

Storage

Organizations must now store more data and get more insights more quickly from the data. With data processing capacity radically improved, the bottleneck becomes the ability to store and retrieve large volumes of data as rapidly as needed.

Traditionally, data has been stored either in limited volatile memory, which provides the fastest access, or on disk, which provides much more storage but is far slower. Companies could have their data fast or cheap, but not both. Now, though, innovations in flash memory are making this trade-off unnecessary.

Vendors such as Fusion-io and Violin Memory are providing flash memory products that address hyperscale issues such as the need for low-latency, low-power consumption; a smaller data center footprint; and a high degree of resilience. These companies are providing case studies and performance numbers that indicate the potential for application performance to increase by at least 25 times, and sometimes by as much as 40 times.[22]

"Innovation at the server and data center levels is causing a bifurcation between the types of processing capabilities being offered at hyperscale: those optimized for general-purpose, Web-scale computing and those optimized for specialized tasks."

That means that CIOs now have new options for solving their scalability challenges. They can start asking different questions: Is tuning application performance a good use of expensive developers? Will future applications run most efficiently on commodity hardware that scales horizontally? Does specialized hardware better serve the business needs? What are the trade-offs? What is the total cost of ownership?

Servers

Innovation is also occurring at the server and data center levels. In fact, this innovation is causing a bifurcation between the types of processing capabilities being offered at hyperscale: those optimized for general-purpose, Web-scale computing and those optimized for specialized tasks.

For general-purpose computing, data center designers now have two options to build at hyperscale: low-power systems such as HP's ARM-based Moonshot or commodity x86 servers. In the most extreme cases of the latter, Google, Amazon, and Facebook are all sourcing custom server designs from OEMs, optimizing for their specific operational objectives and computing and storage needs. Companies looking to build or expand their own commodity x86 data center architectures may find benefit in joining the Open Compute Project. For those looking to radically improve operational costs, low-power systems make sense. While these low-power systems can be configured to run standard Web or big data applications such as Hadoop, they are not compatible with software written for x86 architectures. However, the operational savings may be worth the development investment; HP claims that typical data center operational costs can be reduced by as much as 77 percent with Moonshot.[23]

With specialized tasks such as analytics on large databases and computationally intense tasks such as weather forecasting and DNA sequencing, general-purpose hyperscale systems are insufficient to deliver results at speed and scale. Database software companies such as SAP and Oracle have risen to the challenge by building in-memory computing appliances that give orders-of-magnitude performance improvements on big data analytic challenges. Existing customers of SAP

and Oracle will find streamlined transition paths with HANA and Exalytics, respectively. These platforms and others offer the benefits of hyperscale in a configuration optimized for on-premise installations.

Moving to a greater variety of complex data processing workloads, however, calls for supercomputing solutions. Similar to the in-memory-computing appliances, these individual systems do not scale, but they do provide capabilities that go beyond what hyperscale can deliver. Amazon understands this, which is why its Elastic Compute Cloud (EC2) includes two of the world's top 500 supercomputing clusters (numbers 64 and 165).[24]

app
APPS

TREND 5

The business of applications: Software as a core competency in a digital world

The way we build software is changing. Mimicking the shift in the consumer world, organizations are rapidly moving from enterprise applications to apps. Yes, there will always be big, complex enterprise software systems to support large organizations, and it will still be necessary for IT developers to keep customizing those systems, providing updates, patches, and more. But now, as large enterprises push for greater IT agility, there is a sharp shift toward simpler, more modular, and more custom apps. The implications are significant for IT leaders and business leaders alike: they must soon decide not just who plays what application development role in their new digital organizations but also how to transform the nature of application development itself.

Why now?

Digital transformation of enterprises: IT applications have become the primary driver for growth and differentiation for enterprises.

Accelerated pace of IT change: The increasing push to rapidly deploy new technology is increasing the pressure on IT to provide a faster way to develop and deploy the applications that are driving corporate digital strategies.

Maturation of application platform providers: PaaS players are offering ready-made data service platforms, with sets of services already connected and instant sets of app families available. Tibco, Apigee, and Salesforce are already offering solutions that provide the foundation for a customized enterprise app experience.

Rising consumer and user expectations: Customers and employees are looking for consumer-grade experiences everywhere. They are pressing IT to give them, in the workplace, the kinds of low-cost, accessible, and often intelligent apps they use every day on their own mobile devices.

A large corporation that is as agile as its global customers need it to be? There's an app for that.

But there are big changes in how the application is created. Anyone with a smartphone can see the signs.

In the consumer world, application development has become the province of a new generation of developers eager to strike gold by creating the next Angry Birds or Evernote app for the mobile phone—applications that are smaller and simpler to use. That development approach is now moving into the enterprise, creating new applications for mobile, Web, and desktop platforms alike. The more quickly businesses can create and launch new applications in today's turbulent markets, the better they can innovate, collaborate, improve customer experiences, and enrich personal interactions.

The drivers of this change are not hard to find. Eager for relief from some of their biggest pain points—especially their systems' lack of agility—business leaders have been pushing for software that is far nimbler than the legacy systems they've relied on for decades. They have been pressing IT to give them, in the workplace, the kinds of

low-cost, accessible, and often intelligent apps they use every day on their own mobile devices.

IT is responding. Leading IT groups are building software platforms and architectures that essentially separate the big back-end services from the applications that users interact with. The outcomes are a win for both the IT side and the business side: IT gets breathing room to build solid foundations for complex systems; the business gets platforms that allow for an increased focus on custom software that enables rapid iterations to tailor solutions to fast-changing market conditions.

There's another big consequence of the shift toward an enterprise app world: business functions are partnering with technology organizations to assume joint ownership of the new agile applications. The back-end services—from data centers to networks—still fall squarely under IT, but in more and more organizations, the lines are blurring as the business takes a more active role in many aspects of front-end applications. These are not maverick activities: they are happening with the say-so of IT in those organizations. In fact, savvy IT leaders are deliberately partnering with the business side not just to enable but to encourage them to take on some of these roles.

In a sense, the building of these custom agile applications is becoming a hallmark of the new digital enterprise. The questions are now as much about resources as about technology. How does IT help the business side to acquire the necessary skills and development mind-set? How do IT leaders manage the balance between enablement of the business and building of a stronger technology backbone to support a more agile enterprise? These questions will be high on the agenda of every CIO in the next few years.

The push toward application ecosystems

In the consumer world, applications have the luxury of being relatively self-contained. Shazam, for example, excels at capturing a song heard playing in a café, but the user doesn't need it to manage her playlist; she has another app for that. In the enterprise world, however, the problems being solved are much more complex. They often involve multiple applications to run intricate business processes that may span multiple time zones, several countries, and thousands of employees.

To attack these big enterprise-level problems, then, something more than a single, nimble app is needed. The way forward is to think in terms of the application's ability to connect with other applications. In fact, the push is toward libraries or "ecosystems" of applications that can, while still being individually simple and agile, be bolted together to tackle the most challenging problems. To do this successfully, businesses require more than just separation of the front-end applications from the back-end services. They need software platforms to drive new development ecosystems.

We see this trend most clearly in the movement toward enterprise app stores. Research company Gartner predicts that by 2017, a quarter of all business enterprises will have an app store for managing corporate-sanctioned apps on PCs and mobile devices.[1] The top performers are already leading the way: Accenture's High Performance IT research confirms that 54 percent of high-performance IT groups have deployed a mobile-enterprise app store, compared with just 22 percent of other IT organizations.[2]

China Eastern is a good case in point. In developing its own app store in 2012, the airline wanted to drive mobile app adoption across the company; its rationale was that fast-growing mobile phone use in China would help drive growth for the airline and also improve productivity and operational efficiency, especially among the 50,000 of its employees who use their mobiles for work. The airline makes good use of mobile apps in areas such as aircraft maintenance, employee feedback services, and mobile office automation. China Eastern has also bought 2,500 iPads for in-cabin services, helping it earn a reputation as an early adopter of the latest mobility technologies.[3]

But the real power of enterprise apps lies in how they are amalgamated—combined and connected in ways that create a customized system capable of handling larger business tasks. To some extent, what's old is new again: the rise of these application ecosystems is effectively cashing in on the appeal of service-oriented architecture (SOA), the technology of a decade ago that promised business process owners the ability to rapidly iterate business processes and user experiences by reusing and reorganizing small pieces of functionality—now known as apps—and by providing ways to string them together.

For example, Japan Post Co. is one of Saleforce.com's top five customers and has been using apps on Force.com's platform to streamline business planning and compete in new markets. They created 15 custom apps to provide business process visibility in selling services and products from three companies as a retail outlet: Japan Post Bank, Japan Post Insurance, and Japan Post Service. With 24,000 post offices nationwide, it efficiently serves 14 billion mail packages annually and more than 6 million insurance policies for upwards of 100 million clients while achieving flexibility and a reduced total cost of ownership.[4]

Software platform: middleware redux?

The proliferation of app stores speaks to the consumption and use of small, nimble apps. But the other important story is how IT systems are architected for this new app world. The new direction is to separate applications from the back-end systems that support them. Imagine taking the look, the flow, and the experience of a financial reporting system and disconnecting it from the complex financial models and SEC regulation behind it. The resulting system would allow developers to rapidly update how users interact with it; it would be easier, for instance, to get up-to-date cost projections without having to touch the underlying financial models—traditionally a burdensome effort when such updates are required.

Software vendors and enterprises alike are already changing how they architect their systems to enable this separation. In essence, middleware is being resurrected as the "software platform"—a way to present data services that can make it easier to find modular apps that will perform a particular business function, and to enable modular apps to combine, like puzzle pieces, into "systems" in order to implement more complex business activities. Such systems are more flexible and provide a framework to create a custom, on-demand solution faster.

Companies such as Mashery and Tibco Software—the latter a longtime standard bearer in the middleware world—are pushing this data services space with their platforms to provide an integrated development environment to rapidly create, orchestrate, and integrate modular services and business applications. Helping *USA Today* open and manage its application-programming

interfaces (APIs), Mashery has expedited the media company's ability to negotiate and execute new partnerships with distributors and device makers so that devices from iPads to Samsung refrigerators are now connected.[5] Similarly, Tibco's Silver Fabric cloud platform is designed to give enterprises the ability to quickly provision their own app stores.

Other companies such as Apigee are stepping forward with API management tools that help make it easier for large enterprises to extend their reach with mobile apps, create new products with partners and developers, and more. Live Nation Entertainment uses Apigee's Enterprise API Platform to grant internal developers and trusted partners and clients the ability to extend their ticketing functionality to mobile devices and provide additional functions such as event calendaring and live event applications. As a result, Live Nation's mobile transaction volume has more than doubled in the last year.[6]

And the Platform-as-a-Service (PaaS) players are offering ready-made data services platforms, with sets of services already connected and instant sets of app families available. Salesforce.com's AppExchange is a useful case in point. Using its platform as a base for how these applications are bought, built, and woven together, Salesforce.com has created its own flexible ecosystem that represents the next generation of enterprise-built and -customized systems and solutions. Recognizing that more than 40 percent of their transactions stem from API calls, the Salesforce1 Platform is expanding this ecosystem, opening up ten times more APIs and services for developers to build upon.[7] And acknowledging the increasing value of management required to expose APIs at scale, Microsoft recently acquired Apiphany to integrate API management into Windows Azure.

Importantly, IT leaders should not strive for the holy grail of software platforms; there is no such thing. It's not possible to use a single platform to handle every business requirement. And don't assume that cloud will always be the answer either. According to Accenture's latest High Performance IT study, only 7 percent of applications currently reside in the cloud, and survey respondents expect that figure to approach 33 percent by 2020.[8] In practice, companies will need to adopt a hybrid mind-set, with different platforms, local and in the cloud, for different sets of business needs. Abstraction of the back-end services will have to be a step-by-step process, starting with the highest-priority business needs. Perhaps

the organization starts out by developing a platform for its consumer data and then eventually creates a platform for its ERP data. The more services that are available, the greater the functionality that the apps will be able to leverage and the more diverse and innovative they can become.

Leveraging separation to amplify impact

Of course, nobody is suggesting that ERP, CRM, or large enterprise financial systems are about to become obsolete. Rather, it's important to recognize that IT has entered a new stage in which constant change is the new normal—one in which IT not only supports business applications but also enables the business to play a more active role in those front-end apps. As business users start to embrace technology as a way to drive their business strategies—everything from tools for analyzing consumer sentiment on social media sites to pilots of new pricing models—IT must start opening up the systems, tools, and processes to allow business users to drive these initiatives forward themselves. This lets the enterprise move from the paradigm of a backlog of IT requests from the business to one where IT is empowering the business to experiment, innovate, and drive its strategies.

Enabling the business is just the first phase; business leaders will recognize that extending these services to business partners has the potential to accelerate business imperatives. For example, AT&T opened its phone activation APIs so that its partners could leverage them fully—building apps on top of them, for instance. The APIs are now available as Web services, and the on-boarding process can now be executed in a matter of days or even hours—resulting in a 1,500 percent increase in the usage of the APIs, not to mention a boost in phone activations.[9]

Other companies have taken this "ecosystem" concept further. Positioning their software as an open platform, Facebook and Salesforce.com are among the companies that are using the developer community at large as their app innovation engine. At last count, Facebook had more than 10 million apps on its platform, where more than 25 percent of its annual revenue comes from mobile app install ads.[10] It's not just tech companies that are taking this approach; General Motors has opened

up its OnStar APIs to the public. And, based on an innovative application developed on top its APIs, the company is now partnering with the start-up RelayRides to enter the emerging ride-sharing market. In doing so, GM is threatening to disrupt both car rental and taxi companies—business sectors well outside of automobile manufacturing.

This amplification effect is one of the most powerful advantages for the new approach to enterprise apps. In this way, the organization can be more innovative and react more rapidly. It is not just about applications being easier to build—it's about the numbers of apps that can be built rapidly and concurrently.

Adding intelligence to applications

As more and more apps are driven by the business, they continue to evolve: they are becoming more intelligent. Apps will be better able to sense and respond to users' context, their history, and the world around them. Time Warner, for example, has embedded intelligence in its set-top boxes so that more-relevant content can be pushed to users based on their TV-viewing patterns.[11] In another example, a mobile app called uChek allows users to spot potential problems such as kidney and liver issues as well as diabetes using a picture of a chemical test strip.[12] And Amazon has announced the release of an analytics service for iOS, Android, and Kindle Fire developers that will allow any developers to embed more intelligence into their apps.

Far-sighted business users are also eager to make their applications more useful and more contact-aware—which is why there's a growing push to embed analytics in business applications. Analytics-rich applications can enable users to answer many more of their own data questions. They can effectively become their own data scientists. Tableau Software's simple data visualization capability gives customers like Unilever the opportunity to answer complex business questions very simply, thus rekindling people's interest in asking data questions. This has created a resurgence in analytics and discovery of simple solutions for previously complicated situations, such as determining the fastest-growing products for a very specific demographic.[13] When users can extract intelligent insights from their data in short order, they

can take intelligent action much more quickly. At the same time, the organization's actual data scientists are then freed up to dig into higher-level strategic questions.

The competencies needed to support a world of apps

As enterprises get more involved with the new business of applications, corporate leaders—IT and business executives alike—will need to re-examine the skills and organization structures that must be in place to support the new arrangement. Business will be more aware of technology and its opportunities, and IT will need a better understanding of the strategic business imperatives that the technology will drive. As technology and business strategies become inseparable, multidisciplinary teams will become the norm. User experience skill will become a necessity to drive the adoption of every new application. And as the data collected from these applications is dispersed across the organization, scarce resources, such as data scientists, will need to be built up through hiring and training.

But it's not just tech skills that will be in demand. Unlike many of the packaged software solutions, the business processes are not set in stone in a world of apps. This not only provides a big opportunity to move beyond just technology innovation, it also enables innovation of the underlying processes and adds emphasis to the roles of the business process orchestrator and program manager.

Apps also have different sets of expectations in terms of maintenance. Agility implies iteration. In a traditional software world, deployment is the end of the development cycle. In the app world, deployment is just the first iteration. The expectation is that the applications will essentially be "forever beta"—always evolving.

Crucial juncture for IT and business

Over the next few years, we expect to see some striking examples of business groups that are much more engaged in the lifecycle of "their" own front-end apps. We anticipate something of a resurgence in custom development as leading companies view it as their best option for pursuing the objectives of a digital business.

Your 100-day plan

In 100 days, begin to develop a comprehensive strategy that will lay out the foundation for enterprise app development.

- Appoint a digital champion to coordinate development of your app strategy across organizations in your enterprise.
- Determine your ability to enable cloud and mobile apps against your existing SOA, API Management, and PaaS investments. Based on this evaluation, start preparing a strategy to separate your back-end services from front-end apps.
- Begin the design and architecture of an enterprise apps store for the distribution of mobile and desktop applications.
- Start creating a list of enterprise-level apps to be developed. Work cross-functionally across business units to prioritize the items on your list.
- Start planning a pilot for your highest priority apps that will deploy in conjunction with the enterprise app store. Aim to validate the readiness of your app production environment.
- Review and begin to update your app process and app governance strategy. Prepare to shift toward a hybrid buy and build environment, where your IT buy for front-end functions will decrease.

And we are confident that we will observe more and more CIOs and IT leaders sitting down with their business colleagues to discuss how they can help facilitate the new application development trend.

For many, though—and particularly for IT—this is a crucial juncture. The immediate task is to fully grasp the implications of the evolving enterprise app environment. The second task is to understand the many benefits that come from having the business side assume larger roles in driving new agile applications. The next task is to establish the boundaries of the new roles: the extent to which IT focuses increasingly on back-end system development or partners with the business on the front end—or both.

And the last task? It is to dive into those roles with relish—knowing that they will surely help the company to become a truly digital business.

This time next year

In 365 days, begin the process of implementing the tools and services to enable the development and distribution of smaller, more agile applications.

- Begin the process of abstracting your front-end functions from your back-end services. Start with the consumer applications and services that support the applications going through the most lifecycle iterations.
- Update your app governance strategy to support an agile methodology.
- Re-evaluate your testing methodology to make sure you are not disrupting it when you shift toward a continuous testing methodology.
- Pilot the enterprise app store. Utilize the first set of high-priority apps to test the functionality of both the app store and the applications themselves.
- Based on your pilot results, create a multi-year road map for partnering with the business to build and deliver the remainder of your high-priority apps. Take into account the expected rapid change of pace for IT. Start small but scale fast.
- Identify potential partners to whom you can open up your application platform and development tools.
- Pilot the deployment of a partner-developed application on top of your application platform.
- Evaluate the possibility of opening up specific APIs, and/or pieces of the application platform more broadly to the developer community.

TREND 6

Architecting resilience: "Built to survive failure" becomes the mantra of the nonstop business

In the digital era, businesses must support wide-ranging demands for nonstop processes, services, and systems. This has particular resonance in the office of the CIO, where the need for "always-on" IT infrastructure, security, and resilient practices can mean the difference between business as usual and erosion of brand value. The upshot: IT must adopt a new mindset to ensure that systems are dynamic, accessible, and continuous—not just designed to spec but designed for resilience under failure and attack.

Why now?

Digital transformation of enterprises: Transforming to a digital business implicitly increases a company's exposure to risk through IT failures. More business processes are interconnected and automated, all of which become potential points of failure. The average cost of data center downtime by minute has risen by 41 percent since 2010.[1]

Increased cyber threats: It's not just about gaining access to systems; cyber criminals are also trying to bring them down. Denial of service attacks are increasing in frequency and size. The number of attacks has increased by 58 percent in the last year.[2]

Increased IT complexity: More systems are being integrated, and continuous improvement is becoming the IT norm. But constant change to increasingly complex systems is introducing more risk than ever before.

The expectation of "always on": In a digital world, whether your system is under attack, hit by a storm, or just being updated, the expectation is that it always works.

Netflix loves to fail.

Not by delivering movies late, by overbilling customers or in any of the other ways that the video streaming company could fall short. Instead, its engineers try to find fault with their own IT systems—deploying automated testing tools that they refer to as a Simian Army to deliberately wreak havoc in unpredictable but monitored ways.[3]

Why? Because Netflix's engineers know that what doesn't kill their company makes it stronger. Netflix is not alone; these practices were pioneered at Amazon a decade ago and have seen adoption at the likes of Flickr, Yahoo, Facebook, Google, and Etsy.

Those companies' technology chiefs understand something that IT leaders everywhere must grasp: failure is a normal operating condition. It must be anticipated, accommodated, and designed into IT systems. Practitioners of these "game day" strategies—when days are set aside months in advance to perform internal failure testing, with dozens of staff on hand to respond to incidents—regularly find latent defects in their systems, log hundreds of bugs, and continue to test against the repaired defects in future game days.

This continuous improvement strategy involves more than just ensuring that systems have high availability, a condition that still allows for downtime, however minimal. Today, the idea is no longer about designing for "five nines" (99.999 percent) uptime; it's about supporting the nonstop business—literally 24 hours a day, 365 days a year. There can be no exceptions: if systems are to be as nonstop as businesses need them to be, they can no longer be designed just to specification or engineered to handle only particular incidents. They must be designed to work under failure and under attack.

The rationale is simple. As organizations migrate toward digital, every aspect of their business is becoming increasingly interconnected and automated. In natively digital businesses, the digital channel may be the only channel. In this context, resilience—the ability of IT systems to maintain wholly acceptable levels of operational performance during planned and unplanned disturbances—is of growing importance. True resilience is what will help organizations mitigate risks to revenue and brand reputation caused by service disruptions. It's time to architect resilience into all dimensions of the nonstop enterprise, including applications, business processes, infrastructure, and security.

More vulnerable in more ways than ever

As businesses go digital, they are far more susceptible to disruption—vulnerable because IT systems are constantly evolving to do things they were never designed for, because update cycles keep shrinking, and because the intensity and frequency of sophisticated cyber attacks are increasing. Add the impact of natural disasters—seemingly more frequent and more severe than before—and it's easy to sympathize with the challenges being faced by brand managers and risk officers of nonstop businesses. In an always-on world, business leaders have to expect and accommodate the risks posed by internal and external disruptions.

The economic risks associated with business discontinuities can grow incredibly high, incredibly fast. This is especially true for digital companies that rely on Internet-based business models. Take Google's five-minute outage in mid-August 2013 as an example; it's reported to have cost the company $545,000 in revenue.[4]

Not all outages are so costly; a 2013 Ponemon Institute study found that the average cost of data center downtime across industries is approximately $7,000 per minute in losses.[5] The cost of disruption varies by industry and the scale of the compromised infrastructure.

Arguably, the vulnerability that CIOs feel most acutely is from cyber attacks. As transformations to digital multiply, so do the associated risks from cyber criminals. These attacks are increasingly substantial, sinister, and sustained. In 2013, for instance, charges were brought against a group of five hackers based in Russia and Ukraine for stealing more than 160 million credit card numbers over the past eight years. In that same period, they also compromised more than 300,000 accounts from a single banking group.[6]

One of the myriad vulnerabilities highlighted by this group's crimes is the increasing sophistication of brute-force password attacks. Contemporary password cyphers draw from a dictionary with billions of passphrases, route them through rule engines, and use massively parallel graphics-processing units to test trillions of passwords against a single login credential.[7] In short, passwords—even those stored under cryptographic hashes—are vulnerable. Organizations that understand this insist on multifactor authentication policies.

These days, cyber criminals are highly sophisticated and strategic in their approaches—and rarely brought to justice. Three of the five hackers in the aforementioned example are still at large. Individuals are not the only offenders: organized crime, nation states, and sometimes unscrupulous competitors are also guilty of cyber crimes.

Cyber threats are not just about gaining access to systems. In the case of distributed denial of service (DDoS) attacks, it's also about shutting down or disabling services—or at least causing enough secondary discomfort to damage a company's brand. Security company Prolexic reports that in the third quarter of 2013, its clients experienced a 58 percent increase in the total number of DDoS attacks compared with the year-earlier quarter.[8]

More advanced threats are not aimed at entire systems; they target specific products and services that may be beyond the protection of a conventional security perimeter and may include physical assets. The "black

hats" now have ready access to many helpful tools: for example, the Shodan search engine—labeled the "Google for hackers"—quite easily finds infrastructure components that can be probed quickly for insecure authentication and authorization.[9] Today, a botnet that can do millions of dollars of damage within minutes can be rented for $7 per hour.[10]

A surprisingly large proportion of companies concede that they are unprepared for the scope, severity, and sophistication of today's attacks. Nearly 45 percent of CIOs surveyed in Accenture's 2013 High Performance IT Research admit that they have been underinvesting in cyber security.[11] Many feel overwhelmed about where to begin; their chances of catching up seem daunting and expensive.

"Arguably, the vulnerability that CIOs feel most acutely is from cyber attacks. These attacks are increasingly substantial, sinister, and sustained."

Engineering to be a nonstop business, even under attack

The more professional and prolific cyber attacks become, the greater the role that cyber security plays in business continuity. CIOs must use a business-driven strategy to managing risk across the enterprise by understanding which assets are critical and then prioritizing resilience and active defense measures accordingly. These investments should be proportional to the downside risk in the event of a disruption.

The time to start architecting for resilience is right now—not when customers expect it or when losses in trade secrets, revenue or brand value have reached painful levels. After the necessary discussions about risk with the organization's most senior executives, IT leaders must begin to map out the threat models specific to their businesses. With this information in hand, they can use business process economics to identify the services most critical to the organization's strategic direction and thus those most in need of resilience. This might mean giving different tiers of service to different users.

After that, it's necessary to look for investments that provide security "bang for the buck," leveraging existing investments and going beyond compliance. Once these steps are complete, organizations can start to look at advanced detection and external threat intelligence capabilities to better orient their investments toward the areas most in need. This process will provide the CIO with an immense amount of data necessary to move from a compliance-focused stance to one that is more threat-centric and tied to strategic risk. Resilience is far ahead of compliance and best practices.

Security experts must also architect for a diversity of economic conditions, business risk factors, and a multitude of entry points—including their own security fabric. Can their own control systems trust the information they're receiving? Is their white listing (identifying known entities that are trusted) really working? Has their end-point protection been deactivated by trojan malware?

Ensuring trust among all components of a system—through attestation—is the next security frontier. One of the best examples of exploits that could have been mitigated through proper attestation was the targeted

remote attack of Iran's centrifuge control systems at a uranium enrichment facility. The trojan malware deployed against Iran's nuclear refining capacity caused centrifuges to spin beyond their designed operating parameters while reporting normal operating conditions back to the control systems.[12]

In response to this new class of attack, companies as diverse as HP and Siege Technologies are innovating attestation solutions at the hypervisor level, while others such as Mocana are concentrating on the machine and embedded device level.[13] Putting it another way, the former are focusing on ways to verify and trust the operating conditions of systems while the latter are securing end points so that they're less likely to fall prey to an attack.

Once an organization has the technical solutions in place (DDoS appliances, highly skilled security personnel, applications and infrastructure designed to detect early warning signs, security analytics feeding into proactive quarantining, and automated traffic swings and sink-holing), the most effective response is coordination among peers. This practice has been adopted by the financial services community as a response to a repeating pattern of prolonged, serial attacks against its members. The victims later in the attack chain learn from earlier victims, share architecture recommendations and IP reputation scoring, and provide for continuity in relationships with law enforcement. This has proven to be an effective countermeasure and is being mimicked in other industries and by regulatory bodies as a result of the successes in the financial services sector.

Technologies to improve resilience

Cyber attacks aside, businesses that are striving to become digital are racing to keep up with always-on expectations. It is no longer acceptable to simply post notices about planned downtime. There is less and less tolerance for service interruptions in any form. Whether systems are brand-new or state-of-the-art digital systems from the likes of Google and Facebook, or conventional legacy systems, there are many tools available to help systems administrators provide always-on delivery of digital services.

To a large extent, CIOs already understand that annual release cycles are a thing of the past. Facebook and Yammer are among the leading organizations showing the way forward: they answer the call to be always on by deploying updates in staged releases and using quantifiable metrics and statistical modeling to measure their effectiveness. Only if the features reach predetermined performance metrics are they rolled out to a broader spectrum of users.[14]

Technology companies are not the only ones moving in this direction; high performers in IT are beginning to embrace agile development practices and are adopting related methodologies for operations—that's six times the rate at which other IT departments do it, according to Accenture's latest High Performance IT study.[15] The challenge of transitioning to agile at scale is being met by a suite of operational tactics and technologies, including DevOps, performance monitoring and failure tracing, workload management, and software-defined networking (SDN). Combined, these practices and technologies pave the road to resilience by making it possible to build always-on software and hardware systems.

DevOps is the business-driven integration of software development and IT operations. DevOps tools such as Chef and Puppet allow for highly automated deployment of entire systems from version control. This enables the rapid deployment of new or extended systems throughout the compute fabric of the enterprise without disrupting the nonstop business.

The agile practice of automated unit testing has transitioned to operations as well, where newly committed code automatically goes through thousands of test cases before being deployed; once deployed, best practice calls for it being deployed on a "canary" server first. If there are any issues, the canary discovers them and stops the cascading of flawed code or configuration to the rest of the production environment. Amazon, Facebook, and Google all use Chef to manage the continuous integration of new hardware and software on their cloud infrastructures—while staying always on.[16]

Performance monitoring and failure tracing tools such as Nagios and New Relic provide data center managers with real-time insights so that they can inspect and troubleshoot their systems, from source code to hardware components.

And workload management tools help to make applications more portable across heterogeneous infrastructure—a factor that is increasingly important with cloud-first infrastructure strategies. With tools such as Akka and Docker, developers can now go beyond agile and leverage their cloud infrastructure investments to build more distributed and concurrent applications and services, adding resilience to the organization while decreasing deployment timelines. Gilt, the flash sales site, uses Akka to build a concurrent, distributed, and fault-tolerant event-driven application that handles the daily burst in traffic when flash sales go live.[17]

Traditional content delivery networks (from vendors such as Akamai, CDNetworks, CloudFlare, Cisco, and F5) are providing businesses with integrated workload management technologies that allow them to stay agile all the way to their consumer-facing activities. In many cases, these CDNs also give businesses access to innovation they may not have otherwise. For instance, CloudFlare's proprietary technology was used to reduce the severity of the DDoS attacks on Eurovision's annual Song Contest that reaches 170 million viewers. By moving to CloudFlare after the site experienced crippling DDoS attacks during the semifinal round, service disruptions were eliminated—something that Eurovision could not have done on its own.[18]

For enterprises using private cloud solutions such as OpenStack, CloudStack, and Eucalyptus, SDN enables seamless bursting to public cloud infrastructure when business demands on compute capacity overwhelm internal capabilities. SDN is also invaluable for helping manage the transition to agility at scale. When data centers (or clouds) fail, SDN-enabled organizations can instantly transfer operations to other online assets, often in automated ways and without meaningful service interruptions. SDN showed its ability to contribute to resilience during Super Storm Sandy in late 2012. CurrenEx used a Vello SDN solution to dynamically reconfigure routes, service providers, and hybrid cloud infrastructure. As a result, the company was the only currency exchange in New York City that was able to maintain connectivity throughout the storm and the ensuing cleanup.[19]

These types of services make IT systems better able to withstand failure, notifying administrators of dysfunction, increasing portability, and providing self-healing capabilities—features that circumvent the deficiencies of the highly available, state-of-the-art systems of just a few years ago. Those earlier systems were about hardware; now they're about instances and processes. Rather than trying to design resilience into every component, it is now best to take a systemic approach where the service delivery architecture should be able to survive the loss of any component—including that of entire data centers. And when components or data centers do fail in a resilient architecture, it's no longer a disaster recovery event; it is a high-availability event.

A mindset for resilience in the digital business

Resilience is the new high ground for CIOs who take their strategic business roles seriously.

That does not simply mean putting in place the right cyber security structures and deploying best-of-breed highly available systems. It calls for a wholesale shift in mind-set to the idea of 100 percent uptime. It is a mindset rooted firmly in the context of business risk and a deep understanding of the constant threats of business disruptions—from hurricanes, hackers, or internal upgrades—and the risks that those threats pose to maintaining operational continuity and brand value.

Above all, the resilience mindset is categorically not about compliance. Compliance means complacency; in an always-on world, it is not enough to simply check the Sarbanes-Oxley boxes to confirm that this or that risk management process is being followed. To be clear, leaders don't follow compliance frameworks; they set them.

It's important to know that many of the tools and methods to engineer for resilience—to design for always-on operation—are available and improving all the time. It is not necessary to wait for the maturation or proliferation of a particular technology. As noted, agile development methodologies are already in use, and

Your 100-day plan

In 100 days, consider where you can make the most impact in building a more resilient company.

- Shift conversations with senior executives about security to conversations about mitigating business risks. Talk about the benefits of designing for failure.
- Map and prioritize security, operational, and failure scenario threat models to existing and planned business operations.
- Develop a strategy to handle elastic business demand for IT services.
- Reaffirm a force-ranking alignment of IT systems and their dependent components with business-driven KPIs for success and downside revenue risk. Evaluate the top five for resilience.
- Test your resilience by planning a "game day" exercise for IT operations.
- Consider hiring an outside security firm to attack your infrastructure, monitor the events internally, and reconcile with logs from the security firm to see where your defenses are deficient.
- Perform a data security review. Determine from a business risk perspective where data can reside; consider using the public cloud as a disaster recovery solution.
- If not already doing it, plan a pilot for software-defined networks and a software-defined data center. Start small and scale over time.
- Create a governance model for auditing and testing the entire ecosystem of IT system and process dependencies—both internally and externally. Be sure it includes policies for managing capacity utilization and using hybrid infrastructure.

This time next year

In 365 days, be ready to embark on projects that will build resilience and reduce the operational risks of your digital business.

- During the budgeting process, look for security- and infrastructure-related investments that maximize business process resilience per dollar spent.
- Publish a plan to transition IT operations to a DevOps-based agile organization.
- Mitigate business downtime risks by aiming to shift compute loads to public cloud infrastructure—either during peak times or while under attack.
- Consider piloting automated root-cause analysis tools in the data center.
- Use results from game day exercises to create a prioritized list for operational upgrades.
- Test your system against agile software outputs. Verify that deploying faulty code leads to safe environment fallbacks.
- Create a security road map to build advanced detection and external-threat intelligence capabilities.

they can be used to even greater advantage in building resilient operations and infrastructure. Even some of the hackers' most useful tools, such as Shodan, can be used by the security community as tools to actively defend infrastructure.

The CIOs who truly get the concept of resilience have begun transitioning their organizations to an always-on state. Knowing that it is neither simple nor cheap to provide real resilience, they are taking a pragmatic approach, phasing in resilience over time as business risk and process economics dictate. And some are already thinking ahead to the time when their entire business is digital, cloud-based and always on.

SIDEBAR

A framework for a resilient future

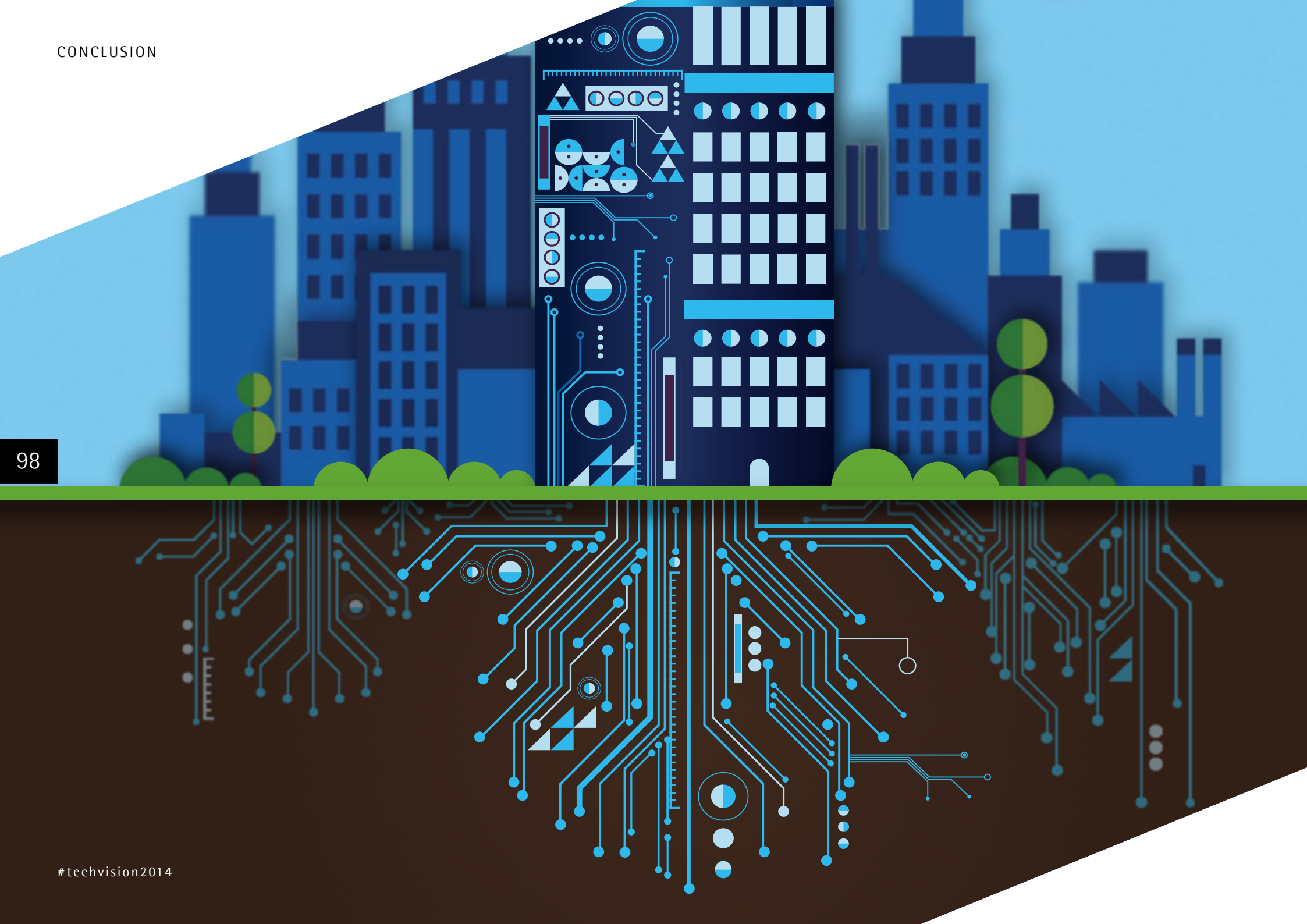
How can IT leaders start to design for failure? In Michael Mehaffy's and Nikos A. Salingaros' studies of resilience in the natural world, they uncovered four key principles that can be adapted for IT.[20] Any truly resilient IT system should demonstrate the following:

Interconnectedness. The evolution of networks, from point-to-point, to hub-and-spoke, and now to mesh, embodies the benefits that interconnectedness brings. When there are more connections at the edge and throughout a network, aggregate decision-making improves, happens more quickly, and has a greater tolerance for the failure of any one node. Many of these same features appear as part of the sharing economy and expanded workforce as well, which further underscores the disruptive power of interconnectedness.

Diversity and redundancy. There should be no reliance on singular data sources; embracing redundancy, IT systems should demonstrate diversity and be designed for failure. The Hadoop Distributed File System is a prime example of these concepts in action; it has data redundancy at the document, file, and system levels. This redundancy allows analytic jobs to be broken into smaller parts, distributed across the cluster, and run in parallel to achieve results in a highly scalable way. Similarly, high availability is a primary benefit.

Modular scalability. Modular systems can be replaced easily and they enable rapid scalability. They find uses across solution architectures and they work well in large and small deployments. Furthermore, when modular systems are also decentralized, each cluster of nodes becomes less and less significant to the functioning of the whole and more independent of centralized control systems.

Adaptation. Sensors that are able to make localized decisions based on quantified measurements, domain experience, and collaboration with peer nodes can have a significant impact on the physical world around them. These decisions on the edge are informed by shared knowledge and, over time, can gain decision making characteristics akin to biological intelligence.



CONCLUSION

The pace of technology change is accelerating

Ten years ago, Facebook was just getting started. Eight years ago, Twitter and Instagram didn't exist. Six years ago, most mobile phones were incapable of much more than phone calls and messaging. Five years ago, tablets were a remedy for headaches—not a means of accessing a universe of data.

Digital technologies have burst into our lives with explosive force, and the shock waves are traveling outward at phenomenal speed. Accenture has tracked these waves in its Technology Vision reports over the last eight years, outlining the impacts and opportunities that continue to lead businesses to become digital businesses.

This year's report continues to expand our Technology Vision of the effects this digital surge will have—but with one difference: this year, we see more and more large organizations, outside of the IT industry, actively riding the surge, even fueling it, instead of being pressured by it. These organizations understand that it is still early in this initial big wave, but they see just how much opportunity it gives them. They are beginning to leverage their vast resources and capital not just to react to technology disruption but rather to embrace and interweave digital technologies throughout their companies to drive the disruptions themselves—and to their advantage. This shift in strategies marks a significant inflection point. The last decade of change and opportunity was driven by digital start-ups. The coming decade will see the traditional companies become the next set of digital giants. Big is the next big thing.

So it's appropriate for all business leaders to now start asking pointed questions. Where exactly is our organization on its digital journey? Making a start, perhaps by issuing tablets to the sales force? Are we experimenting, seeing what's working and what isn't? Still learning which business processes lend themselves best to digitalization? Or, are we confidently planning a large-scale digital transformation that will be the most important initiative our company has undertaken in at least a decade—a way to help us hurtle past our competitors?

All businesses, from the global 2000 to small businesses, are facing a pressing need to re-examine their capabilities in light of the next stages of their digital journeys. The pressure applies to both the IT and the business sides.

The technology imperative is absolute: it is now time for the CIO's organization to decide what role it plays in the emerging digital business—reinforcing the organization's technology backbone while equipping the business side with the knowledge, understanding, and partnerships with IT to leverage it.

For the business, it is now incumbent on the leaders to define their company's place in the digital world. They must redefine their relationships with their customers, partners, and the Internet community at large;

erase organizational silos around how organizations collaborate and data is shared; re-examine the roles that their enterprise plays in their industry; and lower the boundaries barring entry to other industries as potential areas for growth.

The opportunity at hand for each C-suite executive is to be a digital disrupter—re-creating and redefining their businesses to create competitive advantage. The potential for growth is limited only by the creativity of the enterprise itself. Now is the time to move from disrupted to disrupter. The opportunity is here; take it.

"The last decade of change and opportunity was driven by digital start-ups. The coming decade will see the traditional companies become the next set of digital giants. Big is the next big thing."

RESEARCH METHODOLOGY

About the Technology Vision

Every year, the Technology Vision team at Accenture Technology Labs, with the Accenture Research organization, pinpoints the emerging IT developments that will have the greatest impact on companies, government agencies, and other organizations in the years ahead.

This year's research effort began with the collection of over 3,000 ideas and comments on technology trends, disruptions, and hypotheses from the architects, engineers, and scientists across Accenture who see the impact of technology changes every day in their work with clients. Using Mindjet's SpigitEngage, an enterprise innovation platform, the ideas and examples of the trends in action were gathered during a trends spotting contest. Over 850 participants actively engaged in contributing, voting and developing the vast collection of ideas.

These crowdsourced ideas were then screened against inputs from several other sources, including the recent activities of commercial R&D labs, the academic literature, the flow of venture capital funding, and trends highlighted by IT analysts, and key themes at industry conferences. For perspective, we also reviewed many of the ideas with an External Advisory Board featuring diverse perspectives from startups, venture capitalist firms, IT ecosystem players, and public service and enterprise technologists. In addition, we tapped Accenture's High Performance IT research and the findings from our annual CIO Forum.

The ideas that surfaced during this process stood out for their relevance to "real world" business challenges. Specifically, the Technology Vision team sought ideas that transcend the technologies that already drive change—discrete categories such as social, mobile, analytics, cloud—and concentrated on the themes that will soon start to appear on the C-level agendas of most enterprises.

The Technology Vision team then worked with experts from throughout the company to add to, consolidate, filter, and prioritize the accumulated ideas and to test each idea against the following criteria:

- Certainty of transformational impact on enterprises
- Velocity and scale of technology change
- Impact beyond any one industry "silo"
- Ability to be more than a "one for one" replacement for an existing solution
- Practical actionability within the next 12 months
- Transcendence of any one vendor or discrete "product" technology

These tests produced a handful of robust hypotheses that were synthesized into the six overarching themes presented in this year's report.

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