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Software Engineering

Becoming a Software-Centric Business: Best Path Forward in an Uncertain Post-COVID-19 World

Innovating in a post-pandemic world will pose new challenges — from unpredictable shifts in customer behavior to development teams that work from home by necessity or choice. Adapting quickly to new risks and opportunities requires a modern infrastructure and application architecture, new processes and a culture that rewards experimentation.

Executive Summary

Software is today's engine of business. For customers, software is the way they engage with your company — to place orders, request service, apply for loans, view account status, troubleshoot their Wi-Fi access points, and more. If the preeminence of the mobile application wasn't clear before, overwhelmed call centers during the COVID-19 pandemic drove home the point. For the workforce, software delivers the information, analytics and automation needed to dynamically adapt to unpredictable changes — like the onslaught of market disruptions and anxious consumer behaviors due to the viral 9 outbreak and resultant preventive measures.

In short, the pandemic fast-tracked the need for every company across virtually every industry to become software-centric. How well the company can deliver quality software and software products that address real needs — and master virtual teams that can work from anywhere — will have a direct effect on revenue, costs and customer satisfaction.

To learn what leading companies expect from software engineering, progress to date and barriers, in mid-2019 we surveyed 2,628 business and technology leaders in North America, Western Europe and across the Asia-Pacific region. (See Methodology, page 18.)

The study reveals a disconnect between leaders' beliefs — that modern software delivery can make or break the business — and their actions to date. Nearly all respondents (94%) acknowledge that software engineering is important or critical to their company's future. The value they expect includes cost savings of 25% or more (89% of respondents), revenue increases of 3% or more (96% of respondents), at least 45% faster time to market (72% of respondents) and at least a 6% boost to customer satisfaction (96% of respondents).

And yet progress has been slow. While 80% of respondents have begun adopting a digital engineering strategy, only 8% have crossed over to production. Top barriers are lack of budget (cited by 82% of respondents) and "poor perception of the business impact of software engineering" (37%).

Becoming a software-driven business doesn't happen in one go — it's a journey. Companies that adopt the technology, processes and culture to anticipate new customer needs and quickly adapt to unforeseen risks lead the way.

This white paper offers concrete recommendations for overcoming both barriers by converting software engineering from a cost center to a catalyst for competitive advantage. Recommendations are organized in four sections:

▌ **Rethinking the technology foundation:** Agility in an uncertain world requires accelerating the transition to the cloud and modernizing applications to take advantage of cloud scale, automation and elasticity.

▌ **Adopting a software product engineering mindset:** Months-long release cycles are nonstarters when consumer desires and business needs can do an about-face in an instant. Agile methodology accelerates the cadence of innovation to days — even hours or minutes. A focus on customer and business outcomes from the earliest stages of product planning, what we call *"outcome engineering,"* helps make sure the product meets real customer needs.

▌ **Reshaping the software delivery organization:** The new working unit is the pod – an autonomous team, typically with six to eight members that collectively have all the skills needed to design and develop a prototype, conduct user testing and deploy the solution.

▌ **Fostering a culture that rewards experimentation:** Every experiment is a success, whether it proves or disproves a hypothesis. Each experiment uncovers new risks and new opportunities.

Becoming a software-driven business doesn't happen in one go — it's a journey. Companies that adopt the technology, processes and culture to anticipate new customer needs and quickly adapt to unforeseen risks lead the way. Those stuck in reactive mode, with months-long development cycles, will fall ever further behind.
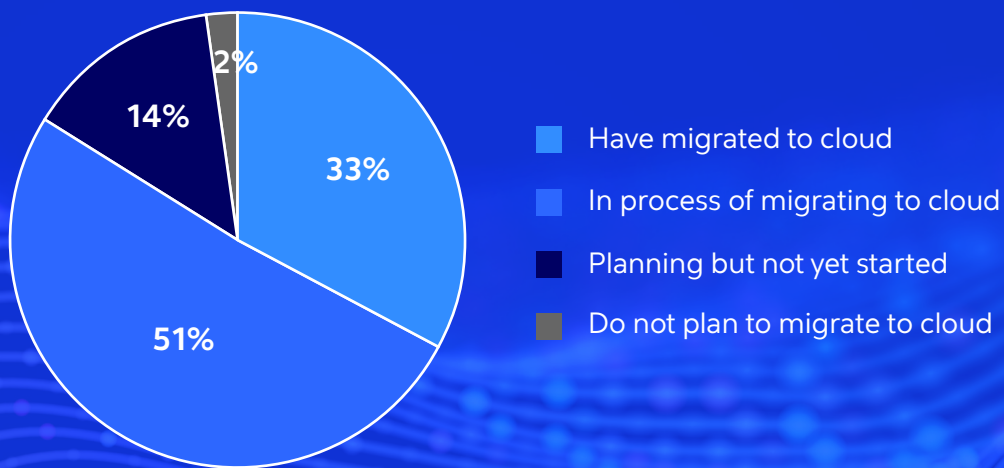
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Rethink the technology foundation

Customer needs and the technology to address them are in a constant state of change. Underscoring how fast emerging technologies can become mainstream, many respondents reported using natural language processing (59%), augmented reality (56%) and biometrics (41%).

Accelerating the pace of innovation requires transitioning from on-premise infrastructure and monolithic applications to hybrid clouds and container-based applications. Social distancing will also require more automation to enable virtual data centers and self-healing networks.

Hybrid clouds — create the "elastic enterprise"

Cloud migration remains a work in progress for our survey respondents. Only 33% have completed cloud migration, while 51% are somewhere on the journey (see Figure 1).

Migration of apps from legacy architecture to cloud-based architecture

- Have migrated to cloud
- In process of migrating to cloud
- Planning but not yet started
- Do not plan to migrate to cloud

Note: Percentages do not sum to 100% due to rounding.
Response base: 2,628 executives
Source: Cognizant
Figure 1

Quick Take

Freight leader quickly adapts to changing market conditions

Challenge: A leading transportation company recognized that it needed a more agile business model to keep up with massive changes taking place in the freight shipping market.

But, its aging and inflexible set of applications development methods made business agility nearly impossible. Moving to the cloud would increase operational efficiency and enable the company to quickly build appealing applications and software products for shippers and truckers.

Solution: We worked with the company to build a modern cloud platform and introduce Agile methodology. More than 400 developers working in pods of six to eight people built microservices-based modules for order management, pricing, rating, assets and yards, and more.

Outcomes:

❚ 80% more electronic orders accepted automatically.

❚ 40% more carrier payments processed automatically.

❚ Up to 10 days of advance visibility for account representatives, improving supply chain collaboration.

Applications can be moved to the cloud gradually. For early results, we recommend starting with heavily used applications experiencing variable demand over the day; cloud services enable organizations to add or remove resources in step with demand, paying only for what is needed. (See Quick Take on the preceding page. For more insight on how to automate the scaling of cloud resources, read "Keeping the Lights on During the Pandemic.")

If the public cloud is farther away from your users than your data centers, reduce application latency by caching frequently accessed content on internal servers. Edge caching works best with content that doesn't change often, such as product and pricing information for an e-commerce application, documentation, and profile data for customers who use the application daily. (Learn more by reading "Social Distancing Investments Made Now Will Continue Reaping Benefits Later.")

Modern application architecture: take full advantage of cloud scale, elasticity and automation

The pandemic introduced new consumer consumption behavior, including more online interactions, more interactions outside normal hours and more video consumption. Some of these behaviors will fade over time, but most will endure and new ones will doubtless arise. Companies that wait for the return of pre-pandemic market behavior and business norms may wait themselves right out of business.

Simply "lifting and shifting" applications to the cloud provides limited value to the business. Taking full advantage of cloud scale, elasticity and automation requires modernizing the application architecture. Cloud-native applications take far less time to update than legacy applications because they are built from self-contained components (microservices or containers) — often one per feature — that communicate via application programming interfaces (APIs). As needs evolve, developers can add components and APIs without changing what's already there. (To learn more, read "Using Containers to More Effectively Manage DevOps Continuous Integration.")

Application transformation rarely requires a full rewrite. Typically it's more practical and cost-effective to reshape the existing legacy monolithic applications into a cloud-native form. (See Quick Take, page 8.) When we measured the impact of a microservices-based architecture for a large insurance client in Canada, downtime decreased from 10% to nearly zero, application management overhead shrank 25% and infrastructure costs dropped 30%.

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Quick Take

Cloud-native card payment platform adapts easily to new payment methods and standards

Challenge: A multinational financial services company envisioned a fully digital payments network. The old mainframe application had reached capacity and made it very difficult to add country-specific features.

Solution: We started with three virtual pods, including members in the U.S. and India, and scaled to 14 pods. The cloud-native payment platform approves or denies transactions quickly — in part because microservices communicate with each other seamlessly.

Outcomes:

▎ Better customer experience: Payments are approved in less than one-tenth the time it takes to blink.

▎ Faster pace of innovation: With microservices, the company can quickly introduce country-specific features and support for new payment methods.

▎ New revenue source: Our client can now offer value-added services for merchants: analytics for targeted marketing campaigns and other decisions.

2 Adopt a product engineering mindset

Shift your team's focus from developing software *applications* to developing software *products*. This transition is not trivial. It requires a mind shift from building functions to serving customer needs. Embracing the new mindset requires Agile methodology, DevSecOps practices, automation and a focus on outcomes.

Agile and DevSecOps: accelerate delivery

Companies release working code in a fraction of the time needed with Waterfall development by using Agile methodology and DevSecOps practices such as continuous integration and continuous delivery (CI/CD). Be sure to loop in customers right from the beginning — in the ideation phase. It's generally accepted that 20% of defects stem from problems capturing business requirements.[1] In our experience, the figure is closer to 30%.

Continue soliciting customer feedback throughout the development process, using it to improve each successive iteration of the product.

Automation: reduce costs and free developers from repetitive work
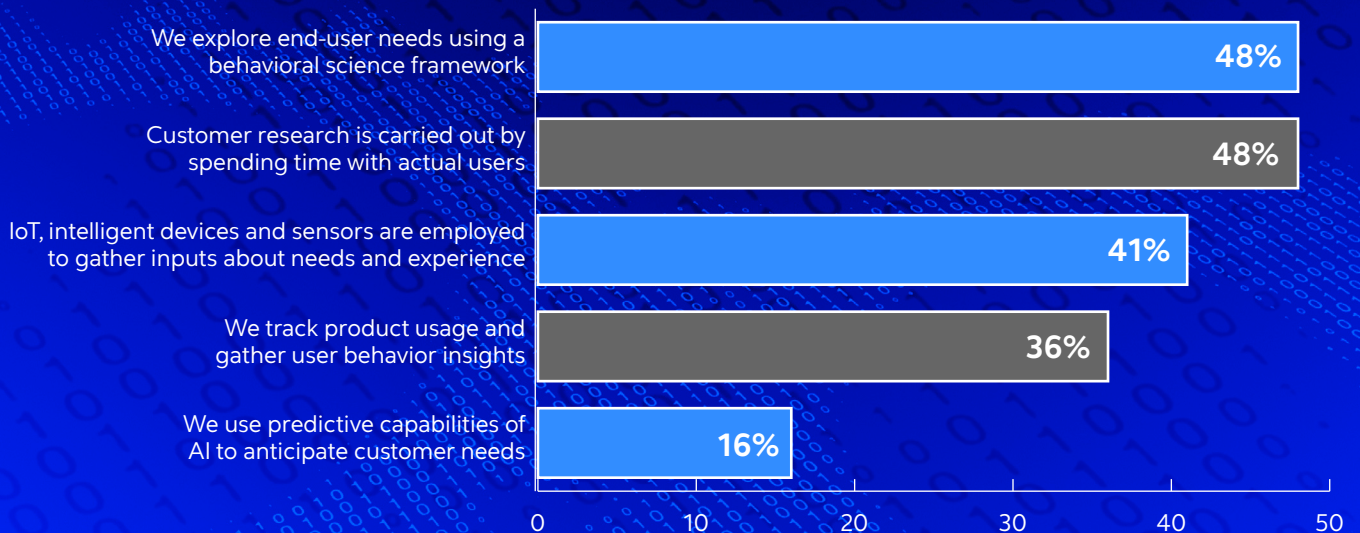
In our study, 96% of companies had automated software development to some extent, and 94% had automated testing. In our practice we've also seen good results from using application portfolio mapping tools to assess performance, usage and business impact of all applications. Insights about feature usage, for example, are useful for deciding which features to retain and which to switch off. Rationalizing the feature set simplifies and improves the user experience, increases the overall value of the product and often reduces costs.

Outcome engineering: keep the focus on the customer

Human-centric design means starting each product idea by understanding the market, customer or consumer needs, frustrations, goals and behavior — and coming back to them continuously throughout the development cycle. In our survey, 61% of respondents said they had significantly embraced human-centric design and design thinking, citing a variety of approaches. The top approaches are behavioral science, analyzing big data to model consumer interactions and buying patterns (48%); field research, observing of customers in their environment (48%); and tracking product usage via internet-connected sensors (41%). Fewer respondents (16%) use predictive artificial intelligence (AI) to anticipate the consumer's next action based on previous behavior patterns.

Approaches to understanding customer needs

We explore end-user needs using a behavioral science framework	48%
Customer research is carried out by spending time with actual users	48%
IoT, intelligent devices and sensors are employed to gather inputs about needs and experience	41%
We track product usage and gather user behavior insights	36%
We use predictive capabilities of AI to anticipate customer needs	16%

Note: Only selected items shown.
Response base: 2,628 executives
Source: Cognizant
Figure 2

3 Reshape the software delivery organization into virtual pods

Handoffs between siloed design, engineering and QA teams prolong release cycles. We recommend organizing team members in pods — small, cross-functional, agile teams that keep the customer at the center of the development process. These teams perform all the tasks needed to successfully complete a given project and deliver a specific product or solution.

In our practice we source pod talent from communities of people around the world with a specific skill set — for example, product managers, user experience designers, full-stack engineers, architects, quality engineers, machine learning specialists and voice interface specialists. Pods can work in physical locations such as design and delivery studios — or, by necessity or choice, from home. "Virtual pods," born of necessity during the pandemic lockdown, enable companies to source talent from anywhere (see Figure 3).

Virtual pod composition
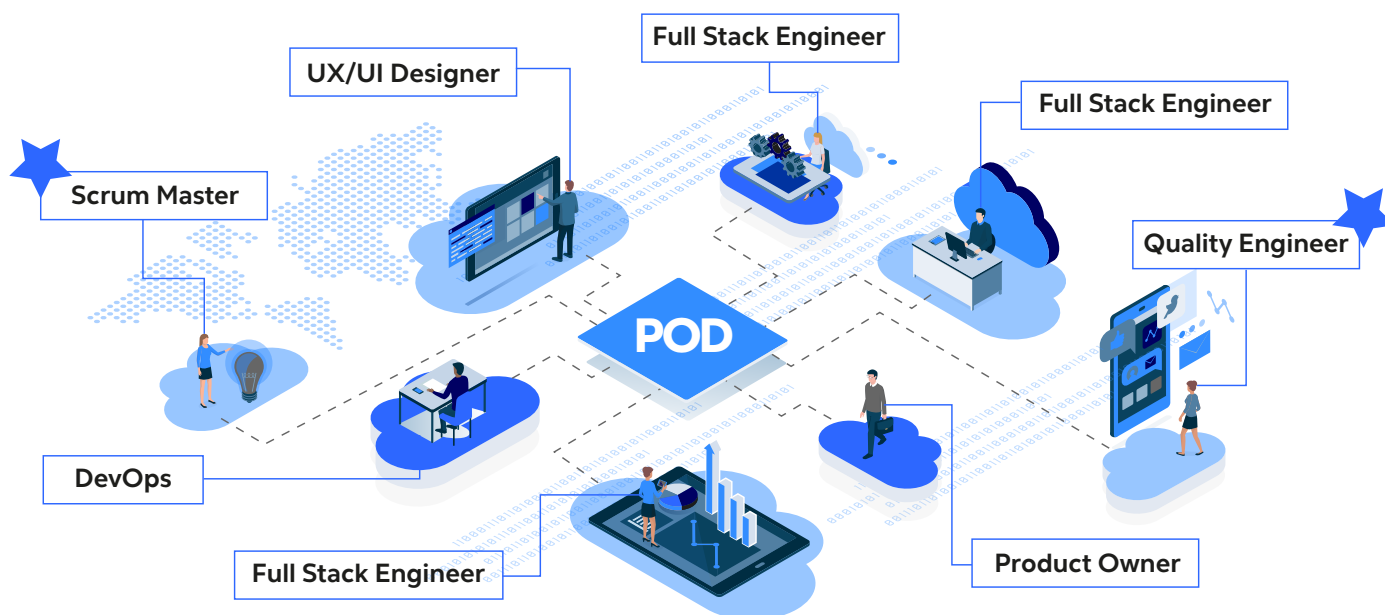
Source: Cognizant
Figure 3

In a post-pandemic world, where virtual product engineering is the norm, pod members need tools and culture to collaborate virtually for ideation, prototyping, coding and testing. Virtual pods also require a supportive culture, including:

▮ **Community:** Community-building ideas include scheduled "lunch and learn" sessions and online coffee breaks. An outlet for socializing is important for morale and spontaneous learning from colleagues. To keep projects on track, consider a morning stand-up call and end-of-day retrospective call for all pod members.

▮ **Communication:** Teams need videoconferencing software, "presence" apps for finding an available expert in a particular discipline and a whiteboarding solution for ideation.

▮ **Focus on business impact:** Evaluate individuals and pods on how well their products improve key performance indicators (KPIs) and meet business needs. Metrics might include traffic, time to market, click-throughs, customer retention, revenue, cost savings, and the like. Keep in mind that measuring business impact of the first release is challenging when there is no "before" metric. In this situation, capture baseline metrics and measure improvements with the second release, ideally delivered within weeks of the first.

New approaches to talent acquisition: hiring, continuous learning and cocreation with partners

Modernizing software for outcome engineering requires talent in full-stack engineering, data science, cloud-native architectures and Agile methodologies. Demand outstrips supply, with 49% of respondents ranking lack of talent among the five top stumbling blocks to modern software engineering.

To acquire and retain top talent, consider these approaches:

▮ **Widen the net.** Search for talent where people hang out (e.g., hackathons).

▮ **Offer robust continuous learning opportunities.** Surprisingly, only 30% of survey respondents provided training in house to fill the talent gap.

▮ **Advocate for corporate social responsibility (CSR).** This is especially important to millennials and Generation Z.[2]

▮ **Establish and cultivate communities for all aspects of software product development.** Don't overlook research, tools development and innovation.

▮ **Build relationships with partners that offer a deep bench of talent to supplement your own.** Partners can provide access to scarce skills that are hard to hire or build internally, providing some or all pod members. (See Quick Take on next page.)

In our survey, 95% of respondents work with a solution provider or system integrator on their transition to application transformation.

Quick Take

Intrado expects to free up $13 million annually through cloud adoption

Challenge: Intrado (formerly West Corp) builds the software that powers services sold by communications services providers, such as 911 calling, videoconferencing, call center operations and messaging. More than 200 legacy applications used different platforms, languages and middleware. Most applications depended on multiple other applications, so deploying new code took up to 12 months.

Solution: We migrated the entire application portfolio to Pivotal Cloud Foundry — a platform as a service (PaaS) solution that can be deployed on multiple public clouds. More than 60 Pivotal specialists worked in pods, first identifying application interdependencies and then transforming applications into reusable microservices.

Outcomes:

❙ $13 million annual savings — money that can be reallocated to innovation.

❙ On-demand deployment of new code, down from eight hours previously.

❙ Faster time to market: new releases take one person-day, down from five person-years previously.
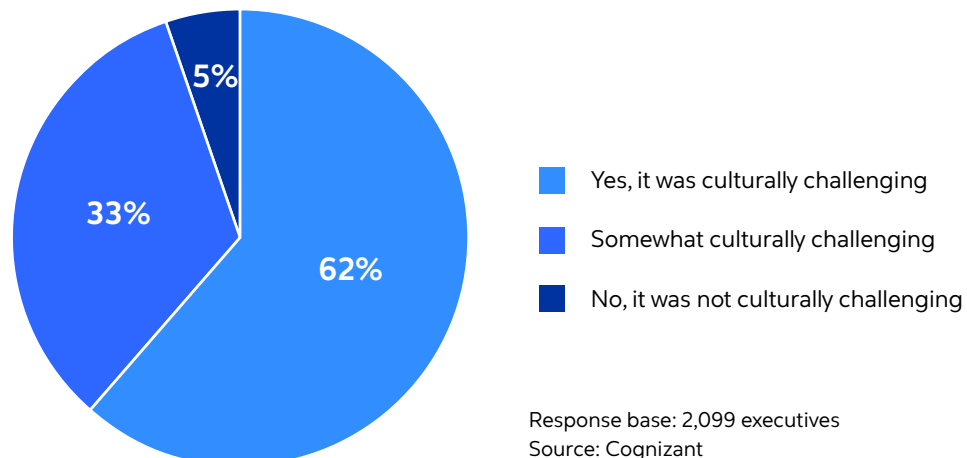
Read more *here.*

4

Culture: The key to long-term success

Culture can make or break software development. Notably, 95% of respondents say that the transition to modern software engineering is culturally challenging (see Figure 4).

To foster a culture that rewards innovation, focus on three areas:

▌ **Team structure and collaboration:** Build an operational structure that makes team collaboration the norm. (See Quick Take, page 16.) We see good results from paired programming. Another approach is to simply make two team members responsible for the same or related tasks and have them collaborate. (For more, see "Seven Changes That Will Shift Your Software Development Approach for the Better.")

▌ **Talent acquisition and retention:** Specifically, reward based on merit, not tenure. The transformation to a simpler, cloud-native architecture can help eliminate dependence on the few people who understand complex monolithic applications built years (or decades) ago. Provide opportunities for people to develop skills.

▌ **A "fail-fast, learn-fast" mindset:** Encourage experimentation and treat failed experiments as learning opportunities. (For more, see "Understanding How to Fail: The Essential Ingredient of Radical Innovation.") Reward and celebrate individuals and teams that improve products and processes. We suggest measuring team performance based not on lines of code, but on velocity, quality, product impact (traffic, click-throughs, revenue, etc.) and autonomy (the extent to which the team meets goals without management interference). This comprehensive view of performance shapes work behavior and drives cultural change.

Business leaders see cultural transformation as a challenge

- Yes, it was culturally challenging
- Somewhat culturally challenging
- No, it was not culturally challenging

Response base: 2,099 executives
Source: Cognizant
Figure 4

Cultivating a software-centric culture increases the visibility of the software engineering organization and its value to the business. As noted earlier, 37% of survey respondents ranked "poor perception of the business impact of software engineering" as a top obstacle to implementation. Outcome engineering — that is, clearly linking software products to KPIs like revenue and costs — gives senior leaders a clear picture of the central role of software in the business. This can have the effect of loosening up the purse strings for more budget, called out by 82% of respondents as an impediment to continued progress.

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Quick Take

Water utility modernizes customer experience — and culture

Challenge: Severn Trent Water, a UK water utility, wanted to modernize its applications to deliver a superior customer experience.

Solution: We worked with the utility to introduce Agile methodologies, tools and culture. Pods included experts in DevOps and automation. We introduced new incentives to reward team performance, and we ran walk-in clinics, Agile meetings open to all staff and brown-bag lunch sessions. These programs brought people together and helped them become comfortable with Agile culture.

Outcomes:

l   300% faster application release cycle — from 12 weeks to four weeks.

l   20% more time available for innovation.

l   88% of employees agreed the new culture improved collaboration and communication.

l   40% increase in first-time-right ratio.

Read more *here.*

Looking ahead: Prepare to be nimble in uncertain times — and never stop

Recognize that becoming a software-centric business is an ongoing process that requires significant change. Where to begin?

For quick wins, start by modernizing legacy applications. By moving them to the cloud you can retire on-premise infrastructure, freeing funds for innovation. And making software products easier to adapt to changing consumer expectations provides a competitive edge.

Organize designers, engineers and QA specialists in agile pods with full responsibility for a feature or set of features, speeding time to market. Embed a product manager in each pod whose responsibility is to solicit customer feedback throughout the process — so what you deliver is what customers want.

As the plan progresses, find the right pace to reshape software engineering — not so fast that it disrupts operations, not so slow that the business succumbs to more nimble, cloud-native competitors. Start with discrete projects and products that have measurable business impact rather than back-office or "safe" projects. Then build on their success to introduce the new thinking and processes across the organization.

Above all, cultivate the mindset that innovation and transformation are not one-time events but continuous processes. Unpredictable events happen all of the time. Transformation efforts need to be ongoing so the business gets ever better at anticipating change in customer behaviors and wants — always innovating to stay one step ahead.

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Endnotes

[1]   Capers Jones, "The Mess of Software Metrics," Vol. 9.0, March 8, 2017, www.ppi-int.com/wp-content/uploads/2018/02/The-Mess-of-Software-Metrics_Jones-C_2017.pdf.

[2]   Jennifer Robison, "Millennials Worry About the Environment: Should Your Company?" Gallup, May 29, 2019.

Methodology

We surveyed 2,628 business and technology leaders across North America, Europe and Asia-Pac in mid 2019 to understand their thinking around software engineering, both building cloud-native applications and transforming legacy environments, to operate in the modern digital world. Survey respondents included primarily C-suite executives and vice presidents (60%), and directors and senior managers (40%) across the following industries: banking and financial services; insurance; retail and consumer goods; and media, entertainment, communications and technology.
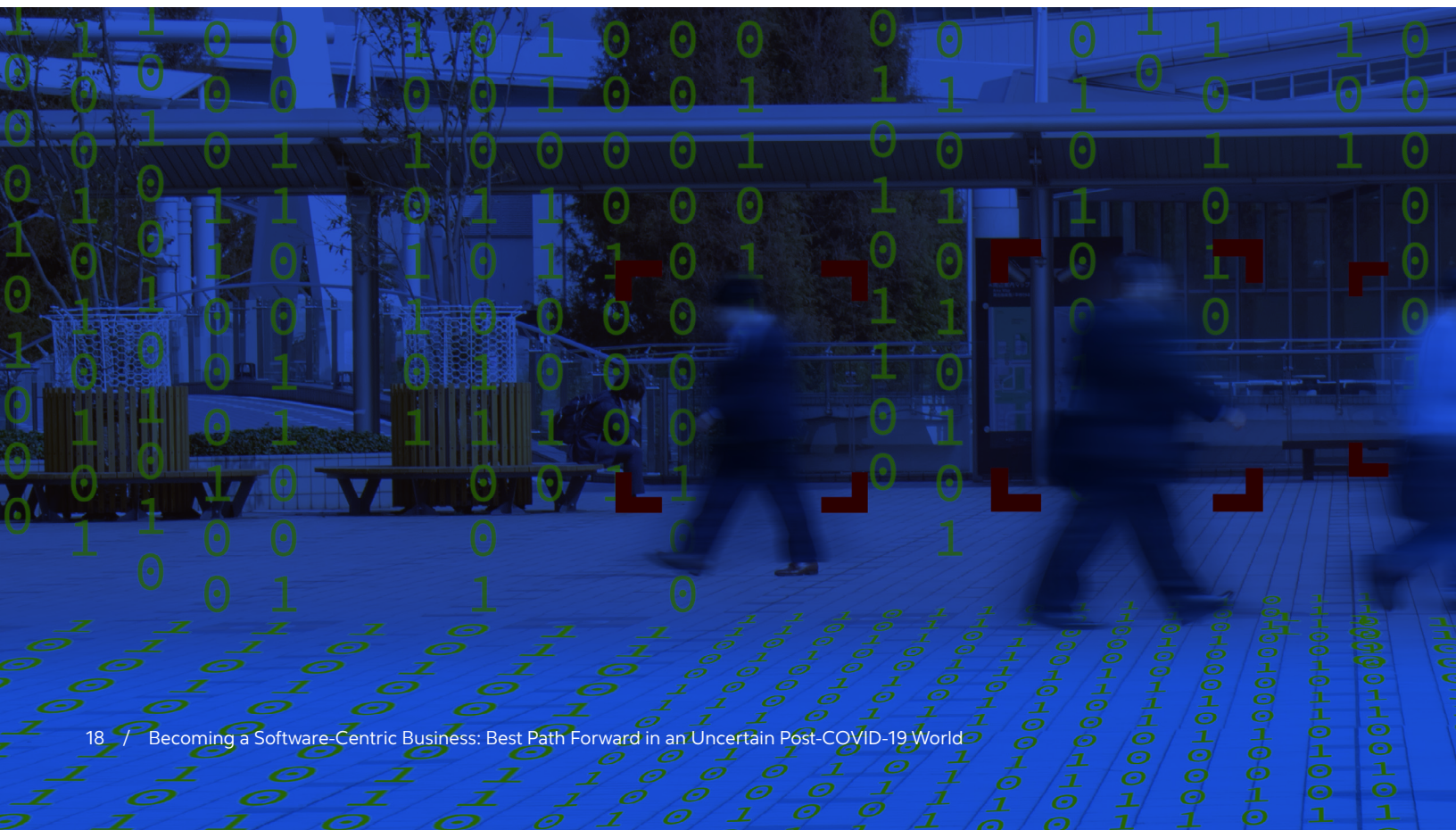
About the author

Allen Shaheen

Executive Vice President, Digital Engineering, Cognizant

Allen Shaheen is an Executive Vice President responsible for Cognizant's Digital Engineering practice. He is also a founding board member of the Cognizant U.S. Foundation, a nonprofit organization established to expand the STEM workforce in the U. S. by providing grants to non-profit organizations that deliver education and skills programs, and other initiatives designed for high school graduates, women, military veterans and other communities seeking specialized technical skills for digital technology jobs. Previously, he led Cognizant's mergers and acquisitions strategy, and was Global Markets Leader for a number of other Cognizant groups including the Advanced Solutions Group, Enterprise Applications Solutions, and Quality Assurance and Engineering Practices. Allen can be reached at Allen.Shaheen@cognizant.com | linkedin.com/in/allen-shaheen-a52101.

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Cognizant

World Headquarters

500 Frank W. Burr Blvd.
Teaneck, NJ 07666 USA
Phone: +1 201 801 0233
Fax: +1 201 801 0243
Toll Free: +1 888 937 3277

European Headquarters

1 Kingdom Street
Paddington Central
London W2 6BD England
Phone: +44 (0) 20 7297 7600
Fax: +44 (0) 20 7121 0102

India Operations Headquarters

#5/535 Old Mahabalipuram Road
Okkiyam Pettai, Thoraipakkam
Chennai, 600 096 India
Phone: +91 (0) 44 4209 6000
Fax: +91 (0) 44 4209 6060

APAC Headquarters

1 Changi Business Park Crescent,
Plaza 8@CBP # 07-04/05/06,
Tower A, Singapore 486025
Phone: + 65 6812 4051
Fax: + 65 6324 4051