Automation Drives The I&O Industrial Revolution

Vision: The Infrastructure Transformation Playbook

by Glenn O'Donnell and Chris Gardner

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Why Read This Report

A digital business needs technology that adapts and scales quickly, reliably, and economically. As infrastructure and operations (I&O) professionals transform their infrastructure to meet this need, they must adopt new tools and skills to handle the transition of everything to software. Automation is at the heart of this, with a rich industrial history and a bold new approach to technology operations. In this report, we lay out the vision for a winning automation strategy for I&O leaders.

Key Takeaways

"Snowflakes" And Command-Line Access Are Among Automation's Biggest Impediments

If your environment is full of custom snowflake configurations, you'll never be able to automate anything. And I&O pros who fat-finger commands at the command line can cause huge damage in highly automated environments, so I&O leaders should remove access from nearly everyone.

Everything Is Software, Which Means The I&O Pro Of 2030 Looks Like A Developer

Software has eaten the world of infrastructure. Software-defined everything includes cloud, hyperconvergence, and composable systems. To master this amorphous mixture, everyone in I&O must learn to write code and define systems as reliable, easy-to-refine models.

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Vision: The Infrastructure Transformation Playbook

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Infrastructure Has Matured, Fueled By Abstraction And Automation

The seemingly immovable technology silos that have frustrated I&O leaders for years are finally crumbling, as infrastructure technology suppliers have succeeded in abstracting much of the low-level complexity away through package design. And not a moment too soon, because as end customers' expectations accelerate, anything that isn't simplified via abstraction and automated simply can't keep up (see Figure 1). Here's what abstraction, simplification, and automation have done for us in the past decade (see Figure 2):

- **Virtualization kicked off the abstraction trend.** VMware undeniably catalyzed a broad movement to virtualize commodity hardware almost two decades ago. Global decision makers predict that 55% of their computing workloads will sit atop some form of virtual server infrastructure by the end of 2019.[1] Virtual machines are well understood and are the default for legacy applications.
- **Cloud computing represented the next big abstraction step.** Building on virtualization, public cloud services fueled the next big wave of abstraction. A hybrid model unifying public cloud with various on-premises technologies is settling in now. For example, in 2015, General Electric (GE) said it would move all apps save its "secret sauce" to Amazon Web Services (AWS).[2] In 2017, GE Healthcare announced it would run key healthcare apps in Rackspace's remotely managed private cloud. At the heart of this new hybrid is a rich array of management software that's morphing at a blistering pace. Inherent automation makes it all work.
- **Converged infrastructure matured into hyperconverged systems.** Converged infrastructure system products developed slowly until vBlock appeared in 2009.[3] Soon after, so-called hyperconverged systems appeared from innovators such as Nutanix; Pivot3; and SimpliVity, now part of Hewett Packard Enterprise (HPE).[4] In 2017, every major infrastructure vendor is shipping hyperconverged systems, which are becoming the go-to platform for on-premises production.
- **Infrastructure-as-code (IaC), including containers, has become the new foundation.** Because your infrastructure is now mostly software, you need to treat it as application developers treat their applications — the systems administrators (sysadmins) of yore are now software developers.[5] Emerging, composable infrastructure solutions like HPE's Synergy represent an advanced IaC concept that brings the concepts down to the bare-metal level.[6] Expect other vendors to follow soon. Containers (e.g., Docker and Kubernetes) currently garner much of the IaC attention.
- **Serverless computing has become the ultimate abstraction.** "NoOps" solutions such as Amazon Lambda and Azure Functions abstract the server away until it no longer "exists." This is a misnomer, of course — the underlying infrastructure very much exists. Compute requests queue, process, and delete themselves inside of Agile infrastructure. Automation manages the workflow.

FIGURE 1 The Increase In Complexity Over Time Necessitates Automation

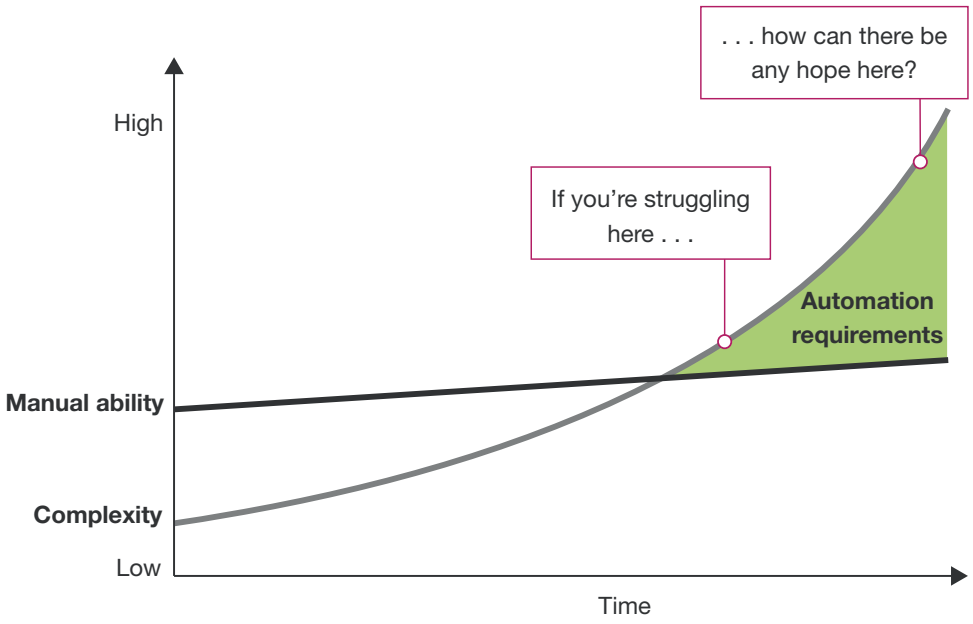
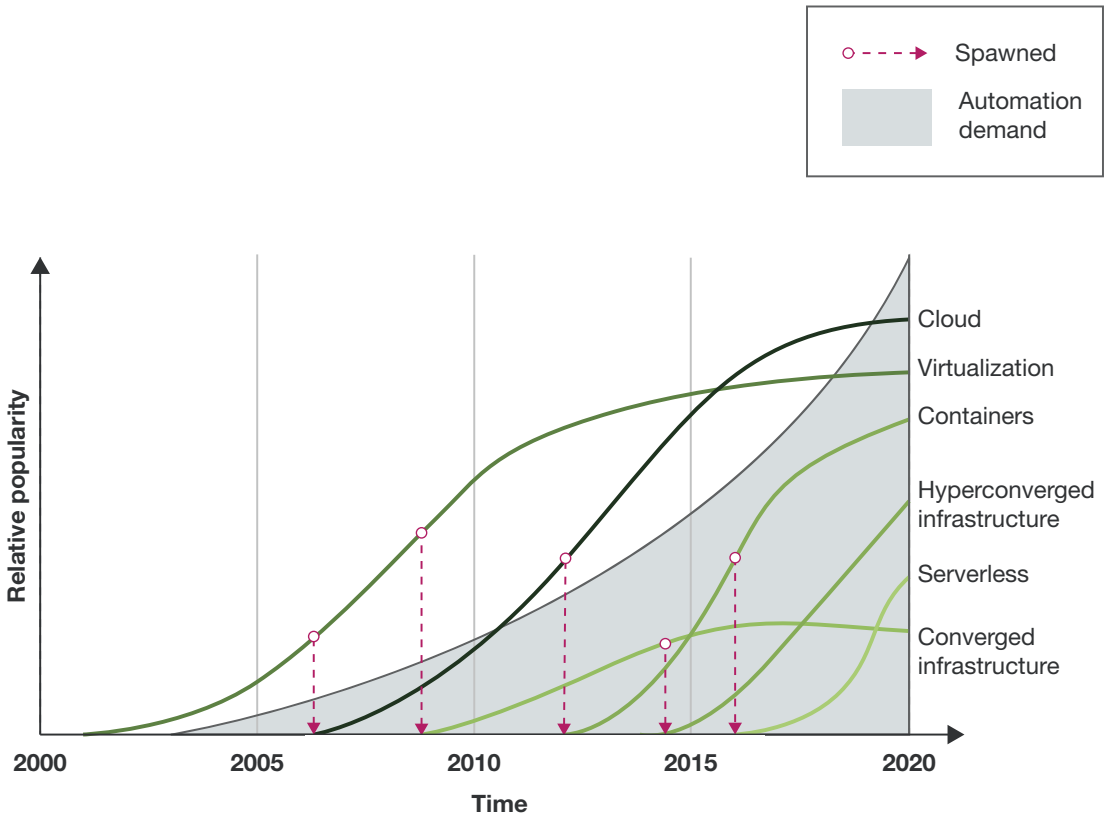


FIGURE 2 Technology Abstractions Build Upon Other Abstractions, Accelerating Automation Demand



Institutional Behavior Remains A Big Roadblock

The technology to achieve highly automated systems is here. Cloud providers and leading firms like Disney and Nordstrom have proven that automation works.[7] Here's what's holding you back:

- **Institutional inertia is powerful.** You need the right people to lead your automation revolution, but a corporate culture that discourages risk will crush them. Your leaders must actively encourage people to take risks, reward them for successful ones, and treat failures as education, not punishable offenses. When Forrester asked a CIO at a large retailer about automation, he said: "I have the right people and tools already. My main job here is to create an environment where they can flourish. Right now, we do not have that."
- **Experience of failed change creates change-aversion.** Acceptance or rejection of change is at the heart of culture. Many technologists embrace change — for example, 38% of the respondents to Forrester's 2017 global developer survey ranked changing their company's business model a critical or high priority — but their companies' processes, policies, and culture can discourage innovation as "too risky."[8]

Automation Is The Heart Of The Infrastructure Revolution

In 2017, only 31% of global infrastructure decision makers identified automation as a critical or high priority, but big changes are coming in 2018: 51% are implementing or plan to implement automation software over the next 12 months, while another 20% plan to grow their implementation.[9] To succeed with automation, I&O teams need strong but flexible processes, good governance, standards, partners, and new skills.

Avoid The "Fool With A Tool" Traps

Automation merely accelerates the execution of whatever it is you do. If you apply automation to a good process, you produce excellent outcomes faster. If you apply that same automation to a bad process, you court disaster. (Remember: "To err is human. To really foul up takes a computer.")[10] Here's how to steer clear of tool-driven foolishness:

- **Refine processes and *then* seek tools.** Needs drive tools, not vice versa. I&O professionals have had this rule backward for years, despite constant preaching by thought leaders everywhere. Bring fresh thinking to the decision process, and never start a tool discussion with tools — start with the functions they must perform. Then, and only then, should you evaluate options.
- **Follow sound development practices to prevent mass-produced errors.** IaC tools define configurations in software. As you write this code, you create a template that will replicate hundreds or thousands of times at the click of a button. In fact, 51% of app developers spend time daily writing some automation code, and increasing the automation of the software development life cycle (SDLC) is among their top priorities.[11] App development and infrastructure development are converging because it's all code in the end.
- **Change your change management.** A natural reaction to past errors is to impose stricter controls on your change management process. This is precisely why traditional IT change management has proven so ineffective. Change management must follow sensible guidelines, but overly rigid rules will apply the brakes to processes that are already too slow for customers.[12]
- **Find vendors that want to partner with you, and do your own tool integration.** Follow the lead of an infrastructure leader at a major financial media company, who told us, "We're looking for automation vendors invested in being partners with customers now, instead of simply vendors." Why? Because for the next three years, you'll still need many tools, and they won't integrate nearly as well as you want them to. This integration is one reason that IaC requires sysadmins to write code. Only I&O teams can own this critical function, which has become one of the skills in highest demand in the age of automation.
- **Continually and relentlessly tweak governance.** Widely implemented automation tools like Red Hat's Ansible and VMware's vRealize Automation have great power, and I&O pros must wield that power responsibly. Limit command-line access to automated systems to very few people;

delegate control to the automation tools instead. Tailor tools to ensure that guardrails are in place to prevent accidental misconfiguration — whether manual or mass-produced. Test, measure, and optimize frequently.

Don't Automate Snowflakes: Instead, Adopt Standard Configurations

It's best to apply automation to repeatable processes, such as manufacturing ball bearings and provisioning containers. These tasks are well defined, with known parameters and clear desired results. You can automate repetitive tasks at an astounding rate with amazing consistency; that was the true "revolution" in the Industrial Revolution of the 18th century. Custom configurations — so-called snowflakes — are all different and thus extremely difficult to automate. Abandon snowflakes and adopt standards that I&O teams can automate easily.

- **Configuration management is the base level of avoiding snowflakes.** This class of automation tools is cursed with an awful name but has important and extremely useful capabilities. Although the term is commonly associated with companies rooted in open source software — like Chef and Puppet — the landscape is getting crowded, with entrants like Ruder and Salt.[13] These tools form the foundation for much of what you'll do with infrastructure automation.
- **Continuous delivery release automation (CDRA) is the next level of maturity.** Tools in this class drive greater development and operations (DevOps) maturity, allowing you to deeply tie infrastructure rollouts to deployment workflows for application releases. Systems from CA Technologies, Electric Cloud, IBM, and XebiaLabs simplify modeling, deployment, and analytics.[14] Many of these rely on configuration management tools under the hood to ensure consistency.
- **Design automation is an ideal that still eludes us — for now.** In a perfect world, we'd use tools to help us design technology services, like the CAD tools that engineers use to design cars, aircraft, semiconductors, and skyscrapers. Because old-school IT favored artisanal tinkering more than genuine engineering, demand for CAD-like tools was low. Thus, very few of these tools exist today, although you can see precursors in network engineering tools like OPNET (now part of Riverbed) and Packet Design. Demand is now increasing to address the complexity that otherwise gets out of control. By early 2019, Forrester predicts that vendors like Microsoft and VMware will simplify these tools and enjoy great popularity.

Plan To Handle The Limits Of Automation

Automation is imperfect, of course. The 2009 crash of Air France flight 447 from Rio de Janeiro to Paris is an extreme case — but a valuable lesson — of the perils of blind faith in sense-and-adapt automation.[15] To protect your business from such consequences:

- **Adopt modular design of your infrastructure, services, and automation.** A major reason for the fragility of many technology services is that disparate systems are often too tightly coupled. Modular design isolates failure. Because APIs and other integrations are limited, the failure affects only a

small component. Good microservice design will plan for failures within the domain of expected outcomes.[16] NGINX has proven popular for modular application design and is now proving useful for software-defined infrastructure at companies like education innovator Learnosity.[17]

- **Pair sense-and-adapt automation with advanced analytics to detect failures quickly.** Most automation still involves a human trigger — to request a cloud resource, for example, or to fail over to a disaster recovery instance. As your automation evolves, sense-and-adapt automation will become more prominent. As your automation matures, use chatbots like Jira and Service Now to combine human intellect with automated actions.[18]
- **Make changes in small, frequent increments.** Traditional change and release management gathered large collections of changes to implement together during a fixed change window. Again, borrowing from Agile and DevOps, make small changes frequently, and don't wait for windows of opportunity. Great organizations make several changes per day — during peak business hours. For example, at Etsy, every new developer pushes code into production on her first day on the job.[19] If something fails, tools allow immediate restoration to the prior state.[20]
- **Build feedback into your automation.** The last thing you want to do is fire off some unproven automation technology and forget about it. You want to observe its actions and results. Use this feedback to improve the system, including the analytics when it's relevant. Make this data available to anyone with a need to know. You'll never finish evolving your infrastructure and its automation — each iteration is new and will always need feedback.

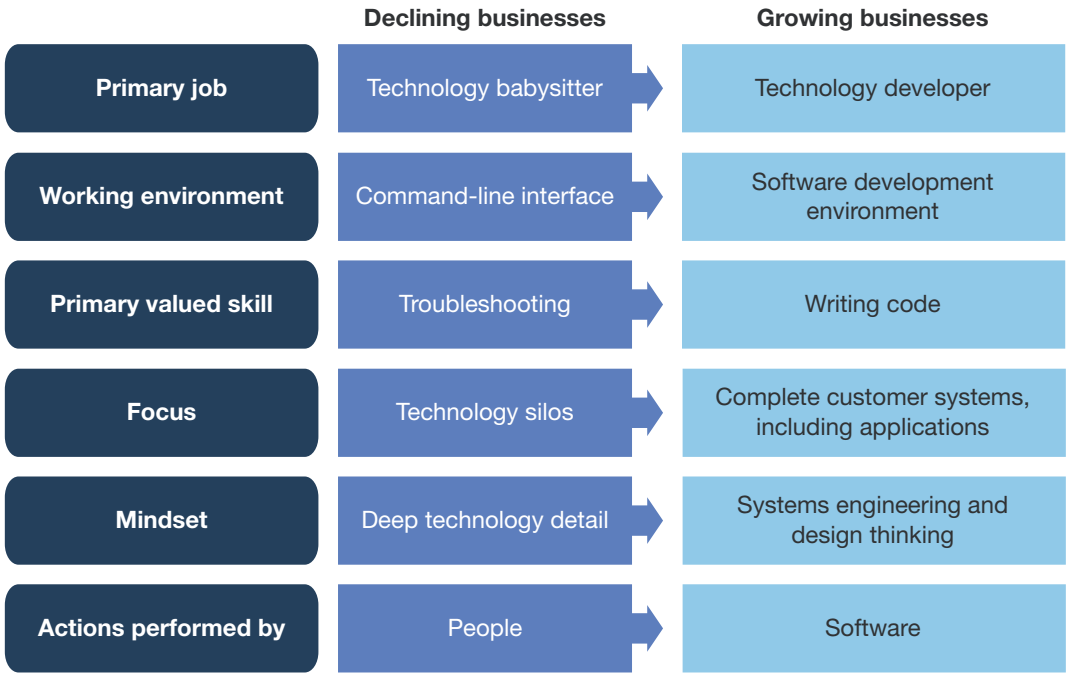
Approach Automation Aggressively And Pragmatically

I&O leaders must move quickly and carefully to pursue automation in these seven ways:

1. **Spread DevOps practices through the whole company.** DevOps may have started with Agile, but it's much more than automation for application development.[21] DevOps embraces velocity; cooperation; continuous testing; and small, frequent changes, and those attributes are critical for every organization that wants to deliver for customers.
2. **Unlock your team's true potential.** Humans are best at creative tasks like architecture and design — and their brains are expensive. Successful technologists now write code, understand cloud architecture and orchestration, and navigate an increasingly complex and dynamic ecosystem of suppliers (see Figure 3). Without the right people driving your new infrastructure program, all other aspects of the transformation will fail. As a leader at a large insurance company told us, "We'd rather teach our existing employees about automation and development than spend the time and effort hiring new staff."

3. **Design a different architecture for speed, scalability, and dependability.** The new way of building systems encompasses microservices, APIs to all flavors of infrastructure, and automation built into it all. Cloud giants like Alibaba and Google don't distinguish much difference between applications and infrastructure, nor should you. Your customers need infrastructure that scales transparently, dependably, and at high speed, just like well-written applications.
4. **Integrate multiple flavors of cloud with on-premises technology.** No enterprise uses just one cloud. You'll be faced with many public cloud services — some of which you don't even know you're using — as well as a cornucopia of on-premises technologies. I&O teams must manage this variety of building blocks and assemble them as needed.
5. **Embrace new economics that challenge established accounting practices.** Cloud-like economics based on actual real-time consumption are now creeping into all technology options, even for on-premises infrastructure from the likes of HPE and IBM. For example, on-premises data storage is now available from ClearSky Data and Dell EMC, with pricing models based on capacity used, not capacity on the floor.[22] Accountants are struggling to deal with this trend, as are many technology leaders and vendors, but it's inevitable. This new economic model is in its infancy, but I&O leaders' demand for this flexibility is so high that it will become mainstream by mid-2018.
6. **Stop "babysitting" your infrastructure.** Much of what infrastructure administrators do amounts to little more than babysitting their technology — keeping a watchful eye over systems under their care and responding heroically when something goes awry. If your infrastructure requires babysitters, you're losing the war for customers. Let automation do the babysitting. The command-line interface (CLI) is the natural habitat for obsolete practices, so get rid of CLI access for almost everyone. Even the intensely automated cloud leaders make these mistakes — rarely, but when they do, they garner media headlines.[23]
7. **Dramatically reduce manual security and compliance operations.** Reactive approaches to security and compliance are now obsolete. Invest in automation that proactively addresses security needs and locks down data using a Zero Trust mindset, such as Bromium vSentry and VMware NSX. Shift your security and compliance talent to use automation and AI tools to manage increasing requirements and comply with new and existing regulations.

FIGURE 3 The Current Industrial Revolution Wave Is Forcing Technologists To Adapt



What It Means

Burn The Boats: Automation Is Here To Stay

The I&O revolution is massive and irreversible. It's already changing the entire tech industry as we know it — and automation is the catalyst. The people, skills, and mindset you need for the next decade are dramatically different than those that "traditional IT" required. Two of the starkest realities are these:

1. **One-third of today's I&O pros will exit.** I&O staff will break down into one of three groups. A third will be passionate advocates for change and will happily develop and automate themselves into new and better jobs. A third will wait and see — they'll watch the first third to ensure that this group is successful before transforming themselves. And the final third won't make it. Some of these people won't be able to learn the skills required; others will refuse to change. Either way, you'll need to replace them.
2. **Pure NoOps won't happen — but the ops professional of 2030 will look a lot like a dev.** While many I&O professionals wring their hands over the idea that operations may someday become so automated that no one will need them, Forrester believes that this is still years away. Even in a fully automated "serverless" environment, someone must manage resources,

model configurations, and optimize the IaC. The ops professional of tomorrow will essentially be a specialized developer, focusing on the core I&O attributes of reliability, redundancy, and resiliency. You can see precursors to this in the site reliability engineering teams at born-digital companies like Google and Netflix.

Supplemental Material

Survey Methodology

The Forrester Data Global Business Technographics® Developer Survey, 2017 was fielded in February 2017. This online survey included 2,062 respondents in Australia, Brazil, Canada, China, France, Germany, India, New Zealand, the UK, and the US. Forrester Data's Business Technographics ensures that the final survey population contains only those with significant involvement in the planning, funding, and purchasing of business and technology products and services. Research Now fielded this survey on behalf of Forrester. Survey respondent incentives include points redeemable for gift certificates.

The Forrester Data Global Business Technographics Infrastructure Survey, 2017, was fielded in July and August 2017. This online survey included 3,923 respondents in Australia, Brazil, Canada, China, France, Germany, India, New Zealand, the UK, and the US from companies with two or more employees. Forrester Data's Business Technographics ensures that the final survey population contains only those with significant involvement in the planning, funding, and purchasing of business and technology products and services. Research Now fielded this survey on behalf of Forrester. Survey respondent incentives include points redeemable for gift certificates.

Please note that the brand questions included in this survey should not be used to measure market share. The purpose of Forrester Data's Business Technographics brand questions is to show usage of a brand by a specific target audience at one point in time.

Endnotes

[1] Source: Forrester Data Global Business Technographics Infrastructure Survey, 2017.

[2] Source: "AWS Case Study: General Electric," Amazon Web Services (https://aws.amazon.com/solutions/case-studies/general-electric/).

For more coverage of GE's cloud strategy, see the Forrester report "OpenStack Fights To Defend Its Claim As A Standard."

[3] Acadia launched in 2009 as a joint venture among Cisco Systems, EMC, and VMware. It soon changed its name to VCE and is now Dell EMC's Converged Platforms & Solutions division. It shipped the first widely successful converged systems, called vBlock (now VxBlock). Source: "Dell EMC VxBlock Systems," Dell EMC (https://www.dellemc.com/en-us/converged-infrastructure/converged-systems.htm#collapse=).

[4] For an examination of hyperconverged architecture as well as a market breakdown, see the Forrester report "Simplify And Accelerate Your Infrastructure With Hyperconvergence" and see the Forrester report "The Forrester Wave™: Hyperconverged Infrastructure (HCI), Q3 2016."

[5] For help on preparing to transform your infrastructure development and operations to leverage infrastructure-as-code, see the Forrester report "How A Sysadmin Becomes A Developer."

[6] Composable infrastructure technologies are very new, but they hold promise for true infrastructure-as-code. One conclusion is clear: Old-school methods won't work. You need to evolve your organization significantly, a recommendation repeated throughout Forrester's I&O research. For more information on composable infrastructure and how to prepare for it, see the Forrester report "Reform Legacy Operations For Composable Infrastructure."

[7] Jason Cox, The Walt Disney Company's director of systems engineering, has spoken frequently about the media giant's innovation around automation. Source: Jennifer Riggins, "Digital Magic: Disney's DevOps Transformation," The New Stack, June 27, 2017 (https://thenewstack.io/magic-behind-disney-devops-experience/). Retailer Nordstrom undertook a similar revolution, as Courtney Kissler, then vice president of digital and store technologies, presented at the first DevOps Enterprise conference in 2014. Source: "DOES14 - Courtney Kissler - Nordstrom - Transforming to a Culture of Continuous Improvement," YouTube video, October 29, 2014 (https://www.youtube.com/watch?v=0ZAcsrZBSlo).

[8] Source: Forrester Data Global Business Technographics Developer Survey, 2017.

[9] Source: Forrester Data Global Business Technographics Infrastructure Survey, 2017.

[10] The true origin of this widely quoted maxim is unknown. Source: "To Err is Human; To Really Foul Things Up Requires a Computer," Quote Investigator, December 7, 2010 (https://quoteinvestigator.com/2010/12/07/foul-computer/).

[11] Increased automation of SDLC tasks is a critical or high priority for 28% of application developers. This is just behind using more cloud-based development environments and adding or improving customer experience measurements, which are tied for first place, with 30% identifying each as a critical or high priority. Source: Forrester Data Global Business Technographics Developer Survey, 2017.

[12] For some very useful guidance on practical — not draconian — change management, see the Forrester report "Change Management: Let's Get Back To Basics."

[13] For an examination of the leading collection of configuration management products that now power much infrastructure automation across all forms of technology organizations, see the Forrester report "The Forrester Wave™: Configuration Management Software For Infrastructure Automation, Q4 2017."

[14] For an in-depth review of all these tools, see the Forrester report "The Forrester Wave™: Continuous Delivery And Release Automation, Q3 2017."

[15] The Harvard Business Review published an excellent article on lessons learned from the Air France flight 447 crash regarding the consequences of automation. Source: Nick Oliver, Thomas Calvard, and Kristina Potocnik, "The Tragic Crash of Flight AF447 Shows the Unlikely but Catastrophic Consequences of Automation," Harvard Business Review, September 15, 2017 (https://hbr.org/2017/09/the-tragic-crash-of-flight-af447-shows-the-unlikely-but-catastrophic-consequences-of-automation).

[16] I&O professionals can and should apply microservice design methodologies to IaC design. See the Forrester report "Designing Microservice Apps For Containers And Cloud Platforms."

[17] Alan Garfield, director of infrastructure at Learnosity, leveraged NGINX as a modular infrastructure platform with good results. Source: Micheál Heffernan, "Infrastructure As Code: Successfully Scaling To New Heights," Learnosity blog, August 30, 2017 (https://blog.learnosity.com/2017/08/infrastructure-code-scaling-new-heights/).

[18] To understand the impact of chatbots on DevOps, see the Forrester report "Cracking The Collaboration Conundrum: Accelerate Customer Focus With ChatOps."

[19] Source: Jennifer Davis and Katherine Daniels, Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, O'Reilly Media, 2016.

[20] To understand the rapidly evolving nature of enterprise configuration management, see the Forrester report "Refine Configuration Management And CMDB For The Modern Digital Organization."

[21] For an explanation of how DevOps philosophies, processes, and technologies are spanning well beyond the original application development domain of DevOps, see the Forrester report "DevOps: The CIO's Guide To Velocity."

[22] For an explanation on how storage vendors are embracing these pricing models for customers that want them — and more now do — see the Forrester report "Embrace Cloud Economics For On-Premises Enterprise Storage."

[23] Even the highly dependable and heavily automated Amazon S3 service fell victim to a CLI error that rippled throughout the AWS ecosystem on February 28, 2017. Source: "Summary of the Amazon S3 Service Disruption in the Northern Virginia (US-EAST-1) Region," AWS press release, February 28, 2017 (https://aws.amazon.com/message/41926/).

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