TECHNOLOGY
VISION

Tomorrow's
Digital Enterprise

Cloud Driven. Cloud Smart. Cloud Strong.

NEUDESIC

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The Fourth Industrial Revolution, powered in large part by digital transformation, is disrupting how we live, work and play so quickly that it can feel overwhelming. From a business perspective, executives are seeking ways to accelerate their digital transformation to both disrupt and avoid being disrupted. From a personal perspective, people are embracing advances in smart home devices such as bots and personal assistants while worrying about long-term implications in areas like employment.

Every day at Neudesic, we are excited to witness and participate in the shaping of this new world. Our 2018 Technology Vision captures our perspectives—gained from our work with clients as well as our own explorations—on the importance of cloud in this time of radical digital transformation. It explores some of the technologies and applications that are using cloud to shift entire industries as well as individual habits. This vision provides ideas on how executives can bring technologies fueled by cloud into their organization to drive innovation, growth, performance and engagement.

As key players in this Fourth Industrial Revolution, all of us have a responsibility— almost a moral obligation—to share what we know to ensure we are all ready to thrive in the dynamic, digital world that continues to evolve. With this vision, we hope to offer both a snapshot and some inspiration to help create and accelerate a richer, more complete picture of where we are now, where we are going, and the best ways to get there.

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A Brave New
Digital World

Digital transformation is changing the way we work, play and live, at a pace we have never seen before and in ways we are just beginning to realize and imagine. As Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, put it, the Fourth Industrial Revolution "is characterized by a range of new technologies that are fusing the physical, digital and biological worlds, impacting all disciplines, economies and industries, and even challenging ideas about what it means to be human." The world as we know it is undergoing dramatic disruption that is digitally driven.

50%

By 2020 almost 50 percent of IT budgets will be tied to digital transformation.

SOURCE: Six Predictions About the Future of Digital Transformation, December 2015, Forbes.

Cloud
The Great Equalizer

Cloud technologies are the great equalizers in today's business world

Unlike the initial Industrial Revolution, where power was concentrated to just a few industry titans, this digital revolution is open to all. And, it is fueled by one of the greatest disruptors that we have seen in modern times—the cloud. Cloud technologies are the great equalizers in today's business world and are sparking unprecedented opportunities and challenges.

The cloud provides speed, scale and stability to organizations of all sizes. With cloud, a two-person startup has access to disruptive capabilities that enable it to innovate, grow, perform and engage in the same ways as any conglomerate that has been around for generations.

The agility and strength of cloud as a backbone for running technologies and applications—from legacy systems to artificial intelligence—has everyone talking about the "journey to cloud". But cloud is not a destination—it is a vehicle. While it was initially seen as an efficiency play, the platform has quickly evolved into a strategic lever. Truly forward-thinking executives are looking beyond mere functionality to where cloud can take them. They are thinking not about what they can put into the cloud, but what they can get out of it.

While cloud is removing barriers to entry for companies and public institutions of all sizes, it is also addressing early perceptions of its own shortcomings. Security, once a major concern, can now be a key feature of cloud— if handled in the right way. Power, capacity and reliability are all far greater in the cloud than could be created by almost any organization on-premise, at a fraction of the cost, while shifting from capital expenditure (CapEx) to operating expenditure (OpEx) on the balance sheet.

With the breadth of innovation driven by digital, and the power and ubiquitous accessibility of the cloud, the only remaining barrier to entry for the Fourth Industrial Revolution is, almost literally, one's imagination.

Cloud IT market revenue is predicted to be $390 billion in 2020.

SOURCE: Roundup of Cloud Computing Forecasts 2017, April 2017, Forbes.

Cloud
The Ultimate Performance Enhancer

**It is not just newcomers who are deploying digital to change the rules of the game**

It is imagination that inspired Airbnb to disrupt the hospitality industry without owning a single property. It is imagination that has AeroFarm reinventing sustainable food production far from a traditional farm. Digital and cloud make it possible for Airbnb and AeroFarm to upend traditional market models. They make it possible for Houzz to change the way people decorate their homes without employing a team of interior designers, and then extend the concept to create a whole new marketplace for home-related goods and services.

It is not just newcomers who are deploying digital to change the rules of the game. With sagging stock prices and an eroding customer base, Domino's Pizza not only looked at improving its product, but also decided to reinvent itself as a technology company in the pizza delivery business. Customers can now place and track orders online, using the Domino's app, website, or even by texting a pizza emoticon. More than 60 percent of Domino's orders are digital, and two-thirds of those are via mobile devices. Domino's continues to innovate, experimenting with voice ordering through Google Home and Alexa and exploring delivery drones as well as specially-designed cars.

Car manufacturer Tesla uses its cloud network as an active—and even dominant—aspect of its relationships with cars and drivers. Updates to the car's operating systems are provided through the cloud, saving trips to dealerships and enabling Tesla's lean infrastructure. When hurricanes hit Gulf Coast states, Tesla automatically extended the battery range of its cars to ensure drivers' safety.

The power of cloud
and digital at work

One pillar of the Fourth Industrial Revolution, Amazon, was launched 32 years after rival Walmart, yet today boasts a market capitalization that is 1.5 times larger, and a workforce that is just 10 percent of Walmart's and produces 2.3 times more revenue per employee.
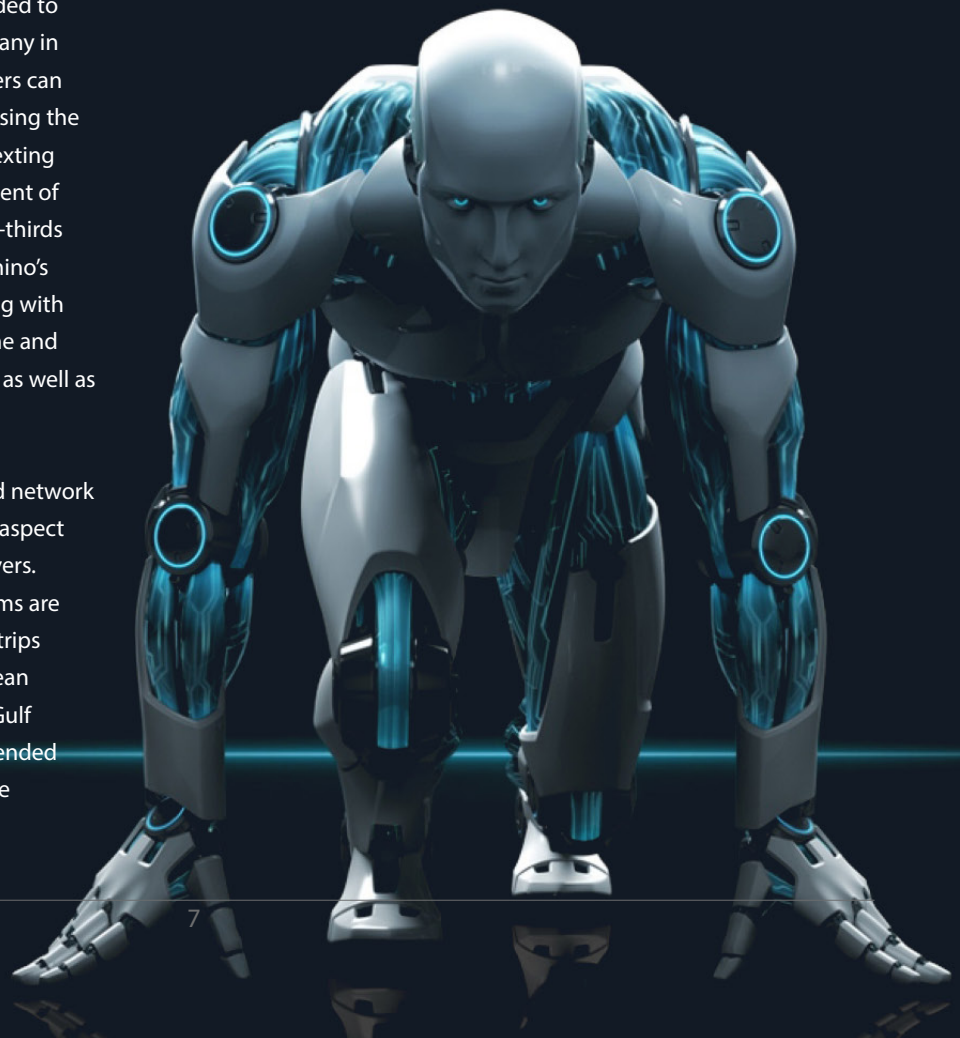
The Impact
of Cloud

For industry pillars and newcomers alike, cloud can drive business results by consistently and cost-effectively delivering speed, scale and stability.

By **2020**, 60 percent to **70** percent of all software, services and technology spending will be cloud based.

SOURCE: Roundup of Cloud Computing Forecasts, 2017, April 2017, Forbes.

Innovation

Cloud fuels innovation by making it faster, easier and cheaper to mobilize around new opportunities, and by freeing up resources— time, money and people—that can be refocused on producing new ideas and smarter ways to operate. The cloud as a business tool has become simpler and cheaper to use, both from infrastructure and people perspectives.

Just 10 years ago, developing apps required an in-house team, server space for development and testing, plus the infrastructure and dedicated people to host, maintain and upgrade the apps. Innovation meant a big up-front investment in capacity and storage plus a commitment to whatever technology was being developed, as changing courses quickly would mean abandoning significant investment and starting the cycle over again.

Now, cloud provides immediate access to processing power, storage and applications that help businesses experiment, scale and adjust on the fly. Organizations can pull together new offerings quickly by combining existing tools and companion apps in a new way, or as a basis for more innovation. Testing of features that once took months can be done in hours, as cloud can deploy a thousand servers simultaneously, rather than having on-premise servers cycling several times over. The cloud environment fosters the experiment-and-fail-fast-mentality that enables an organization to try something out at minimal risk and cost, or even pursue parallel paths to find which will work best.

Costs for innovation go down as organizations pay only for what they need, when they need it. Once those servers have finished testing, users stop paying for that processing power. The efficiency in time and money frees up capital to put toward innovation. Instead of investing heavily on big bets, organizations can now spend a little across a wide swath to see which ideas are worth pursuing.

Cloud helps to inspire innovation as part of a corporate culture, too. Workforces can shift as repetitive tasks are turned over to machines. People can be diverted to more thoughtful and fluid activities and encouraged to experiment in a low-risk environment.

By helping to reshape both the infrastructure and culture of an organization, cloud fosters an environment where humans are thinking and experimenting and accelerating, while digital capabilities are executing and modifying tasks quickly and cost effectively.

Executives can start pushing a cloud-driven innovation agenda today if they set out to disrupt—internally and externally. Fostering a research and development (R&D) culture and rewarding creativity will help spark innovation at all levels. With cloud's fast cycles and easy scalability, launching new ideas into the market can create a competitive edge and shape an organization's brand. Fast failures will be quickly forgotten, especially if they create learning, and spur new sustainable products and services.

Autonomous software agents outside of human control will participate in 5 percent of all economic transactions by 2020.

SOURCE: Six Predictions About the Future of Digital Transformation, December 2015, Forbes.

Growth
Cloud provides a dynamic platform

Imagine being able to scale from serving one thousand customers to one million customers to 10 million customers within minutes rather than months or years

Using serverless computing architectures in the cloud makes that possible. And, if those 10 million customers only show up a couple of times a year, say, to seek out recipes or purchase that special gift on a website immediately before the big holidays, the capacity for those surges is available, alongside the ability to shrink back down to normal operating levels automatically. The only difference is an uptick in the usage bill during the surge.

Being able to scale in real time is a clear driver for growth that is enabled by cloud technologies. However, it is not the only one. Using an application equipped with artificial intelligence can also power growth by achieving economies of scale with less up-front investment. Having bot interactions, utilizing natural language technologies, routing customer inquiries and service requests through the right process or to the right person can speed response times and enable organizations to place a premium on meaningful interactions with more people in less time.

Cloud also fuels growth by providing a dynamic platform that encourages collaboration among organizations. When consumers choose which Spotify playlist to listen to on a Lyft journey—and earn loyalty points with airlines or hotel chains used for the trip—all companies win from the collaboration, and each may gain more customers through cross-exposure. A startup in Seattle, Loftium, lends money to first-time home buyers on the condition that they list one bedroom on Airbnb for three years and share the income with Loftium. It enables more people to own their homes, often helping them to avoid mortgage insurance costs associated with small down payments, boosts the home-rental market and gives Loftium a steady stream of income. The fast, easy and secure sharing of customer data across a network of partners is a new capability powered by cloud, and a quick and steady path to growth.

"The pace of innovation with Cloud is something we have not really experienced before, and that pace is only accelerating."

-Werner Vogels, CTO – Amazon Web Services

"Data monetization" will become a major source of revenues, as the world will create 180 zetta-bytes of data (or 180 trillion gigabytes) by 2025.

SOURCE: Six Predictions for the $203 Billion Big Data Analytics Market, January 2017, Forbes.

> "I believe we've just scratched the surface in terms of the innovation cloud computing is driving… There are major changes only just starting, but all driven by ubiquitous availability of compute, storage, analytics and other fundamental cloud services."
>
> -Werner Vogels, CTO – Amazon Web Services

One other way that companies can grow more effectively is simply by taking advantage of the ability to reallocate resources. Money spent on on-premise servers, large IT teams focused on maintenance, and monolithic legacy systems can be redirected into other areas of the business, or applied to stronger bottom-line results. Whoever said, "You cannot shrink to greatness," did not foresee the potential for right-sizing in-house IT as a catalyst for an increased investment in other areas and an opportunity to refocus people on more strategic, value-adding work.

We know that cloud's ability to scale quickly makes it a great enabler of growth, but executives need to be sure their organizations are poised to scale. Agile and adaptable models, such as DevOps, can drive growth along several parallel paths, while cloud life cycle management helps to establish a pace of change that works. An important, but often overlooked catalyst to growth is outside perspectives. Bringing in new ideas and new ways of doing familiar things can open up a workforce and prepare them to expand their perspectives, capabilities and capacity for growth and change.

Performance
Cloud delivers reliability

The applications that run on cloud elevate an organization's ability to perform as well

Any organization can perform better by utilizing cloud and the technologies and applications that reside within it. Cloud itself delivers more reliability than most organizations could create themselves. Cloud service providers are second to none when it comes to guaranteeing uptime and availability—their business depends on it. In the same way, these companies are committed to maintaining cutting edge security practices that most individual organizations do not have the time or the budget to develop.

Performance also comes through power, where, once again, cloud is unparalleled. With the vast amounts of data generated by humans and machines every minute, storing and making sense of that data is both a huge opportunity and a massive challenge. Only cloud has shown the ability to address the challenge and unleash the opportunity, providing a platform for near real-time insights based on natural language queries that make data more useful for more people.

The applications that run on cloud elevate an organization's ability to perform as well. Robotic process automation (RPA), machine learning, augmented reality—all of these are powerful tools for enterprises looking to do things faster, better and cheaper.

By 2022, the Internet of Things will save consumers and businesses $1 trillion a year in maintenance, services and consumables.

SOURCE: Top Strategic Predictions for 2017 and Beyond: Surviving the Storm Winds of Digital Disruption, October 2016, Gartner.

Engagement
Using machines and automation

Technology shapes the way we work, play and live

Even in this increasingly data and machine-driven world, human connections remain vital to success. As technology shapes the way we work, play and live, it also shapes interactions and connections—mostly for the better. Organizations are finding new ways to connect with their employees, customers, suppliers and partners by tapping into the applications and technologies powered by cloud.

High-end retailer Burberry uses information shared by customers through loyalty programs to bring some of the best features of online shopping into the retail experience. As customers walk into their stores, the associates are prompted to make personalized offerings based on purchase histories, social media profiles and other buyers' behaviors. If a customer has bought a coat on a previous visit, the associate might recommend a bag that others have purchased with the coat. Burberry is creating a tech-driven customer experience in other ways as well, including a feature on SnapChat that pulls up information about an item when its bar code is scanned, and an in-store photo booth where customers can put themselves into ads with their favorite celebrities.

While most organizations are not seeking that sort of instant, attention-getting connection with millions of people worldwide, cloud technologies enable all types of connections across the spectrum. Everything from personalized coupons delivered to a shopper in the grocery store to real-time maintenance information for truckers looking to maximize the life and road time of their vehicles. From the time it takes for an employee to swipe an ID to enter a building and ride an elevator,

By 2020, 100 million consumers will shop in augmented reality.

SOURCE: Top Strategic Predictions for 2017 and Beyond: Surviving the Storm Winds of Digital Disruption, October 2016, Gartner.

the workspace can be booked through an office reservation system, communicated to teammates and set up for personal comfort with preferred temperature, lighting and collaboration tools to enhance productivity.

The immense amount of data collected, stored and analyzed in the cloud delivers both aggregate knowledge and individualized insights, enabling organizations to identify macro trends and micro preferences quickly. As a result, machines can make human interactions more meaningful and productive.

Another aspect of engagement that cloud makes possible ties back into the potential for innovation. Using machines and automation to free people from repetitive tasks opens up new avenues for people to express their creativity, and integrates them more into the values, culture and goals of an organization.

Unleash
The Power

Cloud has something for everyone and is open to all

Taking advantage of the dynamic nature of cloud—both capabilities that exist today and others that we have not yet dreamed of—requires some internal and external discernment.

One of the first things to determine is the level and type of investment available for cloud. While storage is typically cheaper in the cloud—especially when the labor associated with maintaining on-premise servers is factored in—the move to cloud requires thoughtful investment and focused effort.

To realize the value of the cloud, executives must rethink how they define, design and develop solutions and plan investments

Internally, executives need to decide where they want their organizations to go. Thinking that existing technologies, applications and processes can be easily replicated or shifted to cloud is a recipe for unrealized potential. Instead, ask yourself:

- How can we disrupt our own business model?

- What can cloud enable us to do that none of our competitors are doing today?

- How can cloud expand our competitive landscape into tangential or entirely new markets?

Identifying strategic aspirations that are enabled and driven by the cloud is an important first step

The next step is understanding some of the technologies and tools that can help executives move in the right direction for their organization, their industry and the larger world beyond.

Cloud's
Essential Elements

Cloud—Always Advancing, Never the Same

Innovation moves fast in the cloud. Some technologies catch fire and spread, others succumb to the hype cycle or find a niche. The technologies and applications discussed here are ones that have caught the attention of both CEOs and CIOs and therefore merit a closer look.

Artificial Intelligence,
Machine Learning and Bots

What?

In the new world of data, outputs of analytic systems are consumed not only by humans, but also by process automation systems and smart things and devices that can replace humans. Insights developed from machine learning solutions for predictive maintenance can be used by AI solutions to create work orders and dispatch crews. The behavior and action of smart devices can be controlled by insights generated from machine learning algorithms. Smart building automation systems can control the temperature and lighting in conference rooms based on reservations and cancellations.

With connected intelligent devices becoming mainstream, AI can close the gap between insights and action by helping to automate processes that previously required human intervention. As an example, a utility company can automate the deployment of unmanned drones for visual inspection of power generation and transmission assets, based on information gathered from sensors.

Unlike the traditional ways of interacting with reports and dashboards, spoken words can be used to get insights from data. For example, "What is the total sales number this month?" or "When was this machine last serviced?"

> "Particularly over the last three years, we have felt that with machine learning and artificial intelligence, we can do these things better than ever before. They are progressing at an incredible rate."
>
> -Sundar Pichai, CEO – Google

The artificial intelligence market is predicted to become a $100 billion industry by 2025.

SOURCE: Five Ways to Boost Your Strategy with Machine Learning, July 2017, Forbes.

So What?

Enabling computers to think for us is more efficient—and often leads to better outcomes. A building's boiler could trigger a maintenance call before it breaks down, or an employee could receive a reminder to request time off based on vacation plans in an e-mail or on a calendar. An HR analytics company can use machine learning to analyze massive volumes of data, including outside sources, such as LinkedIn and job boards, to identify employees that are at risk of attrition.

These insights are not limited to simple processing, but can move into creative endeavors as well. An airline looking to redesign a cabin separator invited engineers and designers to submit their ideas for a partition that was strong but lightweight and able to fit into an irregular space. A computer was given the same parameters and came up with the ideal design.

Computers that can learn are also able to teach humans. If data analysis shows that a product is especially appealing to 19 to 24-year-old men, the system can predict that shifting marketing spend into more targeted channels could increase sales by "X". AI and machine learning take data analysis from hindsight to foresight.

Natural language processing, enabled through digital assistants and bots, makes it easier for people to ask questions and accomplish tasks, empowering workers to become more effective and informed. A worker who is injured on the job can tell a bot: "I've just come in contact with a hazardous substance," and the bot can coach the worker through immediate steps according to company policy and Occupational Safety and Health (OSHA) regulations, while also alerting a supervisor or a maintenance crew. The bot enables the interaction, with AI driving the retrieval of the right procedures and triggering additional actions.

For most enterprises, bots are the natural place to start with AI. Beyond Web chat bots that answer routine questions, organizations are starting to deploy bots not only to respond, but also to initiate interactions. AI can take unstructured knowledge and present it to the right person at the right time.

Now What?

Make no mistake, AI will disrupt every industry, every market, and every job. But, rather than waiting for the disruption, executives can begin transforming organizations in iterative experiments, gaining efficiency and cost savings that can add up fast.

Big data presents huge opportunities that result from better insights from bigger data sets. However, regardless of what technology is used to process it, being able to identify useful versus unhelpful data presents its own challenges. AI technologies can provide help in sifting through massive volumes of data to decide what is relevant and what is not.

Design sprints undergo three basic steps:

1. Align

How do existing business objectives and current practices align to the capabilities of AI-driven automation? Rather than pursuing innovation for innovation's sake, each organization should look at how technology and apps contribute to strategies and goals.

2. Engage

Drawing upon business leaders—and not just IT—to identify and execute on areas of alignment is a great start. Even better is opening the opportunity more broadly, asking people to generate ideas or even prototypes of solutions that bring the advantages of AI into an organization. Efforts like innovation contests often uncover hidden pockets of potential change, while also building or reinforcing a culture that values creativity.

3. Prove

The only way to determine the value of an innovation is to build and deploy it. It does not have to be big, and it does not have to spark transformation—the key measure of success is if it works and generates even incremental value.

To take advantage of all these unprecedented advancements in AI, organizations must redesign their data and analytics strategy to be flexible and more responsive. Nimble and agile data platforms that can be used to model and train AI systems are extremely important.

Innovations can happen within and outside of IT, requiring a comprehensive data strategy that can accommodate all types of users. Logical data warehousing architectures with data virtualization technologies—backed by scalable data lakes—enable analytic solutions that can cater to the daily needs of report and dashboards users. That same environment serves as an insights development workbench for data explorers and innovators.

Augmented
and Virtual Reality

What?

Augmented reality superimposes images and opportunities for interactions into the viewer's physical space. Virtual reality creates a simulated three-dimensional world that enables viewers to interact through body movements and sensors.

So What?

Virtual reality (VR) was adopted quickly by gaming and other entertainment opportunities, as it involves a unique, immersive environment that is often removed from the look and feel of everyday life by design. Now, VR is becoming more prevalent in education, training and even operations and maintenance, especially when paired with augmented reality (AR). AR is helpful for envisioning changes to an existing space, as well as training and on-the-job assistance.

An energy company wanting to improve the productivity of field personnel is exploring ways to employ augmented reality to complement a field worker's knowledge and skills. AR glasses or a mobile phone with the right app can give the field worker an enriched view of an environment. An offsite maintenance expert could use VR to get a shared view of a machine or whether it needed repair, enabling them to collaborate with field personnel. Videos and overlays from a repository of information can round out a field worker's view and help him or her make sense of and solve the problem. And, being able to see what a worker is witnessing in the field can provide valuable information about machine performance.

AR and VR can increase the efficiency and safety of oil field operations too. Instead of deploying multiple field workers to test equipment and check rigs, one worker can scan a field digitally. If there is an emergency, personnel wearing sensors or holding an AR device can be quickly located and moved to safety, guided by AR and VR.

Many executives think about AR and VR as something requiring significant investment and special equipment. The Pokémon Go craze—which has already come and gone—proved that AR is easily deployed to huge groups of people, who can start (and stop) using it quickly.
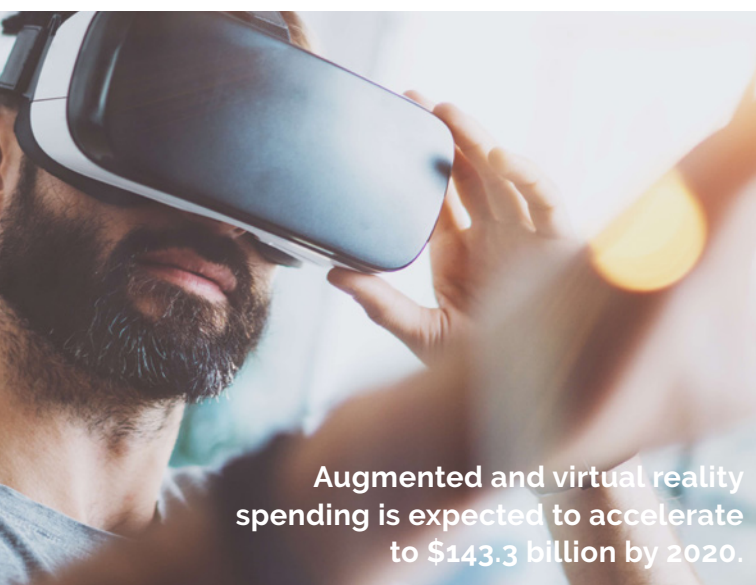
Augmented and virtual reality spending is expected to accelerate to $143.3 billion by 2020.

SOURCE: Worldwide Spending on Augmented and Virtual Reality Forecast to Reach US$13.9 Billion in 2017, press release, February 2017, IDC.

AR and the power of cloud together have the potential to bring real-time information into any number of industries to speed up knowledge transfer and response. Mobile is the delivery device that puts this information into the hands of people quickly and affordably. A smartphone equipped with a camera and the right app can immediately transform into an AR tool.

Imagine a nurse walking into an emergency room with a full map of triage on his phone or tablet, which shows all the patients waiting, their symptoms and priority for treatment. Or a plant manager receiving real-time performance information about each machine as she walks by, including productivity and scheduled maintenance. These scenarios are not futuristic. They just require an organization and its executives to be willing to start experimenting with what augmented and virtual realities can do for them.

Now What?

The best way to make virtual and augmented reality a business reality is to seek out opportunities and start building applications. If executives can move beyond thinking that these applications require a huge up-front investment, organizations can start experimenting and finding ways to make people's lives more productive.

Augmented and virtual reality have the potential to help close four kinds of gaps within an organization:

• Proximity

For organizations with dispersed workforces, AR and VR can work together to enable people to share an experience and take advantage of remote assistance from anyplace in the world. Field repairs, application development, design work— anything that benefits from collaboration can benefit from AR and VR, or the combination of the two, which is mixed reality.

• Insights

From the oil field to the emergency room and beyond, AR and VR can layer information and context to help people make sense of what they see that can lead to better decisions and faster actions.

• Skills Augmentation

AR and VR can be invaluable training tools, either creating a new environment for immersive training or accelerating on-site training with relevant and contextual input overlaid on a physical environment. But, these tools can close the skills gap by enabling a skilled person to guide a less-skilled person through a task. This live knowledge transfer delivers faster and better results while raising the collective skills of an organization.

• Engagement

As our world becomes increasingly virtual, it is easier for people to disconnect emotionally from each other and an organization. AR and VR can bridge time and space to help build tighter teams with more personal connections.
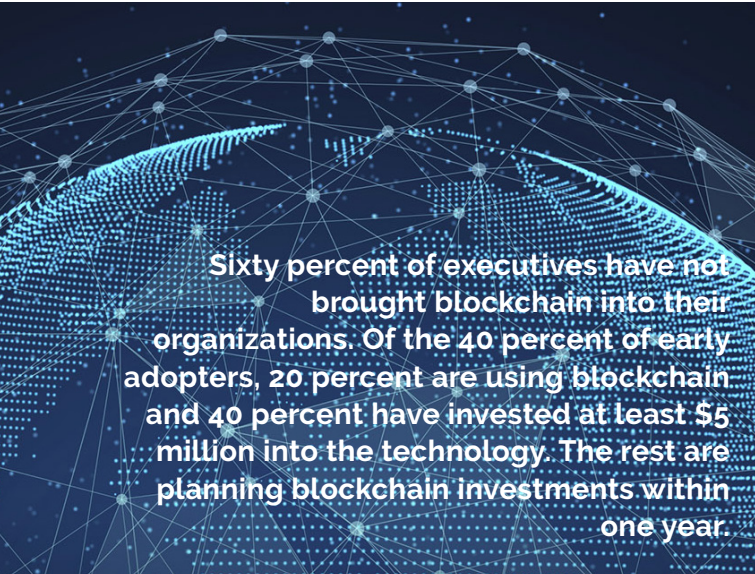
Blockchain

What?

Put simply, blockchain is a series of permanent records of transactions that are simultaneously stored across a network of computers. A single block in the chain represents a snapshot of an event or a status that cannot be altered because it is replicated widely across many nodes. Each time a new block is added, it stores and encrypts all the transactions prior to the new one so that anyone trying to alter the past will immediately stand out.

In more technical terms, blockchain is a distributed ledger that uses encryption algorithms based on existing records in the ledger to create each new entry. These algorithms collaborate with a consensus protocol to commit the entry to each node in the cluster. The blockchain becomes stronger and more secure by adding more copies of the ledger.

So What?

Blockchain democratizes trust by making everyone an owner of permanent records of actions and transactions. This helps to establish and protect the integrity of data by making it difficult to alter once a block is created. The approach also undermines or even eliminates the need for a third-party data broker or central control. Digital rights management, transfer of ownership, financial transactions—all can be securely shared broadly and safely with blockchain.

Blockchain also distributes—and nearly eliminates—the risk of data loss or security breach as data is stored in a decentralized way. And, blockchain makes it easy for organizations to securely share information on their terms through encryption and access. Hospitals can share information about medical procedures with insurance companies without opening up access to the entire patient record. Cars and trucks can provide and receive information about travel times and traffic patterns that can be used for real-time routing and long-term urban planning.

Sixty percent of executives have not brought blockchain into their organizations. Of the 40 percent of early adopters, 20 percent are using blockchain and 40 percent have invested at least $5 million into the technology. The rest are planning blockchain investments within one year.

SOURCE: US Innovation Blockchain Infographic, Deloitte, 2016.

The World Economic Forum predicts that, by around 2027, about 10 percent of the global gross domestic product would be stored on blockchains.

SOURCE: Building the Blockchain of Success: How Cloud is at the Heart of It, January 2017, Cloud Computing News.

While blockchain started as a means to securely and broadly track digital transactions, such as bitcoin payments, the next generation of the technology has begun to execute smart contracts, or programs, on top of the stored information. If a market suddenly dips or a competitor makes a move, that change will be noted within the blockchain and will trigger a pre-programmed response.

This newest layer of capability helps organizations evolve from being digital to being "smart digital."

The road to blockchain is not entirely smooth just yet. There are challenges to adoption as current mining approaches to determine the next transaction are inefficient. This area continues to evolve and will improve as more attention is paid to it. Additionally, blockchain requires a tremendous amount of energy and storage. Imagine having a library that, every time you added a new book, meant the previous library duplicated itself just so you could add that book. The replication of information—while making it ironclad in terms of security—also consumes space and energy to maintain.

Now What?

Unlocking the value in blockchain requires looking first at potential value and then at identifying the best strategy for each business model.

1. Find the angle

Blockchain can help an organization innovate, grow, perform and engage, but only if it is applied to the right areas to…

- Cut out players along the value chain to increase margins and get closer to the customer.
- Expand access to marketable data across the value chain to increase opportunities and grow market share.
- Reduce costs and risks by collaborating with similar players in the market in an environment that shares only what each decides to share.

2. Link to a healthy ecosystem

For established companies, sharing information via blockchain will follow along established partnership channels. Startups will need to build their own chains or connect to existing ones by adding value in a new way.

3. Call in the experts

Technical knowledge and practical skills to implement blockchain and smart contracts are scarce. Identifying partners that have the technical know-how should be done on as soon as the decision is made to use blockchain.

4. Move fast

Both public or consortium blockchains have potential as transformational platforms that will introduce new business models and change the existing ones. In this way, the first mover can quickly dominate the market and eliminate rivals.

Just as the cloud is enabling the democratization of innovation by offering speed, scale and stability, blockchain in the cloud is opening the door to the democratization of data by creating a secure distributed way to share information across a wide swath.

Internet of Things
and Advanced Analytics

What?

The Internet of Things (IoT) connects everyday objects to each other and to companies in consumer and business markets. IoT can collect information that can be used to change the behaviors of systems and humans. Advanced analytics takes the data created by sensors and processes them to reveal trends and predict or even execute future events.

So What?

As prices dropped for sensors, connectivity and data processing, the hype around the IoT soared. After years of promises that our refrigerators would make sure we never ran out of milk again, the hype is becoming reality.
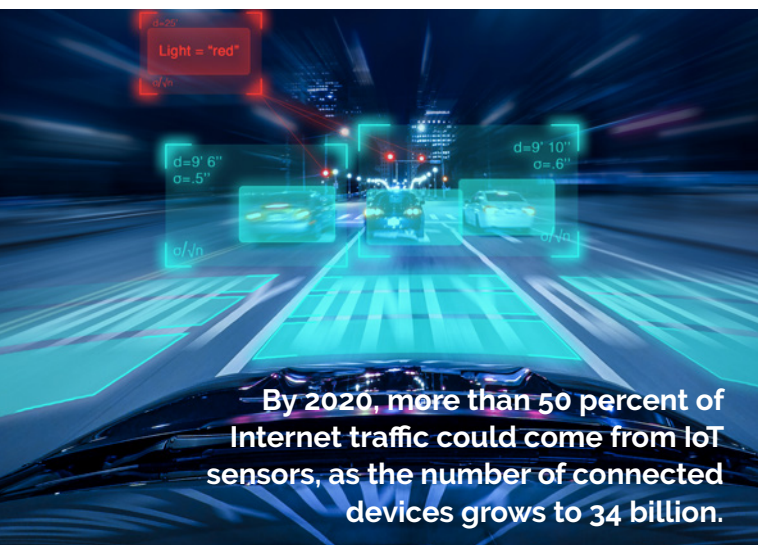
Organizations continue to use sensors as cheap and easy ways to gain snapshots of their business, as well as build a bigger picture, but they are looking for more and better ways to collect and make sense of data and integrate insights into their

operations and strategies. Drones, for example, can provide visual inspections of heating, ventilation and air conditioning equipment on a roof more quickly and safely than humans. A connected drone can focus on areas of the roof where sensors show performance has been compromised, reacting to information fed into it to provide better insights and potential actions, such as ordering replacement parts.

Part of that process is helping organizations understand how to avoid drinking from the fire hose of data that IoT and other digital activities supply. New technologies and architectures enable organizations to let data pool in structured or unstructured formats, providing insights at the right times and for the right reasons.

As analytics continue to get better—through a high-quality set of data going in and more advanced processing coming out— organizations can move from hindsight to insight to foresight, with a greater ability to predict and prescribe future events through artificial intelligence and automation.

With more of the world getting connected, leading organizations will find ways to shift from the physical to the digital and make those connections work for their customers, their partners and their businesses—and their machines. As artificial

Light = "red"

d=9' 6"
o=.5"

d=9' 10"
o=.6"

By 2020, more than 50 percent of Internet traffic could come from IoT sensors, as the number of connected devices grows to 34 billion.

SOURCE: How the Internet of Things Market Will Grow, July 2016, Business Insider.

intelligence advances, machines will begin to consume data as well as produce it. Today, organizations use social media with sentiment monitoring to help product development and marketing. Tomorrow, machines will use insights produced by analytics to automate personalized contacts. In the amount of time it takes for a guest to go from the check-in desk to a room, the hotel can see if the guest is a loyalty member and turn on the room's TV with an invitation to join the program or a membership perk. Or taking this scenario a step further, depending on information collected on the guest and timing of the visit, the hotel can make recommendations about using the health and wellness facilities or dining in the restaurant.

Cloud's ability to collect, store, protect and process that much information, along with the ability to analyze and act on it, is what gives these components the potential to truly drive innovation, growth, performance and engagement.

Now What?

Taking full advantage of cloud technologies and applications requires an organization to keep pace with rapid-fire evolution in IT capabilities. Agility and flexibility are paramount as organizations seek different insights from collected data. Flexibility encompasses the scale of the analytics, the type of data a system can handle, and the frameworks used to process data; for example, is the output meant for humans or machines?

Cloud alone can supply the power necessary to make the most of the IoT and advanced analytics. Cloud service providers open the pathway to organizations of all sizes by taking on the costs of construction and maintenance, leaving it to each organization to find the best strategy and platform for migrating systems to the cloud where they can most benefit from the IoT.

Flexibility and agility are not typical attributes of traditional database management systems. While data warehouses are well-suited to collecting, storing, analyzing and churning out defined data sets in repeatable processes, the volume and velocity of data today calls for a different approach to drive innovation. The evolution of how data is collected, stored and used also requires a new mind-set around the veracity of data. Incomplete or inaccurate data sets will inform a new way of building systems to analyze and predict. The most effective systems will evolve from being serialized to being iterative, agile and parallel.

Executives that want to use IoT and advanced analytics to deliver differentiating value should focus first on revamping their organization's analytics data platform with these criteria in mind:

• Data warehouse versus data workbench. Warehouses are good for predictable, stable inputs and outputs. Workbenches provide more room for experimentation.

• Sort and organize data up front versus collecting it all and making sense of it later. Data warehouses need structured, curated, formatted data as input, while more unstructured approaches like data lakes (see below) accept data in any format, size and shape.

• One-size fits all versus customized approach by business line. Some areas of the business—finance, procurement, production—may depend on well-defined and organized data sets to ensure consistency and accuracy. Others—marketing, product development, recruiting and Human Resources—may be looking for a more dynamic approach.

With these considerations, organizations should be able to understand, rationalize and plan an analytics data platform that can meet the ongoing needs of the business while also setting the stage for innovation, growth, improved performance and increased engagement.

Data
Lakes

What?

A data lake is an enormous storage option that holds data in its raw, unstructured state and enables queries and analysis. The data is sorted and formatted and organized only as it is needed. It is the virtual version of the drawer most people have in their houses, the one where they throw things that do not have a convenient designated place but might be useful someday. In such a drawer, rubber bands co-exist with stray batteries, birthday candles, a flash light and the occasional take-out menu.

So What?

Having vast storage and the ability to collect and store data in a variety of formats removes the constraints of a traditional data warehouse. Rather than database managers organizing and formatting data as it is going in—and deciding what goes in based on storage capacity and perceived value—data lakes take it all. Information that you do not know how to use today can be retained long enough to see if it provides value later.

A huge storage repository where you can dump data as it comes in and make sense of it later sounds great, right? And it is. The wild card in the data lake deck is the veracity of the information. As database managers format and organize and store information, they ensure it is accurate and complete. Data lakes lack that eye toward integrity. Sensor data may be missing if parts of a system were down during collection. Social media streams may use different terms to refer to the same concept. The downside of unlimited, unsupervised storage is the same reason most people call that drawer in their house their junk drawer. It likely holds things that are great to have handy when you need them—like a flashlight in a power outage. But, it is just as likely that some of the rubber bands are old, some birthday candles broken, and the take-out menu out of date.

Organizations working with data lakes often create processes to help address data quality. Data lakes can be segmented into zones, which provide minimal processing and scrubbing of data as they come in, looking for holes, duplicates or outliers. If there are multiple sensors on a factory floor, and one reads that the ambient temperature is 200 degrees Fahrenheit, then the problem can be quickly pinpointed to the sensor rather than the environment.

Now What?

The effort to rationalize the data analytics platform applies to using data lakes as well. In organizations that are primarily dependent upon data warehouses, we sometimes see shadow analytics capabilities cropping up. Parts of the business that are not getting what they need from the sanctioned approach are finding their own solutions.

In short, a successful data lake environment would be built around three key aspects:

• **A shared vision**
Understand what various organizations need from analytics and work together to build the right environment that brings people out of the shadows.

• **Skills**
Pulling insights from data lakes requires a mind-set and skills that are different from the usual database manager. Data scientists bring critical thinking to understand what useful information might be drawn from the amorphous data pool and have the coding skills to extract it.

• **A new approach to governance**
The term governance typically implies limits and controls, but getting the most out of the treasure trove of data means being open to experimentation and innovation. Governance in the cloud-driven digital age means building data awareness and encouraging creativity within an environment of compliance.
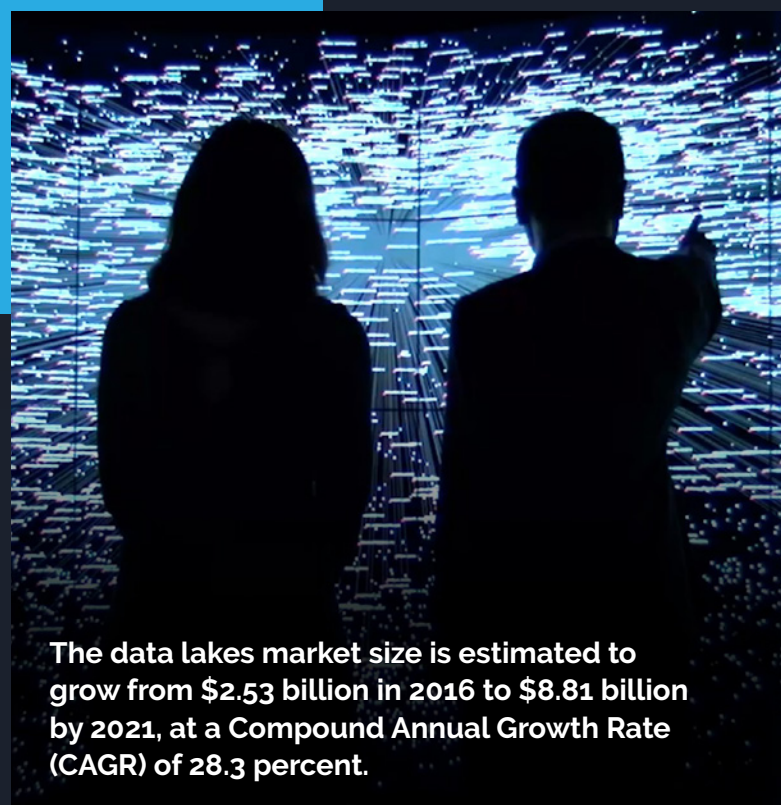
The data lakes market size is estimated to grow from $2.53 billion in 2016 to $8.81 billion by 2021, at a Compound Annual Growth Rate (CAGR) of 28.3 percent.

SOURCE: Data Lakes Market by Software, Business Functions, Service, Deployment, Organization Size, Vertical & Region Global Forecast to 2021, September 2016, MarketsandMarkets Research..

The move from data warehouses to data lakes—and from a highly controlled environment to one with less structure and more room for experimentation—mirrors the evolution many organizations are seeing with their IT departments and the roles they play. As technology drives innovation in all parts of an enterprise, CIOs are relinquishing control and working instead to provide a governance model and advisory services to ensure each business leader is getting what he or she needs from the available tools at hand.

Containers

What?

A container is an application and all its dependencies packaged into a single image. Because containers have the parts necessary to execute on their designated processes, they can be easily moved from one environment to another without any degradation in functionality. The operating system used in the image is extremely small and lightweight which yields two key benefits. First, it reduces the attack surface, making the container more secure than applications running on full operating systems. Second, it enables the containers to start quickly, which is critical when using them as a unit of deployment.

So What?

Being able to package applications and functions into discrete containers that can be moved among environments opens up possibilities for organizations seeking agility and speed.

Containers bring agility both in managing and upgrading IT environments. Because containers are easy and cheap to work with, an organization can scale up and shrink its infrastructure quickly and more often.

"Our industry does not respect tradition – it only respects innovation."

-Satya Nadella, CEO – Microsoft

More containers can be deployed to handle a surge, and then retired again to reduce ongoing costs. Containers bring agility to deployment as well, reducing the stress and cost of adding or improving systems features, and replacing or improving areas that are underperforming or ripe for improvement.

Containers also accelerate software development and innovation. Working in containers presents opportunities for parallel processing in both development and testing. Instead of testing code 1,000 times on one server, containers can simultaneously test on 1,000 servers at once. And, because of the discrete nature of containers, developers can tinker with and innovate small pieces of a system without compromising broad performance. Being able to improve one aspect and seamlessly plug it into the larger whole means that speed no longer comes at the expense of quality.

Containers are cheap and disposable, so it is viable to keep version 1.0 of an application in one container and build 1.5 in another, making it easier and faster to both move forward and roll back. Additionally, container orchestration tools, which help to deploy containers and can manage several within a group, are broadly available from cloud service providers. These tools enhance organizations' ability to access, connect and scale containers.

Now What?

Containers have been a hot topic for a while, and with good reason—they are cheap, transportable and easy to work with. They are great tools for application modernization, continuous integration, moving into cloud, or becoming cloud agnostic.

As with all the technologies discussed here, containers are no magic bullet. They deliver substantial benefits when used for the right things.

To get the most out of containers, an organization should:

• **Map out a strategy**

Moving enterprise resource planning (ERP) systems into containers almost never makes sense. Putting complex databases into containers is possible, but involves a high degree of difficulty. Looking at an organization's goals—and capabilities—is an essential first step toward containerization. This includes determining where the containers will be stored and how they will be managed. An IT team can store and manage containers both on-premises and in the cloud, and most cloud service providers offer a continuum of management options.

• **Start small and learn by doing**

Because containers are, by their nature, contained, experimenting and learning has few risks and many rewards. Learning to work with containers is straightforward, but it does require a shift in how one thinks about technical processes and architectures. Having a trusted partner who is well versed in containers often helps people move up the learning curve quickly. Learning to work with containers is an excellent opportunity for an organization to launch or enhance a DevOps approach. Containers bridge the natural chasm between developers and operations teams by providing all the information each needs to know in an easy-to-understand format.

• **Speed up**

Once a team understands containers and has a good idea of how to use them to an organization's advantage, containerization can move quickly. One financial services company took two weeks to put its first two applications into containers, but within three months, had repeated the process 5,000 times.

Getting the most out of containers is a little like riding a bike. Knowing the terrain being covered (road, trail or mountain), helps to find the right bike and ease the journey. With the right equipment and a strong comfort factors, business leaders can soon move quickly toward desired outcomes.

By 2020, more than 50 percent of global enterprises will be running containerized applications in production, up from less than 20 percent today.

SOURCE: Market Guide for Container Management Software, August 2017, Gartner.

Serverless
Computing

What?

Serverless computing involves breaking down applications into functions, and hosting and executing each function in the cloud. When triggered by a programmed event, a function will come online, execute to deliver a specific outcome, and then go off-line again. While containers hold everything needed to run all or part of an application, serverless computing breaks down the components even more into functions, which are placed directly into the cloud.

So What?

The big benefits of serverless computing are less maintenance and cost combined with scalability and speed to market. Even containers, which are less costly to host, are always "on" and taking up space and processing power. Serverless functions are only online as long as it takes to execute their functions, which means billing in seconds rather than hours and days.

Additionally, functions stored in the cloud can be replicated nearly instantly, making it possible to scale up capacity exponentially in seconds. A small company that runs a Super Bowl advertisement can handle a tenfold increase in traffic for an hour, and will only pay for the surge in usage, down to the micro-second. Standing up servers to handle that sort of instant blast would take months and a lot of up-front investment; even containers would take time to replicate and charge for the services regardless of being used to full capacity.

Finally, serverless enables an organization to reduce its infrastructure to nearly nothing. Once a function is deployed into the cloud, it is the cloud service provider's job to manage how, where and when the function is stored and executed.

Serverless removes barriers to innovation in ways similar to cloud overall, by lowering the cost and risk of experimentation. An organization—or even an individual—could quickly combine some existing APIs to create something new and test it out in the market to see if it sticks. If it does not stick, the application can be dismantled and the only cost to the innovator is the time and use of cloud services.

The downside of serverless is the discrete nature of the functions that compose the technology. Each function is programmed to act, but there is little visibility and integration across them. It can be difficult to understand who manages each function and even harder to get an end-to-end view of efficiency. Additionally, serverless functions can also be unpredictable in their start times, which IT is trying to solve by keeping them alive and active, so they can deliver sub-second response times.

Now What?

Serverless draws on the power of the cloud and benefits from the pricing models that cloud services providers have traditionally used. While some organizations are beginning to explore how this functionality may help them to innovate, grow, perform and engage, the frontier is still open.

• **Look for opportunities to use serverless**
Test out some smaller functions to get used to the pros and cons of working with this emerging technology.

• **Know your limitations**
Serverless is not always the best choice. Pick some functions to try in a serverless environment, acknowledge limits, and see what works best for the organization.

• **Drive infrastructure overhead to close to zero**
Not only are there efficiency gains, but also capital can be freed up to be spent elsewhere. And, business leaders will already be farther down the road where everyone is headed.

• **Get comfortable with your provider**
Serverless means committing to a cloud services provider. It lacks the transferability of containers, so any platform change would require a complete rebuilding of functions.

"One of the things that has come out of this serverless movement is the recognition that an event-based or trigger-based programming model is actually a very powerful model—one where I can get code activated very quickly and respond to it."

-Mark Russinovich, CTO - Microsoft Azure

The Function as a Service (FaaS) market size will grow exponentially 7x to 10x by 2021.

SOURCE: IBM Analysis, Serverless Conference, April 2017.

Where

Next?

The power and potential of the cloud today and into the future is undeniable.

Be
Cloud Driven

With unprecedented speed, scale and stability, cloud is fundamentally reshaping business and enterprise IT as we know it

Barriers to early cloud adoption are coming down. Executives once hesitated to embrace cloud because of security, cost, regulations and reliability. Service providers continually innovate to address those concerns. As a result, today's cloud is seen to be equal or better than on-premise infrastructure in terms of security and reliability and far better on cost.

Now, the biggest obstacle to full adoption of cloud is not just legacy systems, but legacy strategy, processes and organizations. The turf war between the business and IT on where innovation happens is rapidly shifting in favor of the business. Technology executives must stay relevant by shifting their roles from providing software, infrastructure and services to their organizations, to becoming more of a trusted advisor and liaison officer for leveraging the capabilities and capacity of the cloud and other technologies.

Within IT, the traditional line between developing and operating technology is blurring, especially as large aspects of both functions are moving into the cloud. DevOps pulls both the idea and the execution into the same stream, speeding up cycles of innovation, enabling a quick change of course and creating opportunities for continuous improvement, even to applications that are out in the world.

As IT leaders adjust to new ways of working within their own teams and with their peers across their organizations, the migration to the cloud must continue at an accelerated pace—and must be managed in a way that the result is effective and integrated. Life cycle management providers, such as Neudesic, bring all stakeholders into the process to reduce chaos and deliver more value than individually migrated workloads tend to generate.

Be
Cloud Smart

For some time, we have been talking about technology driving business strategy, rather than just enabling it. More than any other innovation—with the notable exception of mobile computing—cloud is unlocking opportunities for both new and established businesses that few could have imagined just a short while ago.

- Opportunities to invest in the ambitions and vast competitive opportunities of the enterprise.
- Opportunities to launch or expand businesses quickly, and change them just as fast.
- Opportunities to become part of a digital ecosystem that provides new or complementary goods and services to penetrate markets.
- Opportunities to drive exponential performance gains.
- Opportunities to engage with customers, suppliers and employees on a whole different level.

With all this promise, everyone is focused on building their cloud strategies. Successful organizations will not start with a cloud strategy, but with a business strategy with cloud at its core. Any business strategy should include how to use cloud solutions—infrastructure, software, platforms—that help advance an organization's ambitions and strategy profitably. All other activities in the cloud are merely distractions.

1. Plan for all cloud and no humans

We are heading toward an era where organizations will not need either on-premise IT infrastructure or people to build and maintain it. Start moving in that direction now with plans for moving all applications and services into the cloud, as well as focusing on automating processes, wherever possible. It might prove to be too costly at first, but even incremental changes will steer the organization toward increased growth and better performance.

2. Look to IT for the art of the possible

As the day-to-day operations of IT move aggressively toward cloud and automation, technology-minded people within the organization should be at the forefront of figuring out what is next in terms of the business opportunity that next-generation technology can bring.

3. Invite outside perspectives

It is unlikely that any IT team will have a full view of the technology and innovation landscape. Partnering with an organization that has fresh ideas and practices can stretch an IT team's thinking and spark both incremental and big advances.

4. Dare to innovate

Re-focus creative technical minds within an R&D culture, fueled by innovation opportunities, blue-sky thinking and agile methods. Some organizations are creating startups within their own walls, freeing teams from constraints to see how they might leapfrog current processes.

Be
Cloud Strong

As executives try to find their footing in the Fourth Industrial Revolution, one of the era's main voices, Klaus Schwab, expresses concern that, "Decision makers are too often caught in traditional, linear and non-disruptive thinking or too absorbed by immediate concerns to think strategically about the forces of disruption and innovation shaping our future."

Cloud—and the endless technologies and applications that it enables—is without doubt a major force of disruption and innovation. But, embracing cloud and the disruption it brings does not require an organization to throw itself into chaos in an effort to transform all at once. Innovative and strategic thinking can help any organization achieve its bold vision, as long as it takes the time to find that vision and commits to moving it forward.

Focusing on how cloud can enhance an organization's ability to innovate, grow, perform and engage, will help organizations actively evolve rather than abruptly transform. There are plenty of opportunities to move toward a strong cloud future while advancing the immediate needs of the business. Ultimately, the difference is not the destination, but rather the journey that is taken to arrive there.

"If you are running cloud at scale, that means you are powering the data platforms that will transform many industries. Will there be an economic opportunity there? I absolutely think it will be big."

-Sundar Pichai, CEO – Google

Technology Vision
Authors

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Tim Marshall is Neudesic's Chief Operating Officer and Chief Technology Officer responsible for leading the company's business operations, client engagement teams, and technology leadership teams. In his role, Tim guides the business in defining and executing its business strategy, ensuring successful engagement with our customers and developing Neudesic's technical capabilities to meet the future needs of our clients.

Tim's wealth of experience in different technologies, along with his extensive expertise across a wide breadth of vertical markets, enables him to assist organizations in making proper technical decisions that help them achieve their visions. His ability to synthesize business and technology concepts into executable action has been leveraged my numerous organizations since he co-founded Neudesic in 2002 and he is regular presenter at industry conferences.

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As Vice President of the Digital Innovation Group, Jason drives the daily innovation pipeline that fuels Neudesic's client solutions and successes. He leads a team of technology experts, dedicated to digital enterprise transformation through trending technologies including collaboration, integration, cloud, data and analytics.

Jason has spent over twenty years helping medium-sized businesses and Fortune 500 enterprises build and manage complex, mission critical digital platforms that advance collaboration through knowledge and management applications. In addition to his Vice President role, Jason also leads product development for Neudesic's Firm Directory and Pulse products.

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