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upSkilling 2021

Enterprise DevOps Skills Report

Third Annual Report on DevOps Skills:

Human Readiness Must Take on New Importance

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Foreward

Jayne Groll
Co-Founder and CEO,
DevOps Institute

Human transformation is essential for digital transformation. This fact has never been more apparent than in this past pandemic-stricken year when global organizations had to shift their business models drastically with little to no notice. Some enterprises pivoted to a remote environment well; some did not. Sadly, some are no longer in business. The key differentiator seems to be the efficient flow of people, process, and automation, resulting in a positive culture in difficult times. Enterprise IT professionals are indeed the unsung heroes of 2020.

For the third year, DevOps Institute has proudly fielded the Upskilling DevOps Skills Survey to understand which skills are considered "must-have," "nice-to-have," and "optional." The pandemic has given this year's report even more significance by reinforcing the need to invest in and update our humans with the same enthusiasm as we do our automation.

We are grateful to the over 2,000 global respondents who took the time to complete the Upskilling survey this year. This is data from the trenches. Some of the results may surprise you, some may be disappointing, and some may reinforce your strategic plans for 2021. Regardless, our sincere hope is that this year's Upskilling 2021: Enterprise DevOps Skills Report is a catalyst for action by both the enterprise and the individual. Like it or not, the pandemic pushed global workforce development several years forward into a "next normal" that will require an army of skilled IT talent to succeed.

Wishing you all good health, prosperity, and success as we move ahead in the next decade.

Jayne Groll, CEO, DevOps Institute

About Us

DevOps Institute, a professional member association for advancing the human elements of DevOps, conducted the third-annual Upskilling DevOps Skills survey between August and December 2020. The survey invited individuals from a broad range of industries in the global software development and delivery community. Two thousand sixty-nine survey responses were collected, analyzed, and prepared into this summary report by DevOps Institute.

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ADVANCING THE HUMANS OF DEVOPS

Top Takeaways

Here is what we discovered:

1 **DevOps teams stay the same or keep expanding even during the pandemic:** We wanted to understand what impact the pandemic had on the current DevOps teams. 38% of our survey respondents said that their DevOps team(s) stayed the same while 23% said that they expanded the DevOps team(s). We can conclude that DevOps teams are critical to ongoing IT and business operations.

2 **Building DevOps teams from internal resources.** When asked "Which statement reflects the relative thinking relative to the hiring of DevOps team members?" almost half of the respondents (49%) first look internally. If there is no qualified individual, they look externally. Also 25% prefer to hire internally and then opt to train the individual. The existing skill gap in IT and specifically in DevOps is a great opportunity for advancement for individuals inside IT organizations today and in the future.

3 **Building a learning culture:** 70% of our respondents told us that building a learning culture was one of the top DevOps ways of working. Continuous learning is a fundamental and important principle. The building of a learning culture can only happen if there is a no-blaming or shaming on problems and if problems are made visible so that everyone can learn and profit from the problems, solutions and knowledge.

4 **Upskilling program development.** However, development of DevOps upskilling programs has not accelerated since last year. Individuals are neither excited nor disappointed about their companies' upskilling programs.

5 **The must-have skill domains have slightly shifted.** While in our previous years' research we saw the ranking of importance around key skill domains was led by: 1. process skills and knowledge, 2. automation skills and 3. human skills. The pandemic puts automation (which is defined as the replacing of manual processes, tasks, or events) atop the upskilling agenda with human skills as ranked second and technical skills as ranked third. This is not a surprise as COVID-19 creates a strong incentive to minimize the risk inherent to manual tasks and processes by automating them. The shift to remote work implies more workflow automation with the business and within IT.

6 **The human skill development is essential.** Collaboration, problem solving, sharing, knowledge transfer and communication skills are essential but interpersonal skills, flexibility and adaptability, and empathy are key in the next normal. No matter what role or job one has, last year has demanded an incredible amount of flexibility, adaptability and empathy that will play a critical role in the new normal.

7 **The DevOps team is a multi-disciplined empowered team.** The word DevOps could be misleading as it seems to suggest that it is only addressing Development and Operations. When looking at the top five functional skills important for a DevOps team, we see IT Operations, Infrastructure, Security, Application Development & Design and Architecture are the prevalent functions to be part of a multi-disciplinary empowered team.

8 **From project to product thinking.** Our probing for strategic, product or customer experience skills has shown that our survey participants value product thinking, business understanding and strategic thinking. We believe that this represents a priority shift to find DevOps individuals who are product thinkers paired with business understanding to deliver customer value. As shown in the 2020 State of DevOps Report, a product mindset is key to scaling and evolving DevOps[1].

9 **No one framework or best practice model prevails.** The adoption of a mix of frameworks and best practice models such as Agile, DevOps, ITIL or Lean continues. DevOps is augmented with additional best practices and frameworks such as Site Reliability Engineering (SRE), Value Stream Management (VSM), DevSecOps, DataOps and ModelOps. This specialization will continue to create new specialized areas of best practices to address ongoing challenges and technology innovations.

10 **The DevOps Leader must be able to empower and influence others.** When looking for what leadership skills a DevOps human must possess, we found that 68% of respondents indicate that a DevOps leader must be skilled in empowering and developing others and be able to go beyond one's self to help the group. 60% of respondents are looking for an influencing leader capable of taking others' perspective into account, getting people to change their minds and acting in a way that acknowledges others' opinions.

Executive Summary

SECTION ONE

The Pandemic Has Changed Everything

- The transformation to digital business was accelerated in 2020 by the worldwide pandemic, which changed the speed at which digital services were made available.
- According to McKinsey, companies moved 20 to 25 times faster than they thought possible before the pandemic
- Reasons for this are digital is now a priority, barriers were removed and technical issues could not be used as an excuse
- IT teams gained trust and visibility from the business as business valued their performance during COVID-19

SECTION TWO

The DevOps Evolution Continues Strong

The adoption of DevOps stays strong with 36% at the project level and 20% across the entire enterprise. The key trends influencing DevOps at large.

- DevOps shifting left
- Security is integral; welcome to DevSecOps
- Cloud models such as PaaS, IaaS require intelligent automation
- Pressure continues to force old IT operating models to change
- Artificial Intelligence and Machine Learning are adding value
- New models such as DataOps and ModelOps are showing up
- Value Stream Management keeps rising in importance
- SRE continues its adoption journey

Four key challenges which hamper DevOps evolution within your organization

- DevOps must involve all members of IT and the business
- Multiple frameworks together shouldn't stop the progress
- The thinking of DevOps can just be implemented

SECTION THREE

Capabilities and Skill Development Must Go Hand-in-Hand

- Assessing your DevOps capabilities is the first step
- Upskilling according to the needed capabilities should be on your personal and organizational roadmap
- The top 5 must-have skills are automation, human skills, technical skills, working in a multi-disciplined team, and leveraging best practices and existing frameworks for speed and quality improvements
- You own your skill-building journey, but let your leadership owns the initiation of upskilling so that the organization shifts towards learning

SECTION FOUR

How to Shape Your Future Towards an E-Shaped DevOps Human Depends on a Variety of Factors

- Learning is not passive but active
- Take responsibility for your journey into the future

SECTION FIVE

Additional Details from Our Survey

SECTION ONE

Respondent Demographics

The 3rd annual survey collected responses from a diverse set of organization sizes, geographic locations, roles, and DevOps evolution experience.

Survey representation of 26% respondents were from North America, 22% from India, 16% from EMEA, 8% from Latin America and 31% from the rest of the world. The percentage of organizations reported as having more than 1,000 people was 43%. There is a good balance between development and operations. 30% of respondents came from management and 52% from practitioners across various IT functions. While 54% of survey respondents claimed to be in the beginning stage of their DevOps evolution, with less than 2 years of DevOps experience, 31% indicated that they are advanced DevOps individuals with 3 to 5 years DevOps experience. For additional details on demographics, see the end of the report.

How the Pandemic Changed Everything

Any transformation implies a strategy change with the goal to bring an organization from where it is to where it wants to be. Transformation difficulties depend on the degree of change required and may involve efforts at all levels from C-level, leadership, and individual contributors. The transformation to digital business was accelerated in 2020 by the worldwide pandemic, which changed the speed at which digital services were made available. According to McKinsey's study in July 2020, 899 C-level and senior executives reported that they moved 20 to 25 times faster than they thought possible on implementing online purchasing/services for their customers[2].

The cause of such acceleration is clear within key areas. For example, the pandemic required organizations to prioritize remote work for employees. Businesses also needed to connect with their customers digitally, online. Organizations had stalled the development and adoption of digital services before the crisis. McKinsey found three key reasons why digital services were not introduced earlier:

- **Not a business priority:** When asking executives and leaders across IT and business functions what their organizations' priorities were before the pandemic, one got a plethora of priority statements. What changed in 2020 at the onset of the pandemic was that key priorities, such as transitioning to digital services, became essential for ongoing business operations and gained priority. Organizations had to create digital services almost overnight to cope with the business demands. Key activities consistent with the priorities of keeping employees, customers, and partners safe while continuing operations and service revenues had to be pursued while other activities had been tossed. Resource allocation and funding happened immediately.

- **Organizational issues and barriers have been circumvented:** The required changes towards digital services represented too big of a shock for the established ways of working before the pandemic. Existing budgeting processes, resource allocation and approval processes that translate priorities into activities had to respond to the new situation quickly. Different ways of operating were needed, including how to utilize organizations' resources such as people, money, and time. All had to be short-circuited. Activities that kept the business's delivery of its priorities alive were essential.

- **Technical issues are always a good excuse:** In many IT enterprises, technical debt, legacy or insufficient IT infrastructures, tight budgets for resources, shortage of skills, and people caused transformation challenges. Additionally, existing organizational silos impeded commitment to and execution of required and necessary changes to run, grow or transform the business. With the immediate need to shift the workforce to work from home, collaboration technologies, security capabilities and cloud platforms became essential to support this changed working model.

There is Some Good News Despite the COVID-19 Crisis

The pandemic has touched many aspects of many organizations worldwide, including its finances, competitiveness, reputation, people, process, and technology.

But there is some good news, despite COVID-19. In a survey conducted by PwC across more than 10 countries in Europe, 84% rated the overall IT performance in response to COVID-19 as good or very good[3]. Additional IT budgets will stay the same or only show a small decline for 2021. New investments in IT infrastructure, network capabilities, cloud, security, and the velocity and quality of development of software in support of digital services will be easier to justify. This will shift IT to the forefront as digital services are essential for the continuation of business operations. The demand for faster, secure, quality digital services and applications to continue to increase customers, clients, or patients' experience puts a spotlight on existing application delivery and IT operations teams. They need to ensure that their work is in lockstep to support the digital transformation of their organization. This has driven the adoption of DevOps and some other operating models and will continue to do so.

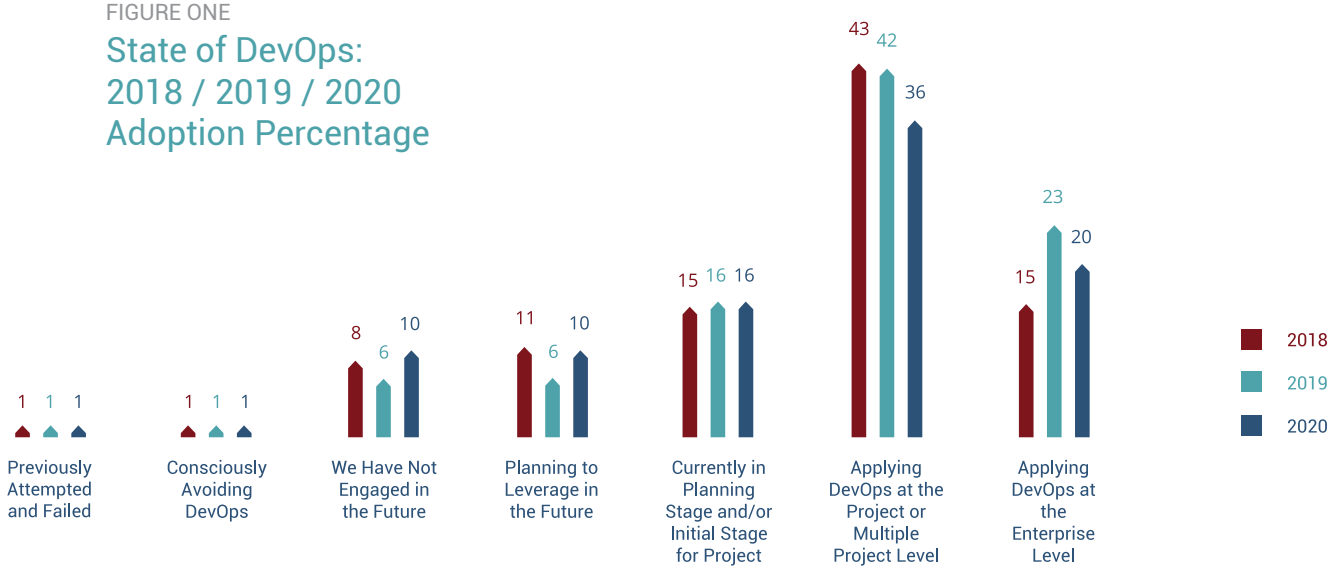
SECTION TWO

DevOps Trends and the Future

DevOps is no longer a question of if organizations need it or not, but rather a question of when to adopt it. Today's global enterprise-level adoption of DevOps at the project or multiple project level is at 36% and 20% across the enterprise (see Figure 1)[4]. While the adoption has fluctuated over the past three years, there are four key trends that influence the future of DevOps at large:

FIGURE ONE

State of DevOps: 2018 / 2019 / 2020 Adoption Percentage



1 **DevOps continues to shift left:** DevOps has 'shifted left' over the past several years recognizing the importance of baking security safeguards into software solutions (i.e., DevSecOps). There is a similar 'shift left' movement underway around such things as identity as code, privacy as code, and policy as code that broadens the scope of the DevOps universe. Successful DevOps teams embrace 'shift left' opportunities across a spectrum of activities that make their products fundamentally more useful and extendable. Teams that fail to embrace this 'shift left' mentality more broadly will be left behind.

2 **Security is integral to protect the business and enforce internal and external policies of the company.** The operating models such as DevSecOps and SecOps might be confusing at first, but at a closer look, the most important thing to know is that they are somewhat similar philosophies. While DevSecOps makes security an equal consideration alongside development and operations, SecOps focuses more on integrating the security and operations teams. According to our third Upskilling DevOps survey participants, DevSecOps achieved a must-have percentage vote of 56% in the automation tool category. DevSecOps is a critical domain. According to a survey conducted by SecurityCompass, 75% of enterprises in the US and UK have adopted DevSecOps in 2020[5].

3 **A plethora of cloud models requires intelligent automation.** Platform-as-a-Service (PaaS) (e.g., AWS, Google LLC) is expected to grow at a Compound Annual Growth Rate (CAGR) of 26% to a US $68 Billion market by 2022. Similar growth is expected in the Infrastructure-as-a-Service (IaaS) and Database-as-a-Service (DBaaS) markets. This requires mature cost and resource management, plus automation configuration management and change management. For 62% of survey respondents, cloud skills are a must-have technical skill requirement.

4 **Pressure on old IT Operations keeps rising due to more App Dev Models.** New forms of hybrid computing, including the adoption of microservices, serverless computing, and the need for applications to run on smartphones and IoT devices, liberates developers from the rigidity of old architectures. These forms of computing also give application developers more freedom on the choice of tools and languages. As this adoption increases, IT operations teams not yet practicing DevOps feel more pressure to embrace DevOps. The IT operations and IT infrastructure functional category are a must-have functional skill domain for 62% of our survey participants. As Raffi Margaliot, Senior Vice President and General Manager for Application Delivery Management at Micro Focus[6], points out, "IT Operation teams need to operate differently in the future, but there are a lot of variations. We have seen IT Operations teams that are on the review board and are guiding developers. We have also seen IT Operations turn into key designers on how things are being run, such as taking key responsibility on how to run the infrastructure. Or some IT Operations teams are owning the observability and monitoring strategy of applications and infrastructure and helping the management of resource consumption".

5 **The adoption of Artificial Intelligence and Machine Learning will further optimize DevOps.** The increasing use of Artificial Intelligence (AI) and Machine Learning (ML) across the DevOps pipeline provides additional insights and actionable data for DevOps engineers, developers, and IT operations leaders. 25% of our survey respondents voted AI and ML skills as must-have technical skills.

6 **Early convergence of DevOps, DataOps and ModelOps teams.** Data is an integral component of modern applications that DevOps groups must become smarter in how data is sourced, managed, and certified before use within their applications. In some instances, they may need to be aware of how the data flowing from their application impacts downstream applications. DataOps was voted by 27% as a must-have skill domain in the automation tool skill domain, whereas ModelOps received 22%. Future DevOps teams may need to add roles for statisticians, data engineers, and machine learning modelers to be successful.

7 **Value Stream Management keeps rising in importance.** While the software is a key part of every organization's interactions inside and outside, today's leadership teams across the business and IT must ensure that value is delivered from the software and the development process. DevOps and Agile practices have been adopted to innovate and create more iterative approaches for software development and delivery. However, the value must come through the customer lens. This is where VSM comes in. In simple terms, understanding and examining value streams of software being delivered end-to-end enables teams to make complex processes visible and provides the ability to pivot towards further value improvement. VSM skills are seen by 39% as a must-have skill within the process and framework skill domain from our survey data.

8 **SRE to continue the automation autobahn and reduce toil.** While organizations have adopted Agile and DevOps to improve the software development and deployment aspects with increased speed and quality, some IT operations teams have adopted SRE to bring efficiency into their processes and workings. The adoption of SRE as an operating model is 22% in 2021 compared to 15% in the previous year. 47% of our survey respondents voted SRE skills as a must-have skill in the process and framework skill domain this year compared to 28% in the previous year's survey.

Four Challenges That Hamper DevOps Evolution

Many leaders want to improve the outcomes and value of their software development and deployment for their companies. When we asked our survey takers how they would describe their transformation experience during their DevOps journey, 47% of them said it was difficult. Last year 52% said it was difficult. As indicated by our survey takers, the challenges are in equal parts spread across the people and the organization, the processes work, and the technology topics. Analyzing the challenges from our survey results, DevOps Institute has concluded that DevOps evolution obstacles come in the following four ways:

1 **An organization's structural barrier keeps DevOps teams from thriving.** Formal, rigid barriers encourage that introducing change is someone else's job. These organizational structural barriers include the following:

A The excessive layers of anxious middle management which stand between ideas and their execution

B Pathologically siloed organizational structures with no history of or incentives to engage in collaboration

C Senior-level executives who are not able, willing, or skilled to lead digital disruption in the company

Organizational structure barriers are easy to spot but difficult to change. Mark Settle, 7-time CIO, explains "DevOps pioneers and business executives all too often speak in different tongues. DevOps teams want to deliver features and functions while executives want to buy business capabilities. Sometimes those two agendas are aligned - other times, they are not. DevOps practitioners and their business partners need to find ways of synthesizing features and functions into business capabilities that can integrate into a firm's current business operations. That's the real key to successful adoption of DevOps practices[7]." The current challenges coming from our survey participants in priority order are shown in Figure 2.

FIGURE TWO

Structural Barriers

Excessive layers of anxious middle management which stand between ideas and their execution

Pathologically siloed organizational structures with no history of or incentives to engage in collaboration

Senior-level executives who are not able, willing or skilled to lead digital disruption in the company (see note)

2 **Cultural inhibitors prevent individuals and teams from innovating.** Culture refers to the organization's informal patterns that signal to people which behaviors are appropriate and which behaviors define you as difficult. Our survey respondents attribute the lack of DevOps progress in tackling challenges with the organizations' culture. The current challenges in priority order are shown in Figure 3. The challenges can be summarized as 1. not bringing the right people into the organization or not retaining and developing them once there, 2. aversion to risk-taking and proposing new ideas, and 3. existing habits of seeing past failures and successes inhibit change. Unfortunately, culture is the hardest obstacle to identify and alter.

FIGURE THREE

People or Culture Challenges

3 **Existing processes, bureaucracy, and procedural hurdles challenge even motivated disruptors and teams.** Existing complex processes hamper the ability to make changes as there are too many dependencies and constituencies to connect. The current challenges around the topics of processes are shown in Figure 4. The lack of management support makes the possibility for changes around processes extremely tough. Formal or informal procedures are found and described in policies or in patterns and provide steps to individuals for accomplishing tasks. Existing processes and procedures are important as they are useful in getting things done, but they also cause issues if there is too much emphasis on internal processes and procedures versus the focus on outcomes. Slow budget and approval processes and additional bureaucracy lead to stalling efforts. Additionally, metrics that are internally focused instead of promoting the customer value do not accelerate transformations.

FIGURE FOUR

Process Challenges

4 **Technology trends will continue to drive challenges.** While there are a variety of technology topics which are interesting, exciting and might provide a variety of benefits, the current trends of IT automation, Gigabit Wi-Fi networking, Internet of Things, converged/hyper-converged infrastructure and container orchestration are those which are being implemented or planned by organizations within two years[8]. Technology challenges are unavoidable, but topics like tool proliferation, tooling support, and not having the right tools should be yesterday's problems.

SECTION THREE

DevOps Evolutions Require Good Habits and Goals for Success

While DevOps keeps evolving, we know that evolutions towards a DevOps success involve more than development and operations working closely together. Before progressing more in-depth into the research findings and providing some initial guidance to those who said that DevOps is difficult, here are key aspects to remember:

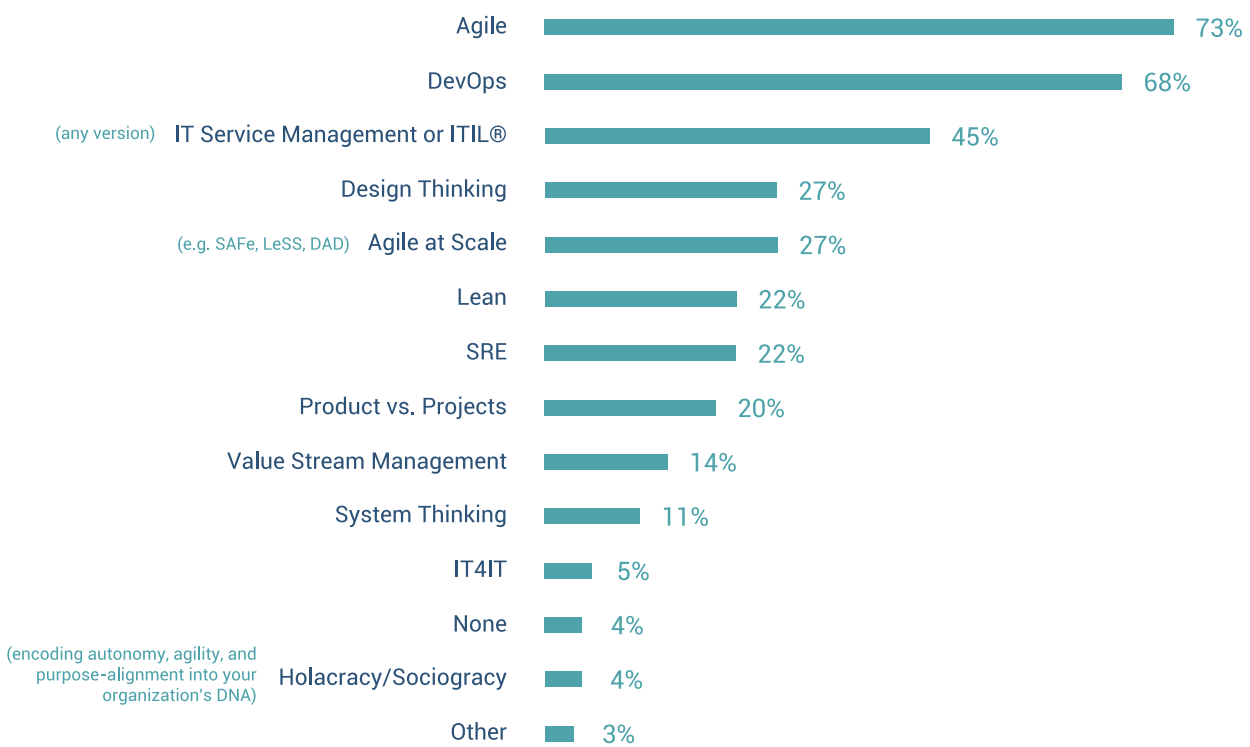
- **DevOps involves the entire enterprise, not just IT.** One key important aspect is that DevOps involves the organization as a whole. The shift towards digital services to either stay competitive and improve customer and employee experiences is the responsibility of all functional areas involved when developing software. Hence, all functions must take a deeper look and interest in how software can be delivered with velocity, quality, and reduced risk for the organization and its customers.

Agile, DevOps, ITIL, and other frameworks or disciplines which complement each other. Our survey results show that there is a variety of different frameworks and disciplines adopted today (see Figure 5). No matter which methodology, or combination thereof, an organization or team chooses, achieving success implies a common vision and a purpose, the infusion, and management of a culture of care ensuring that decisions made are visible and that all can be measured before you start while continuing to prove the value of your efforts to your stakeholders. Because digital transformation is not achieved instantly across an organization, established companies should start small, with best practices and methodologies suited to their needs, then learn, build expertise, and scale-up.

FIGURE FIVE

Current Adoption Across a Variety of Frameworks

Which discipline(s) or framework(s) does your organization primarily apply within your IT environment today? (select all that apply)



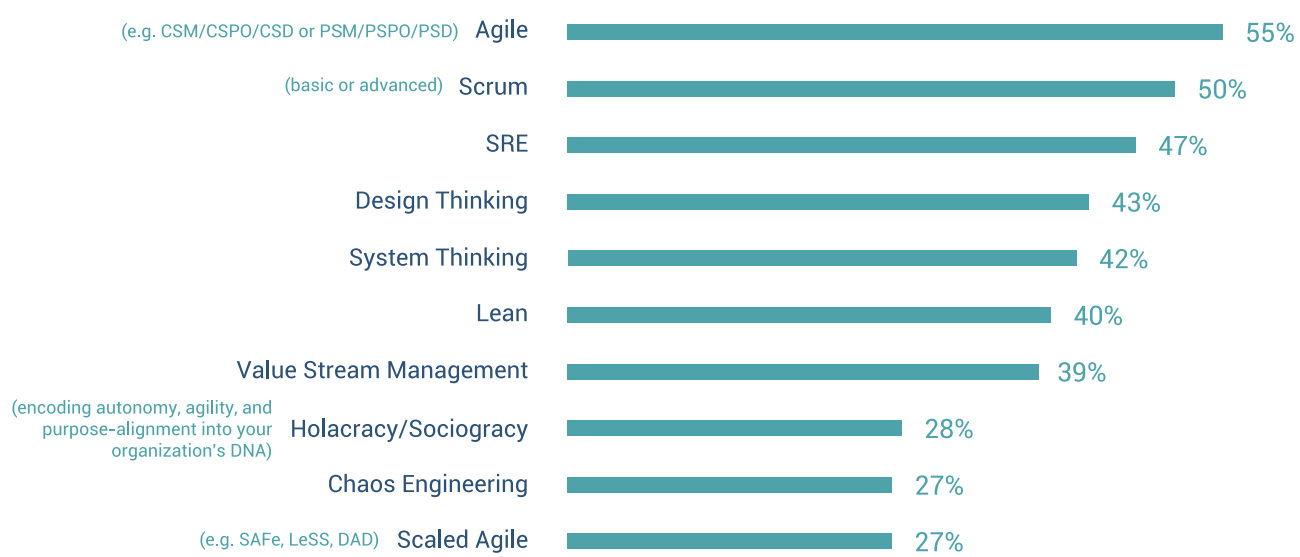
— **DevOps is an evolution, not something which can just be implemented.** This transformation is not just a matter of getting the Dev and Ops teams working together but also transforming the organizational culture, the processes, and the technologies being used. Therefore, all stakeholders in an organization across all levels must be involved with full support from the organization's leadership and management.

— **DevOps practices are complemented with additional specialized areas.** Since its conception 11 years ago, DevOps has been complemented with additional best practices and operation models. Operating models such as SRE, VSM, Holacracy, and Chaos Engineering are all considered must-haves within the process and framework skill domain (see Figure 6).

FIGURE SIX

The Mix of Must-have Process and Framework Skills Keeps Expanding

How would you rate the following modern concepts, process, or framework skills for a DevOps team member?

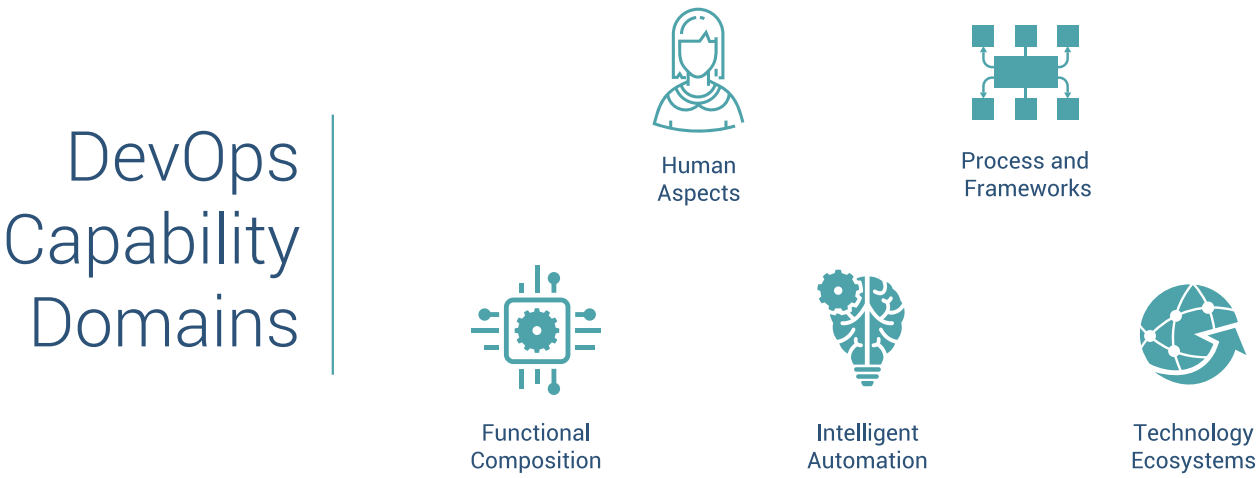


Skills and Ongoing Capability Domains Must be Synchronized

Overcoming the above challenges can be addressed by two key initiatives during your DevOps journey. First, DevOps teams must assess which critical capabilities they currently can perform, or not, across key areas. It is important to understand what skills within the organization are available or need to be developed to start or continue the DevOps evolution. DevOps Institute suggests that evolution in capabilities must be supported by a corresponding evolution in skills. (see Figure 7)

FIGURE SEVEN

DevOps Capability Domains Must be Supported with Skills in the Skill Domains



Initiate DevOps Capability Assessments to Understand Where You Are and Where To Go Next

One key step is to understand existing capabilities and then develop a roadmap on which further capabilities need to be addressed. For this, DevOps Institute has crowdsourced and developed an Assessment of DevOps Capabilities (ADOC)[9] model, which leverages five key capability dimensions (see Figure 8). We recommend leveraging the ADOC assessment to provide DevOps teams and enterprise-wide DevOps programs to understand where they have weak or non-existent capabilities across the five capability areas to implement improvements. An assessment should then be paired with the DevOps Human skill journey, which describes the must-have skills individuals should focus on to support the work within the five dimensions. Leveraging the ADOC assessment will provide guidance for focus areas with high chances for success that will produce high-impact improvement. For DevOps evolution, it is essential to achieve quick wins to gain the momentum needed to tackle additional challenges continuously. Such assessments are either done within a team or across the entire enterprise, with the help of experienced consultants[10], to accelerate the generation of ideas that can be tried to evolve within a key dimension or multiple dimensions. After some time, the assessments should be repeated to identify key improvements and locate new high-impact focus areas. The goal is for the relevant team to change its routine and culture into eventually owning continuous improvement. The reassessment across the different dimensions allows for ongoing experimenting and learning and ultimately achieving key goals on all dimensions.

FIGURE EIGHT

Assessment of DevOps Capabilities (ADOC) Five Dimensions (High-Level)

Human Aspects

This dimension focuses on culture, psychological safety, dynamic learning, transformational leadership, The Three Ways, happiness at work and diversity and inclusion.

Process and Frameworks

This dimension focuses on agile, lean, ITSM, GRC, VSM, Project to Product, SRE, DevSecOps, Design and Systems Thinking, Holacracy and Humanocracy.

Functional Composition

This dimension focuses on collaboration, portfolio and product management, change, architecture, build, test, release, operate and support.

Intelligent Automation

This dimension focuses on artifact and source control, CICD, environment management, continuous compliance, observability, AIOps and Value Stream Management.

Technology Ecosystems

This dimension focuses on elastic infrastructure, containers, microservices, APIs, serverless, DevOps toolchains, open and innersource and secrets management.

Unleash Your Infinite Potential Towards The Skillful DevOps Human

As part of your DevOps evolution, the second key initiative must be to determine the available and needed skills within the different skill domains. Understanding the combination of capability weaknesses with an assessment and determining necessary skill domains will allow individuals, teams, and leaders to implement an upskilling plan to ensure ongoing success and progress within DevOps. In support of the critical work in developing upskilling programs which aim and guide individuals, teams, and organizations with their evolution, we found that in a recent study conducted by IDC, 46% of the respondents said their challenges for building software development and delivery capabilities are around not having the relevant skills, while 31% said the lack of management support and 31% selected cultural change[11].

Deep Dive Into The Top Five DevOps Must-Have Skill Domains

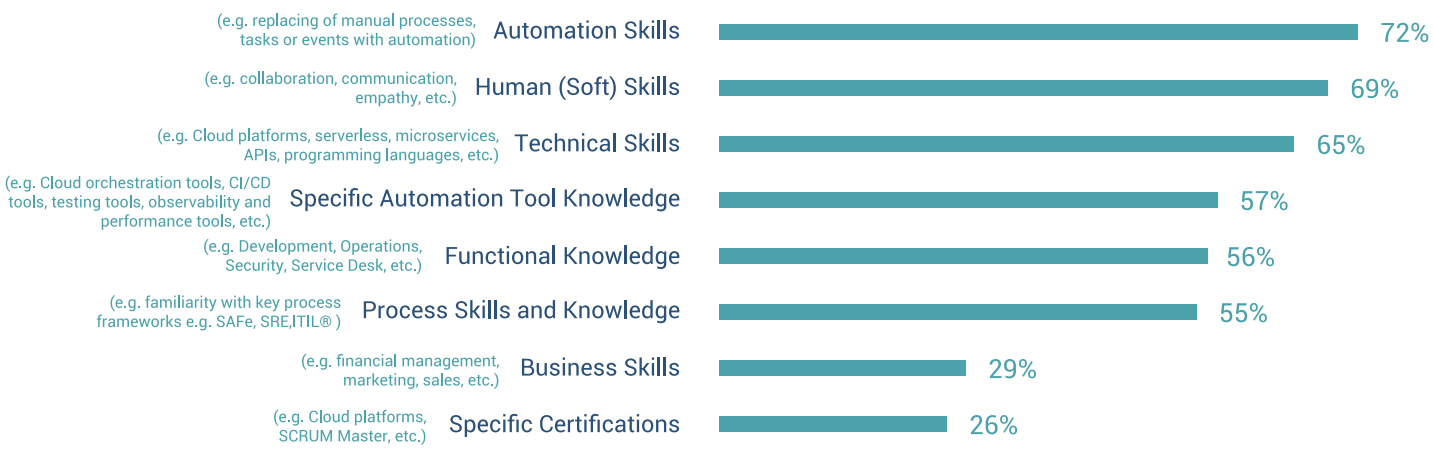
The DevOps skill domains are powerful categories that are essential for developing DevOps skills and unique talents. They are the starting point for developing an organization or individual upskilling roadmap to enable the greatest chance of success, within your organization or anywhere else, in leading and evolving DevOps.

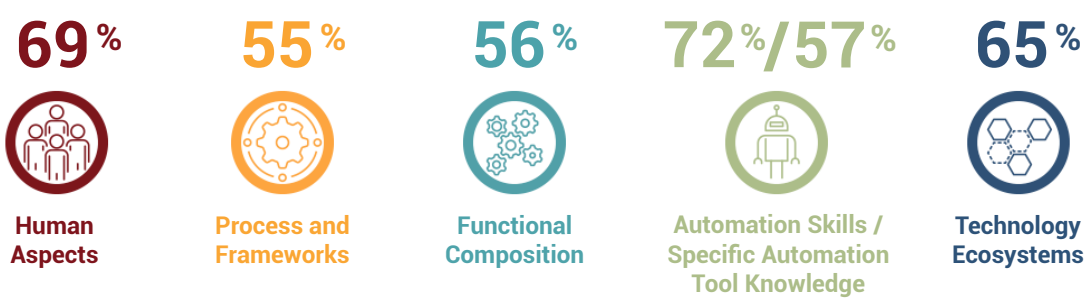
Upon examining the priority domain skill categories, our survey data shows that the essential combination of skills for a successful DevOps human are across the automation, human, technical, functional, process and framework knowledge skill domain categories (see Figure 9). In the following section, we take a deep dive into the different skill domains.

FIGURE NINE

The DevOps Human Skill Domains

How would you rate the importance of the following major skill categories for a DevOps team member?





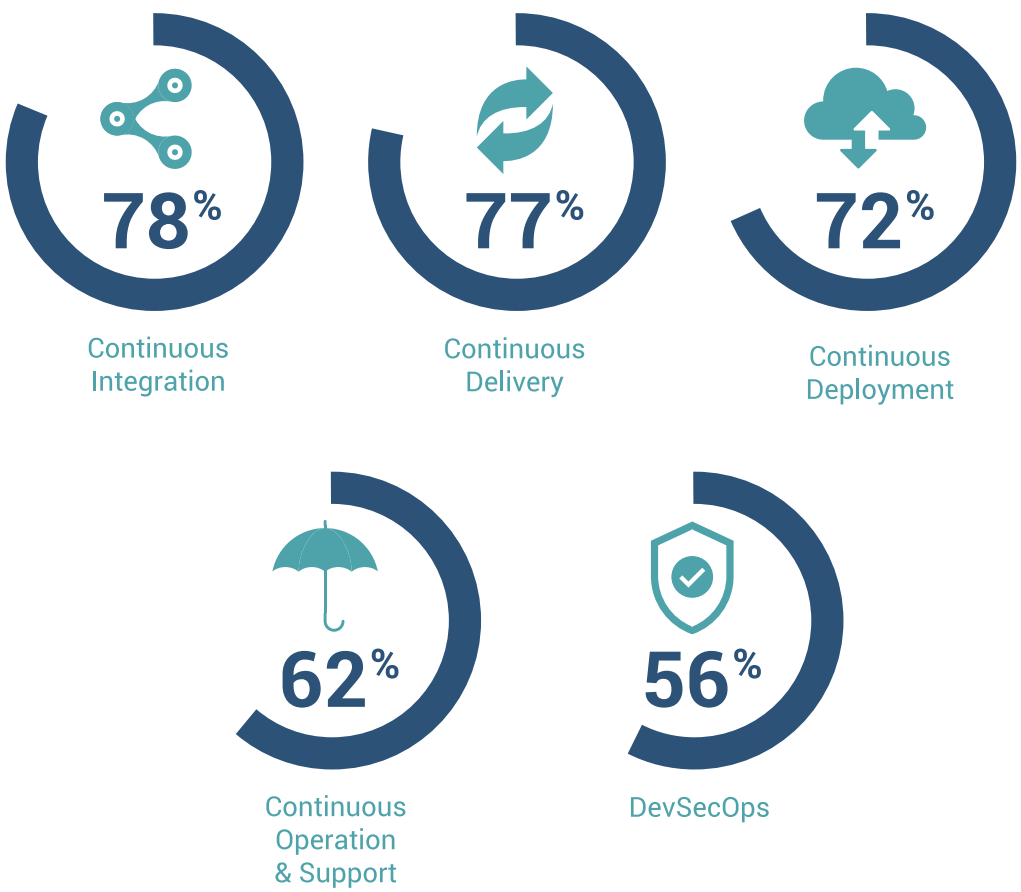
To Continuously Drive Value Within DevOps, You Need Automation Skills

Automation skills is the most important skill domain. 72% of survey respondents selected the Automation skills as the top five must-have skill domains. When we probed on specific automation tool categories, 57% of survey respondents felt that having specific automation tool knowledge is a must-have (see Figure 10).

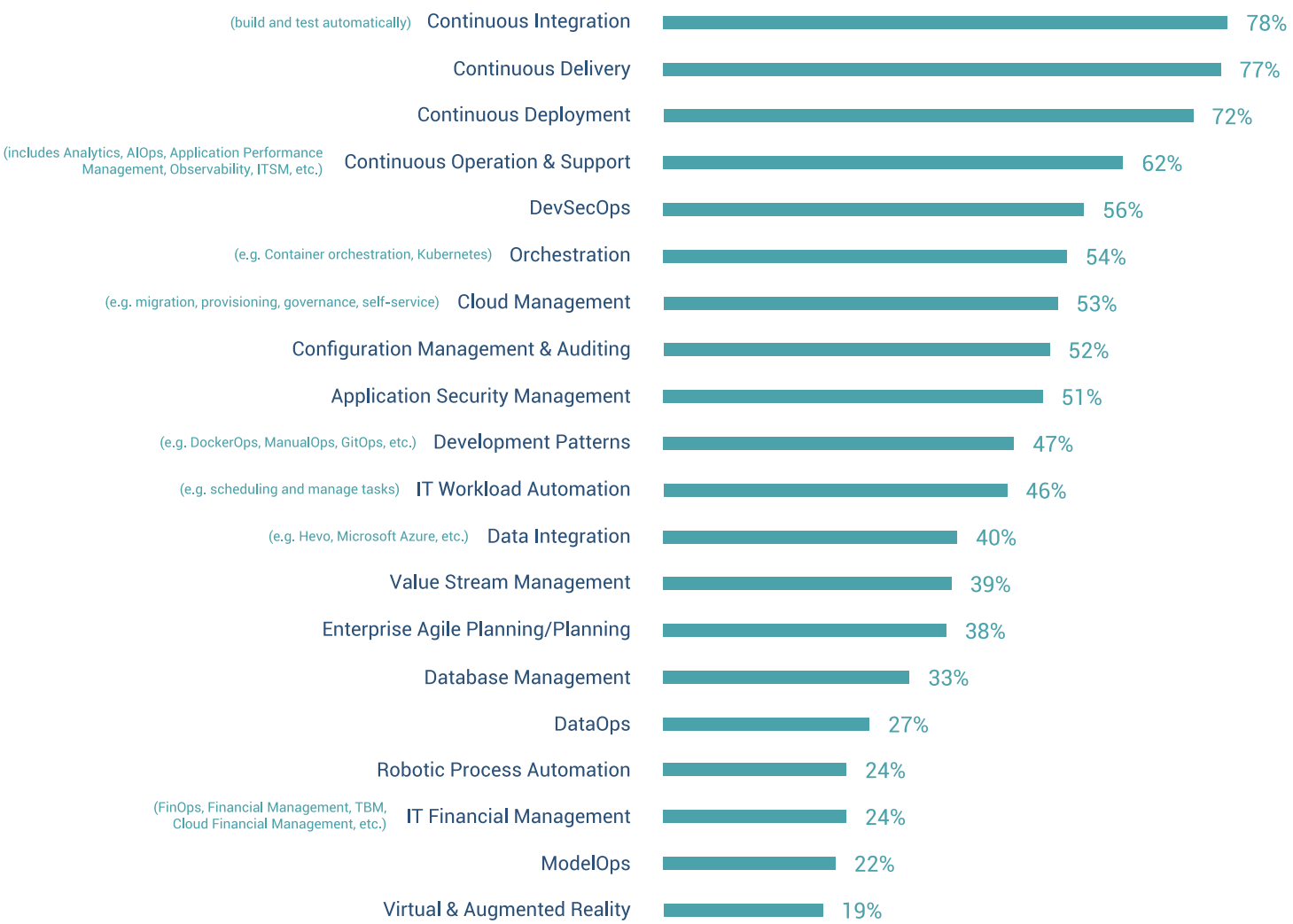
FIGURE TEN

Top 5 Must-Have Automation Tool Categories

How would you rate the importance of being familiar with the following IT Automation topics for a DevOps team member?



CD, Continuous Deployment and Continuous Operation are Essential Automation Categories... Hello DevSecOps!



One of the DevOps goals is software development efficiency. DevOps values are about collaboration and automation. Each phase in the overall DevOps process focuses on bridging the gap between development and operations teams through continuous integration, delivery, deployment, and feedback; all focused on creating a more seamless development process. Automation is a critical undertaking as it manages, changes, and adopts how IT and other business functions operate. Processes, tasks, and decisions are key targets for automation work. The outcome of automation is to get work done faster, free up staff to focus on more innovative topics, and eliminate human errors.

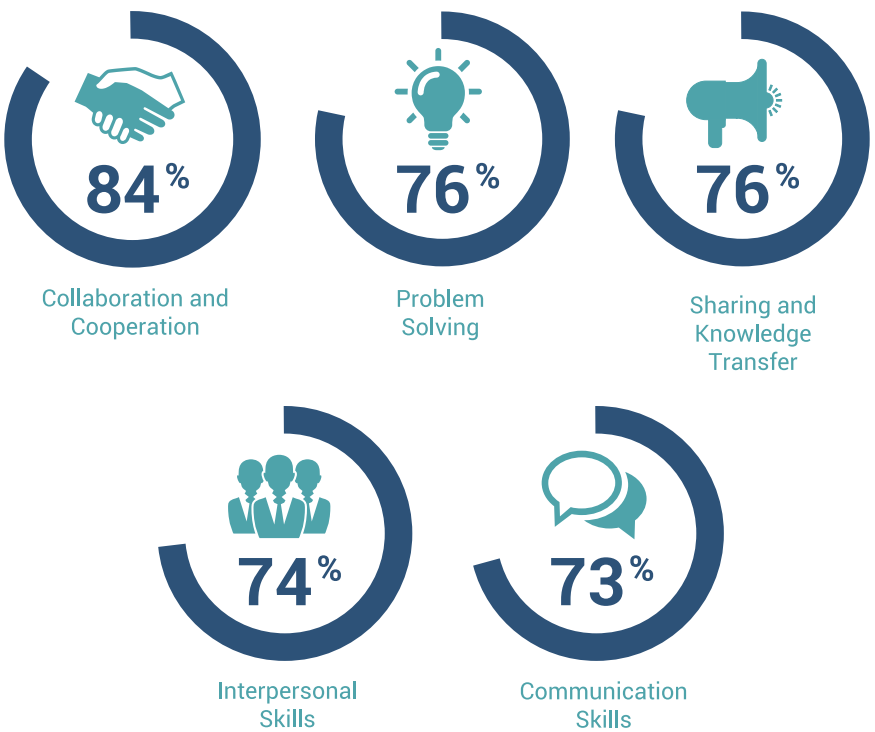
Focus On Human Skills To Improve Your DevOps Culture. 69% of survey respondents selected Human skills as the second-highest must-have skill domain.

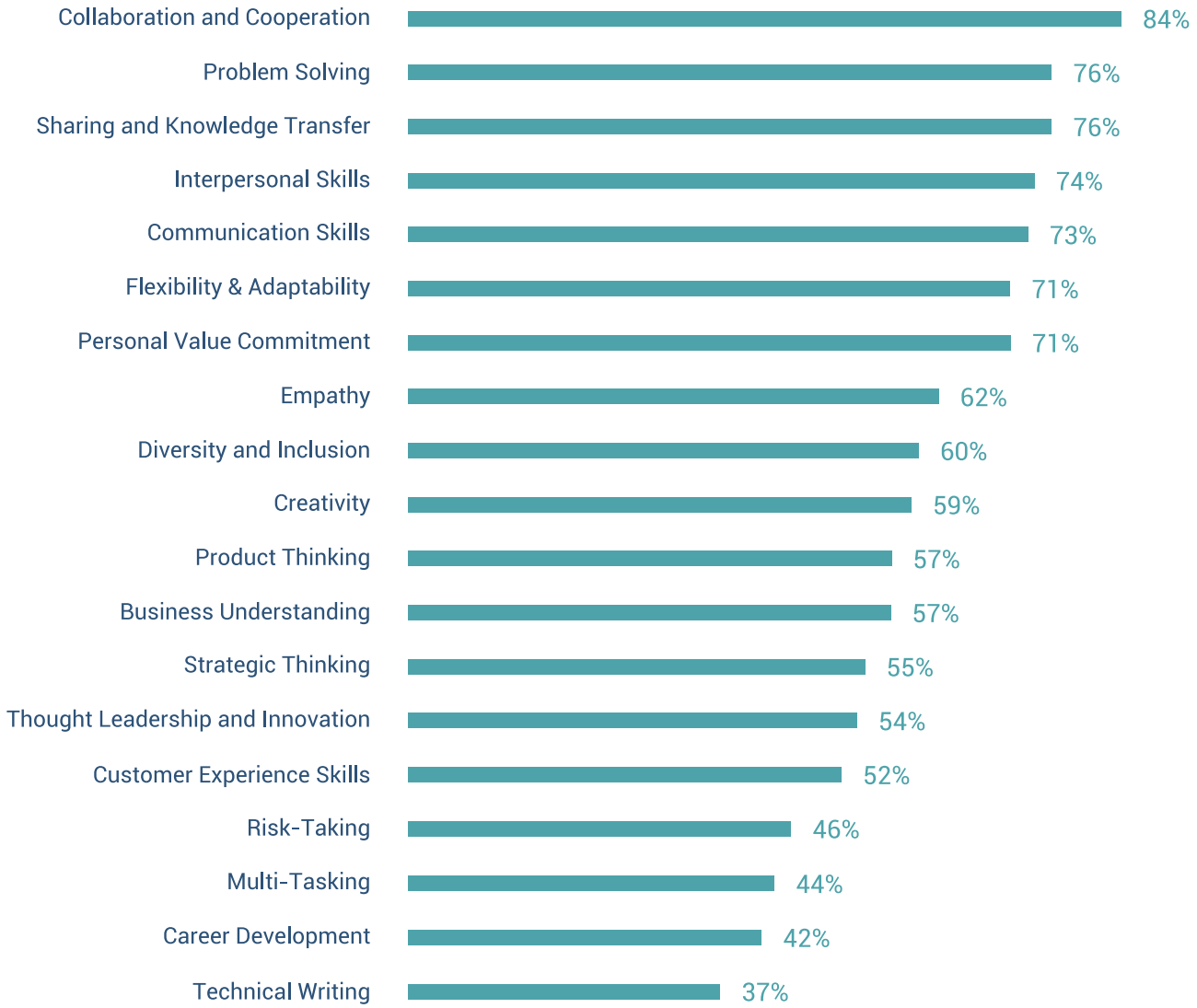
In 1972, a US Army training manual began the formal usage of the term "soft skills".[12] There, soft skills were defined as *'..important job-related skills that involve little or no interaction with machines and whose application on the job is quite generalized"*. We introduced the word human skills in our last year's research report and will continue to do so. However, if you want to use the word soft, there is nothing wrong with that term. No matter which word you use, it will take fundamental changes in mindset to help humans recognize the value that strong human skills bring to a team. It will require a leader with vision and resources to foster, coach, and develop this valuable skill set in employees. We found that the following human skills are essential must-have skills for the DevOps human (see Figure 11). These must-have human skills, determined by our survey audience, will help you explore what human skills to hone in on or start developing or coaching with your teams. For details on what is included in each of the human skill categories in details please refer to Appendix A.

FIGURE ELEVEN

Top 5 Must-Have Human Skills

How would you rate the importance of the following human (soft) skills for a DevOps team member?




Collaboration and Cooperation 84%
Problem Solving 76%
Sharing and Knowledge Transfer 76%
Interpersonal Skills 74%
Communication Skills 73%
Flexibility & Adaptability 71%
Personal Value Commitment 71%
Empathy 62%
Diversity and Inclusion 60%
Creativity 59%
Product Thinking 57%
Business Understanding 57%
Strategic Thinking 55%
Thought Leadership and Innovation 54%
Customer Experience Skills 52%
Risk-Taking 46%
Multi-Tasking 44%
Career Development 42%
Technical Writing 37%

Leverage Technical Skills To Unlock New Potentials For Innovations. 65% of survey respondents selected Technical skills as the third-highest must-have skill domain.

When researching the priorities of CIOs, CFOs, and their business partners across a variety of sources, we found the following trends:

- There is tremendous demand for drastic digitization measures to improve the customer experience.[13]
- The top seven technology trends implemented or planned within two years around technology investments are IT automation technology, Gigabit Wi-Fi networking, Internet of Things, Virtual Desktop Infrastructure, Converged/ Hyperconverged infrastructure, and Container technology and serverless computing.[14]
- In line with the top seven priorities, investments in cybersecurity, communication and collaboration tools and customer experience transformation are likely to continue in growth.[13]
- About 80% of IT budgets will either increase or stay the same between 2020 and 2021.

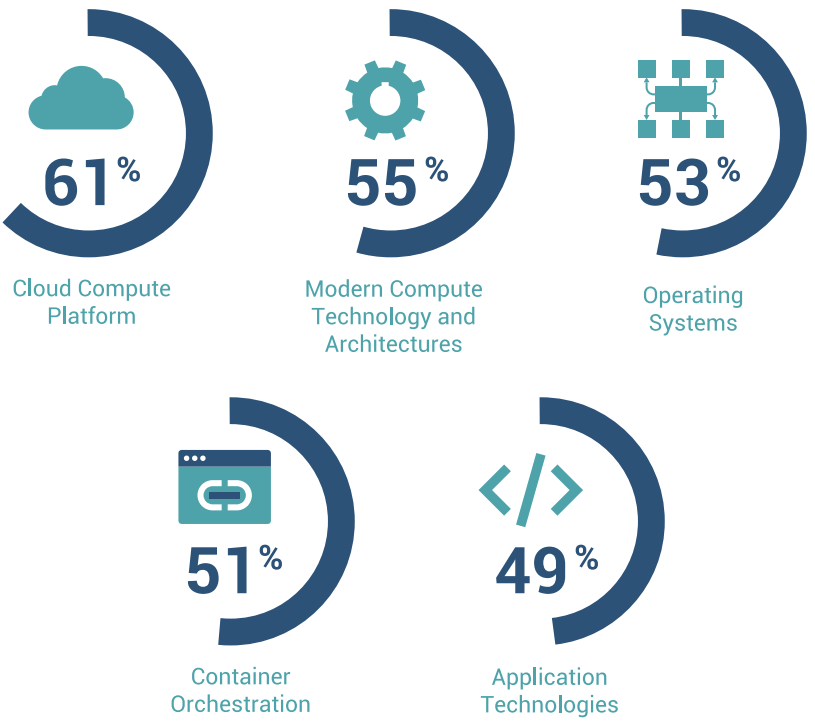
The priorities of must-have technical skills for the DevOps human are shown in Figure 12 and 13. Understanding cloud platforms, modern compute technologies such as serverless, microservices and containers, operating systems, container orchestration and different application technologies are key when transforming but also key for running and growing the digital business.

FIGURE TWELVE

Must-Have Technical Skills:

Cloud, modern compute tech and architecture, OS and container orchestration and app technologies (API, REST…) are must-haves.

How would you rate the importance of the following technical skills for a DevOps team member?



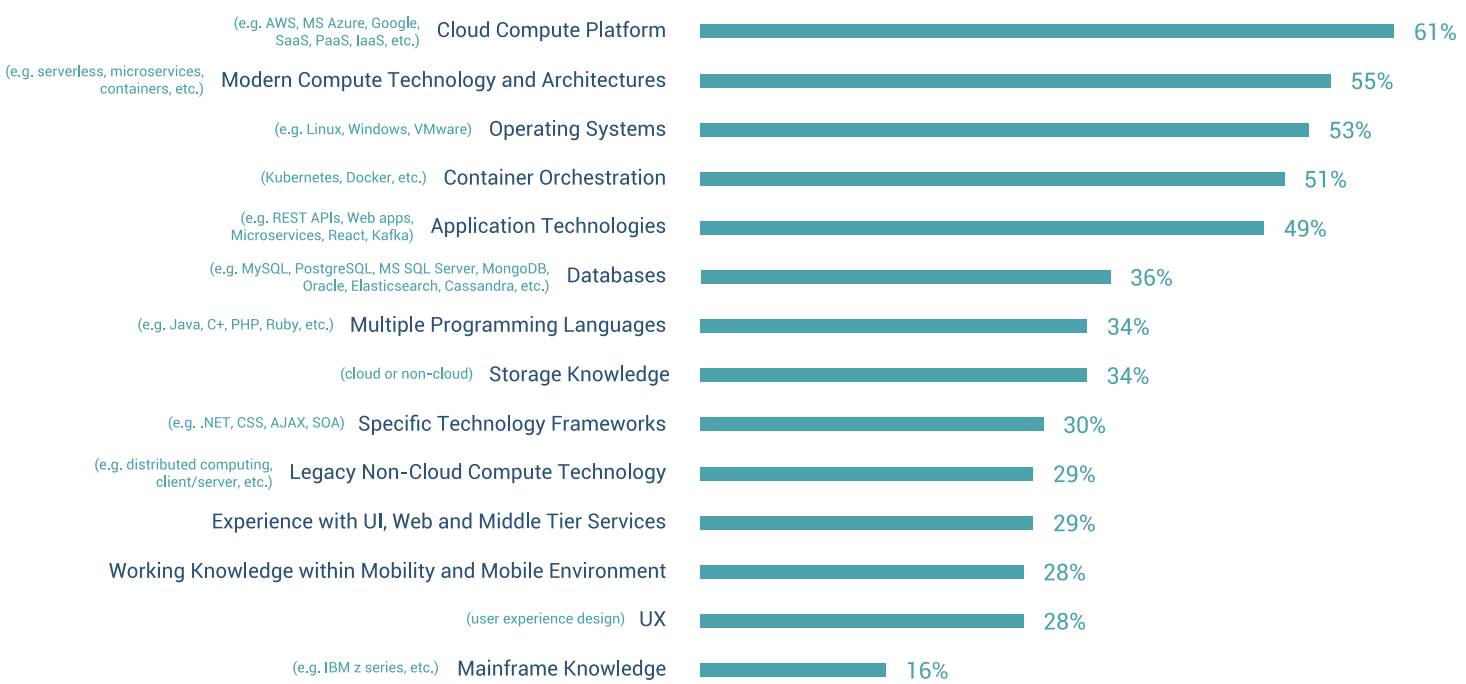


FIGURE THIRTEEN

Additional Must-Have Technical Skills are AI, Big Data and Analytical Knowledge

How would you rate the importance of the following subject areas for your DevOps team member(s)?

Create A Multi-Discipline Empowered Team Through Functional Skills And Knowledge. 56% of survey respondents selected functional skills and knowledge as the fourth-highest must-have skill domain.

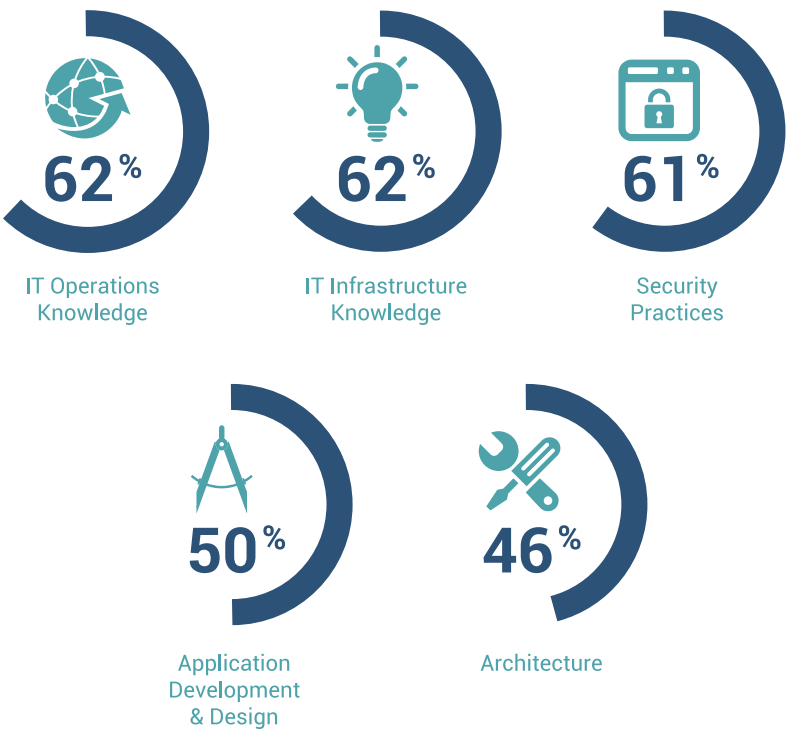
Multidisciplinary working involves appropriately utilizing knowledge, skills, and best practice from multiple disciplines and functional boundaries. Multidisciplinary teams (MDTs) are teams of professionals from different functions across IT and business all working together to achieve key goals. There is no one set form of how multi-disciplinary teams must be organized but the DevOps Leader course by DevOps Institute gives us examples of modern organization structures to be considered[15]. The level of integration can range from a single functional expert to multiple functional experts holding shared responsibility for products or services, all working together on a product or service. Depending on the current state of the DevOps evolution, DevOps humans must have functional skills which include IT Operations, Infrastructure, and Security as these are key to ensure customer satisfaction and protect the company brand. Continuous delivery requires knowledge depth in IT Operations processes such as release and change management. Security topics and concerns must be addressed, even though security topics in-depth, just as the other functional topics, are covered by functional experts which are part of the extended DevOps team. Figure 14 describes the functional must-have skills for the DevOps human.

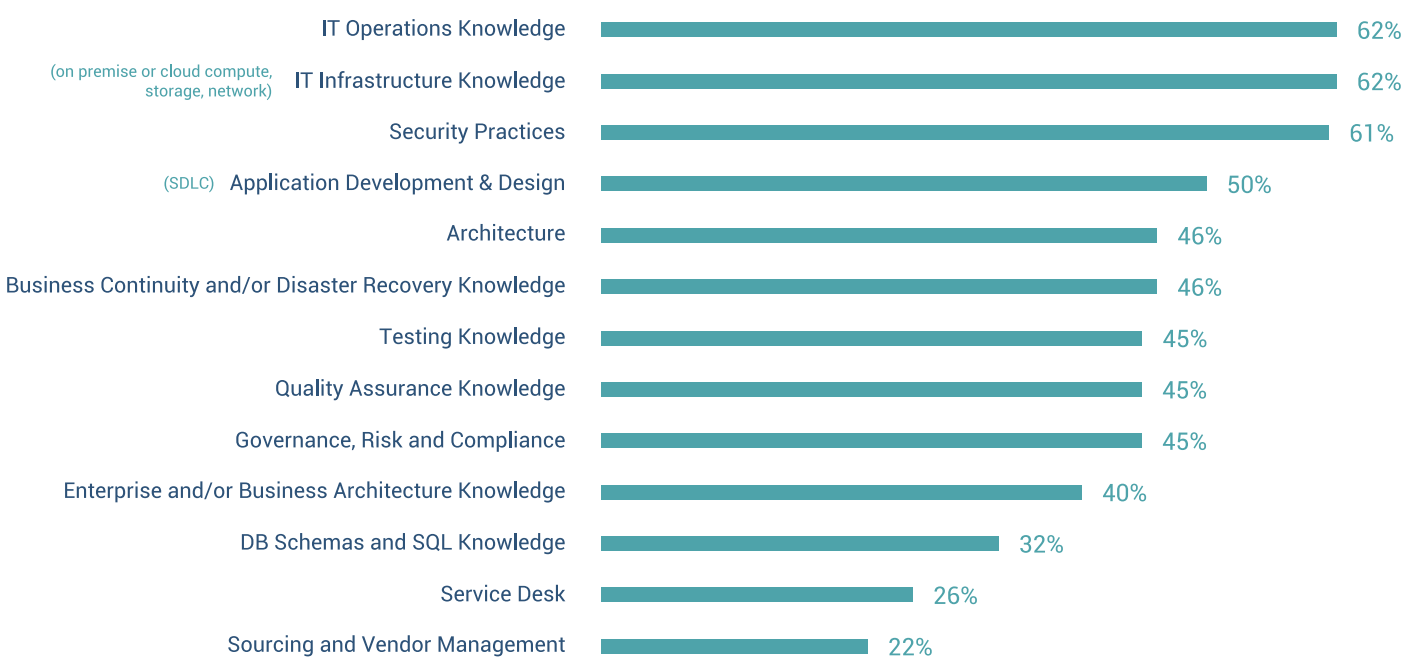
FIGURE FOURTEEN

The Top Must-Have Skills of the Multi-Disciplinary Empowered Team:

Functional Skills of IT Operations, Infra and Security are Key to Ensure Customer Satisfaction and Protect Company Brand

How would you rate the importance of the following functional skills for a DevOps team member?





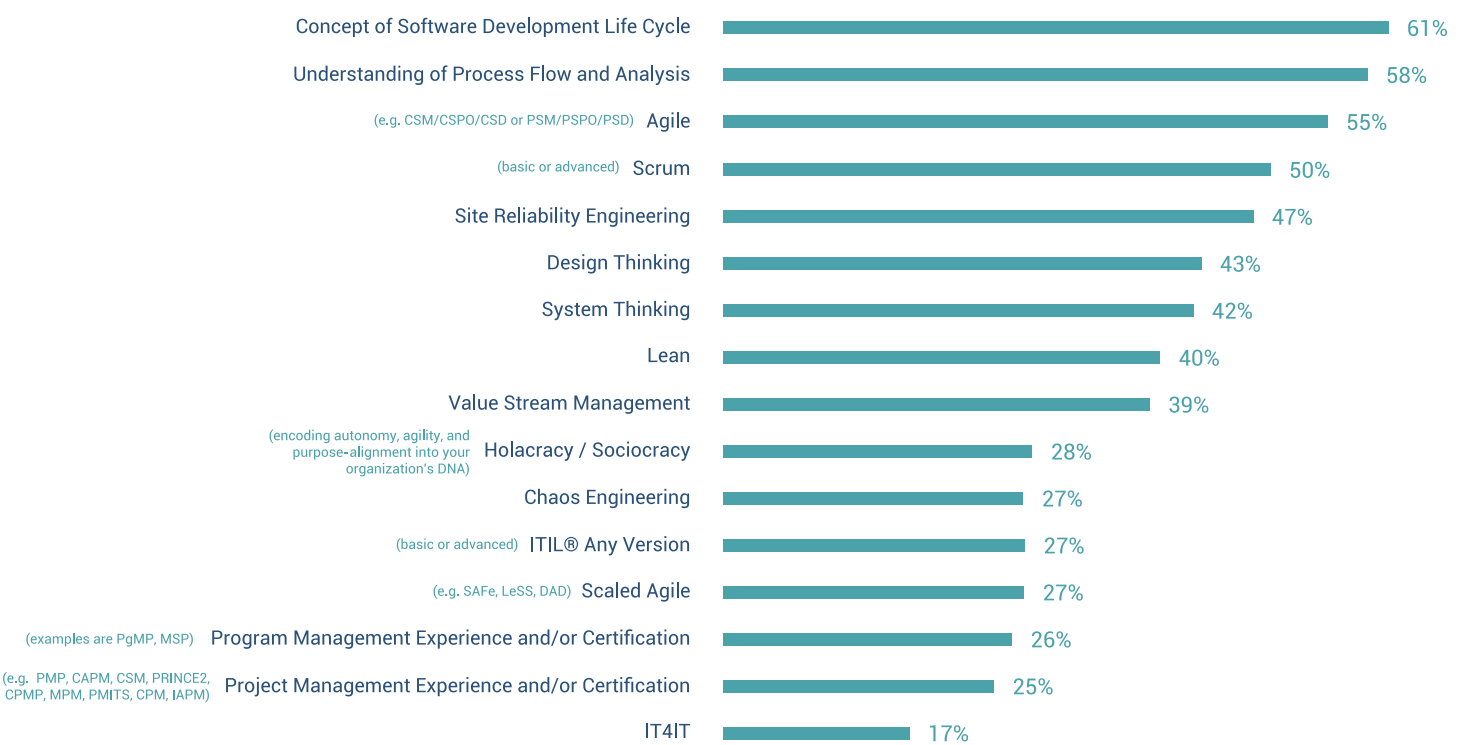
Rewire For Value Alignment And Continuous Process Improvements. 55% of survey respondents selected process skills and framework knowledge as the fifth must-have skill domain.

We know that lean and agile practices are further amplified through similar efforts that achieve faster feedback loops and faster learning. The leverage of the kaizen bursts of lean and the retrospectives of scrum enables DevOps teams with continuous learning and continuous improvement within the organization. In this year's survey, SRE has received 47% of our survey respondents vote for a must-have skill (see Figure 15). SRE as an operating model allows for balancing the work of IT operations teams between automation and troubleshooting all for the purpose of improving across a wide area of topics in a continuous way. Beyond achieving fast flow, DevOps is driving opportunities to provide measurement across the entire software delivery value stream for fast and continuous feedback. The top five must-have process and framework skills are understanding process flow and analysis, Agile, Scrum, SRE, Design Thinking, and System Thinking. We see a significant amount of must-have votes, 39%, for skills on value stream management which involves looking at an entire value stream from initial value stream mapping to understanding how to continually reduce waste and increase flow. This capability requires making processes visible, analyzing bottlenecks, and big picture thinking. ITIL skills, even though ITSM is still high on the adoption (with 45%), are at 27% of votes for a must-have skill.

FIGURE FIFTEEN

Must-Have Skills in Process and Frameworks, Concepts, Methodologies or Best Practices Domain

How would you rate the importance of skills around concepts, methodologies, frameworks, or best practices for a DevOps team member?



Skill Building For The DevOps Human

Many organizations struggle with the cultural aspects of DevOps evolution.

As technologists, we are not used to talking about emotions, feelings, and behaviors. It can feel very 'fluffy' so it helps to apply neuroscience research to our approaches in changing behavior, and changing behaviors changes culture. What we understand about cognitive load and disturbance and fear/avoidance response versus novelty/approach response influences what we expect from humans in terms of how they unlearn and learn[16]. The fight or flight response directly connects to what motivates us in the workplace so understanding what neuroleader David Rock's research shows us about how to manage human variance, desires and discomforts can make or break a team's willingness to engage[17]. Britt Andreatta's work, 'Wired to Resist' explains how all humans are literally built to push against change and shows us how important it is to empower people to participate and not frighten them with large scale transformation programs[18].

SKILup in 2021 with the DevOps Human Skill Journey

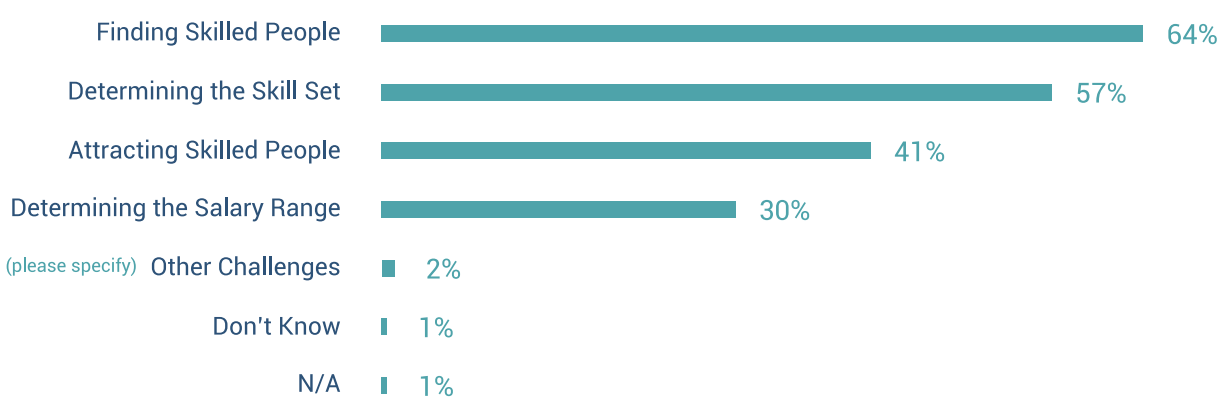
We found that 52% of surveyed individuals, many of them executives and leaders, say that they do not have an upskilling program or are just developing one for improving skills and capabilities within their companies.

While there are a few challenges finding and recruiting DevOps humans, one of the biggest is to identify the right skills (see Figure 16).

FIGURE SIXTEEN

Finding Skilled People is Tough

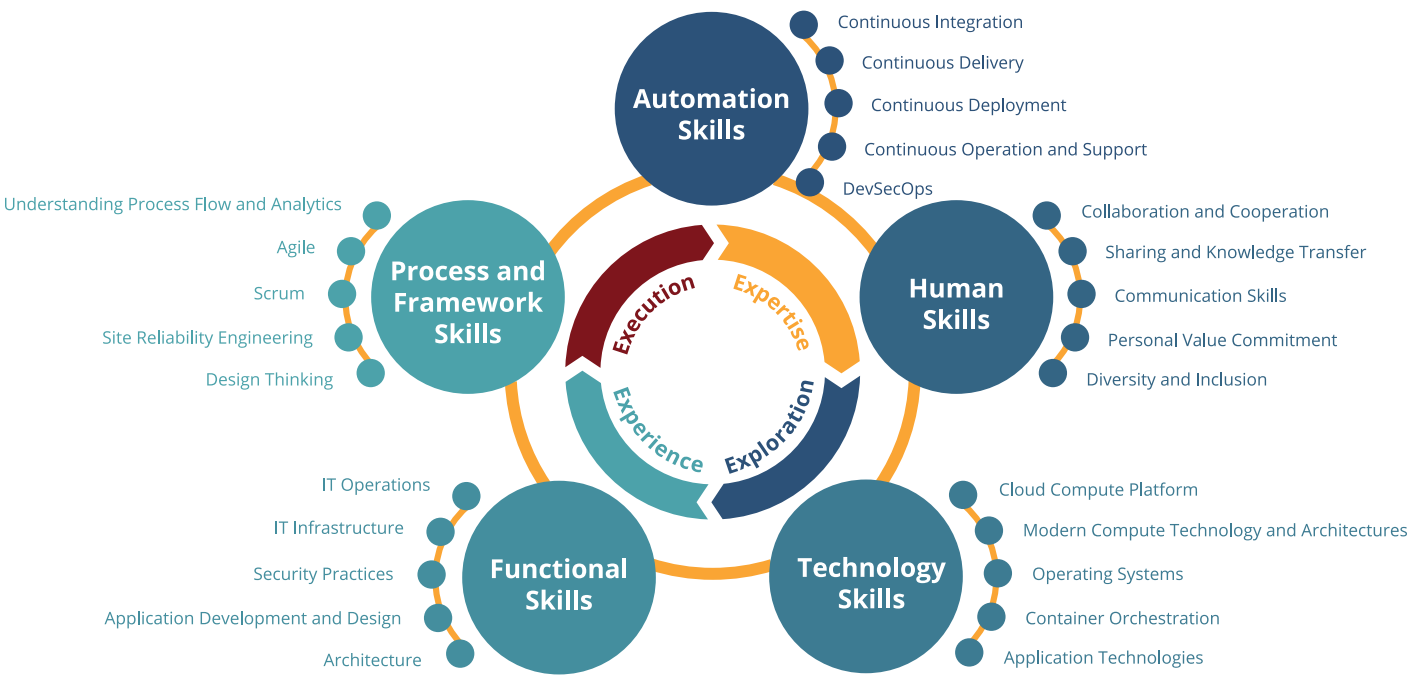
What challenges have you encountered (or do you anticipate to encounter) while recruiting candidates for your DevOps team?



Use the skill journey to plan out your upskilling in 2021. Leveraging the findings from our survey we have developed a DevOps human skill journey that will allow you to identify your upskilling journey (see Figure 17). The skill journey can be applied by individuals, DevOps leaders, coaches, and DevOps teams either in conjunction with an ADOC assessment or without.

FIGURE SEVENTEEN

DevOps Human Skill Journey
Top 5 Skill Domains and Top 5 Skills



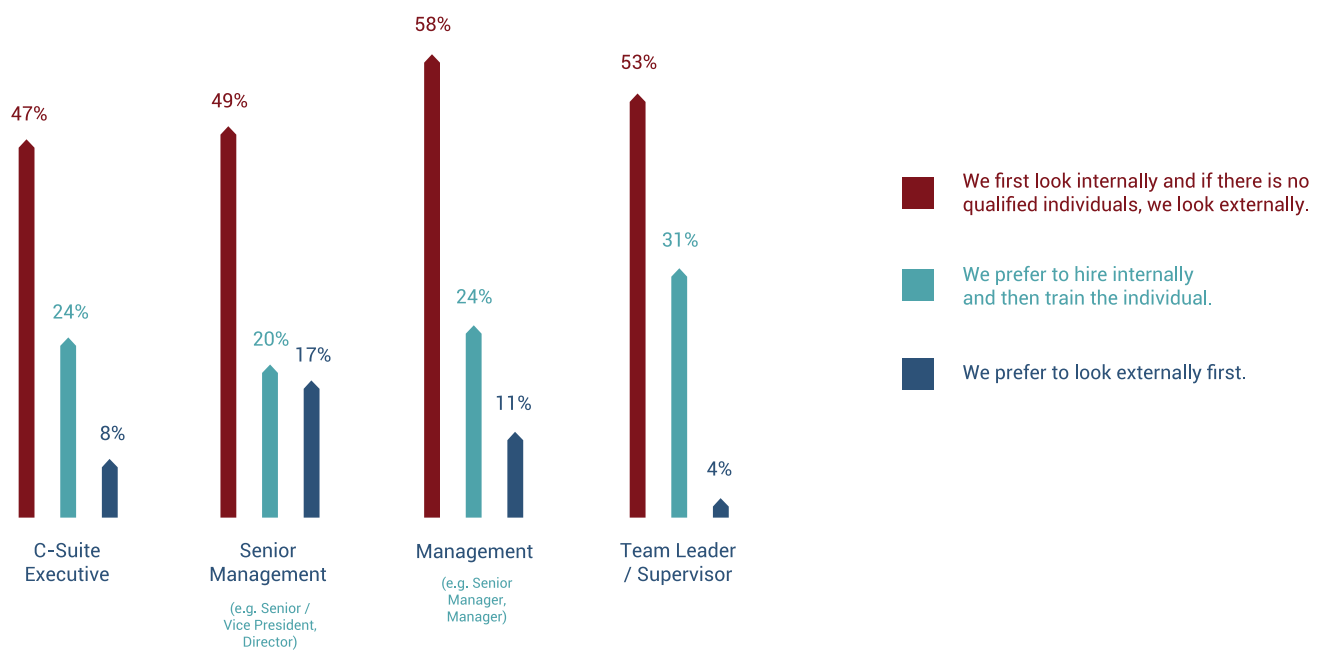
Know that COVID-19 has increased the priority of upskilling. When we asked the question 'How COVID-19 had changed the priority of the organizations or team upskilling program?' 69% of our survey respondents indicated that it had increased in priority or it had not changed. Additional findings from a study conducted by McKinsey show a similar result[19]. There, 78% of respondents said that responding to the COVID-19 crisis has brought the building of skills and capabilities front and center.

Skill Building is best done through reskilling existing employees. The management and leadership survey respondents have given a clear signal, their preference is to recruit from the existing employee pool (see Figure 18). This is great news for the existing team members who want to change and step into a new career.

FIGURE EIGHTEEN

Management and Leadership Prefer Internal Hiring for Today and Beyond

Which statement reflects (or reflected) your thinking relative to the hiring of DevOps team members?



- **If you want to hire from within you must put real effort into your upskilling.** Our survey respondents had neither something good nor something bad to say about the existing upskilling programs. This indicates a significant lack of enthusiasm around existing upskilling programs. Our ask to all leaders is to take charge and put together a strategy for updating your existing upskilling program leveraging the DevOps human skill journey to determine priorities of domains and skill topics. Additionally, the resources of DevOps Institute and its partners can help you assess your needs.

- **Make certifications a key priority.** One way to upskill your existing team members is to provide them with certifications around key technologies and topics. Almost three-quarters, 66%, of our survey respondents said that certifications are extremely valuable.

Across IT, DevOps is consistently one of the fastest-growing and highest-value fields in the tech workforce. In the US, there were over 300,000 job openings requesting DevOps skills in the past 12 months. This demand is spreading rapidly across many roles and industries. In fact, over the next 5 years, DevOps skills are projected to grow 122%, making DevOps one of the fastest-growing skills in the entire workforce. As DevOps skills spread to new fields, however, it will require teams with minimal DevOps experience to quickly identify workers with the right combinations of new skills, suggesting a strong need for credentials that signal DevOps proficiency. Already, demand for existing DevOps credentials is surging. Since 2018 demand for the AWS Certified DevOps Engineer certification jumped 57% indicating a growing demand for credentials that serve as an effective proxy for DevOps expertise[20].

Develop leaders which can empower but also influence.
Our data makes it clear that the DevOps evolution of today requires leadership skills. More than 68% of survey respondents indicated that empowering, developing, and going beyond one's self to help the group are a must-have skill for DevOps leaders. The second must-have skill is influencing which means taking others' perspectives into account, but also changing people's minds about a topic and act in a certain way by acknowledging other people's opinions. But how does an organization develop such leaders? As Dan Roberts, CEO of Ouellette & Associates Consulting, Inc. states "To prepare for the demands of the future, there has never been a better time to have the opportunity to step up as a leader to change mindsets and foster new skills". Unfortunately, research shows that the largest group of leaders today are "accidental leaders" and 60% of frontline leaders say they have never received any training for their new role.[21]

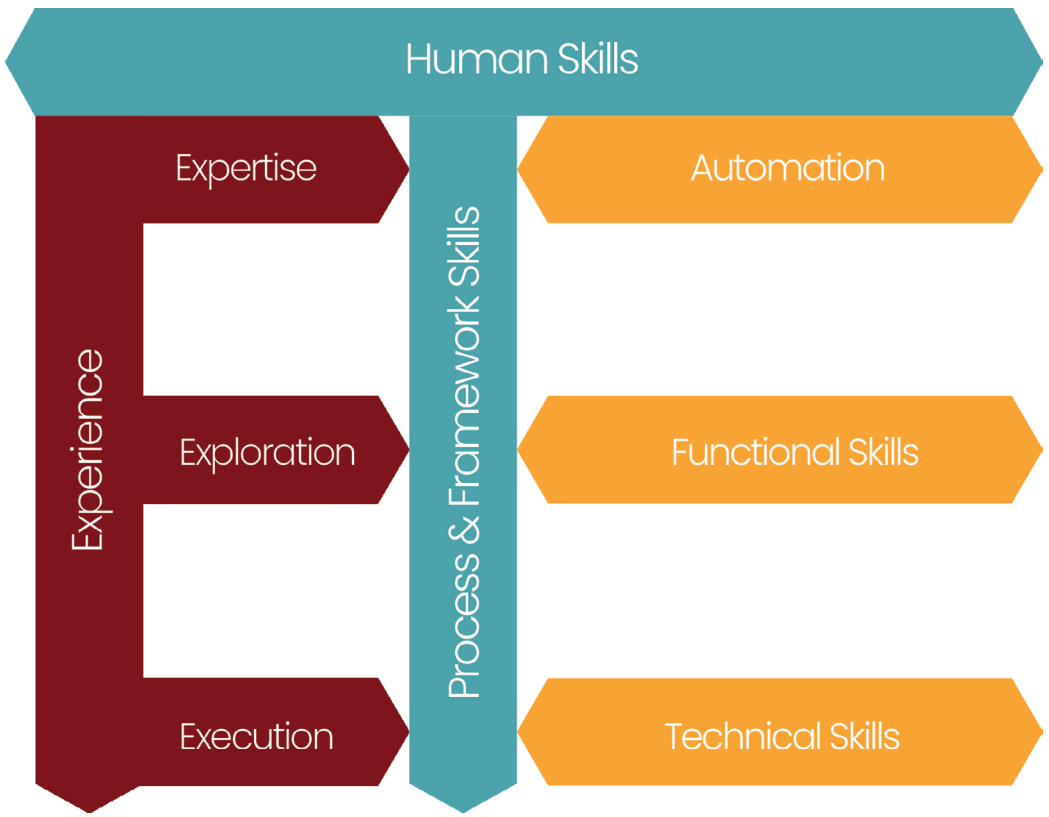
SECTION FOUR

Your Turn to Reflect, Plan, and Initiate a DevOps Upskilling Journey

Last year's report focused on the E-shaped DevOps human. There we stressed that each person has their own unique experience, expertise, examples of execution, and various tolerances for exploration (see Figure 19) and are enhanced by the skill domains. In this third 2021 Upskilling Enterprise DevOps report we have leveraged the E-shape within the DevOps Human Skill Journey (see Figure 17). To use the skill journey, you should:

FIGURE NINETEEN

The E-Shaped Human



1 Reflect on your current DevOps skills in terms of experience and expertise. Think about your experiences (breadth), expertise (depth), and what tangible execution examples you have gained throughout your current or previous positions or during past DevOps journeys and engagements. Take this inventory and compare it to the DevOps skill domains and must-have skills to examine where you already have sufficient experience and/or expertise or where you could improve.

2 Understand where you have made an impact through your ability to execute. List some key tangible achievements and contributions you have made throughout your personal DevOps journey. These could be specific results, improvements, or other achievements. Do not neglect where you had influenced results or outcomes as these are also important.

3 Understand your willingness to explore and change. Now reflect on your motivations and where you see yourself today and in the future. Are you comfortable with the current experience, expertise, and contributions you have made to your team and to your organization? Are there opportunities that you see where you could add additional value or take on a different role? Try to capture and understand your tolerance for exploration and ability to change, which will make it easier if you want to explore other opportunities or roles. Your willingness and ability to be flexible in expanding, learning, and acquiring new skills are essential in the current and future evolution of DevOps.

The following figures are self-explanatory and are intended as a backdrop for the *Upskilling 2021: The Enterprise DevOps Skills Report*.

SECTION FIVE

Additional Findings

FIGURE TWENTY

Transformation to DevOps has Become Less Difficult than in 2020

How would you describe the transformation experience in general during your DevOps journey (think across people, process, and technology)?

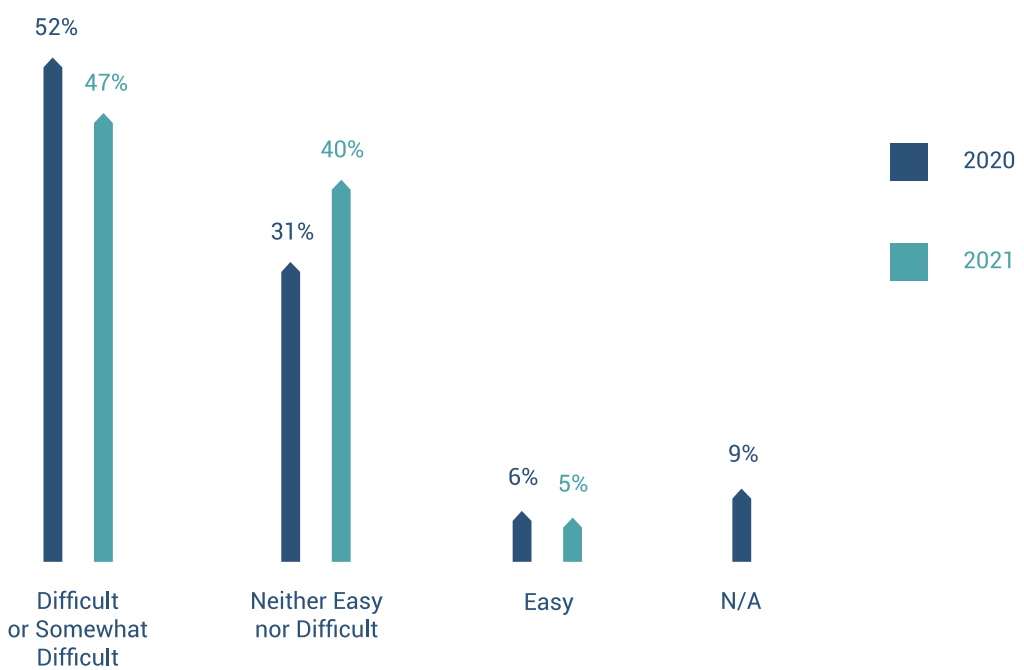


FIGURE TWENTY-ONE

During the Pandemic, Most Respondents Say No Change in DevOps Teams, or They Have Expanded Their Team

What impact has the current COVID-19 pandemic had on your current DevOps?

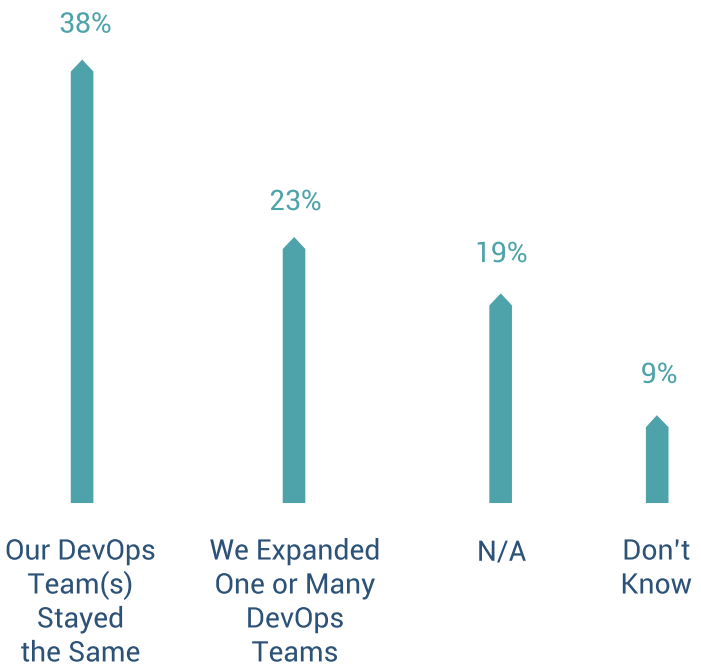
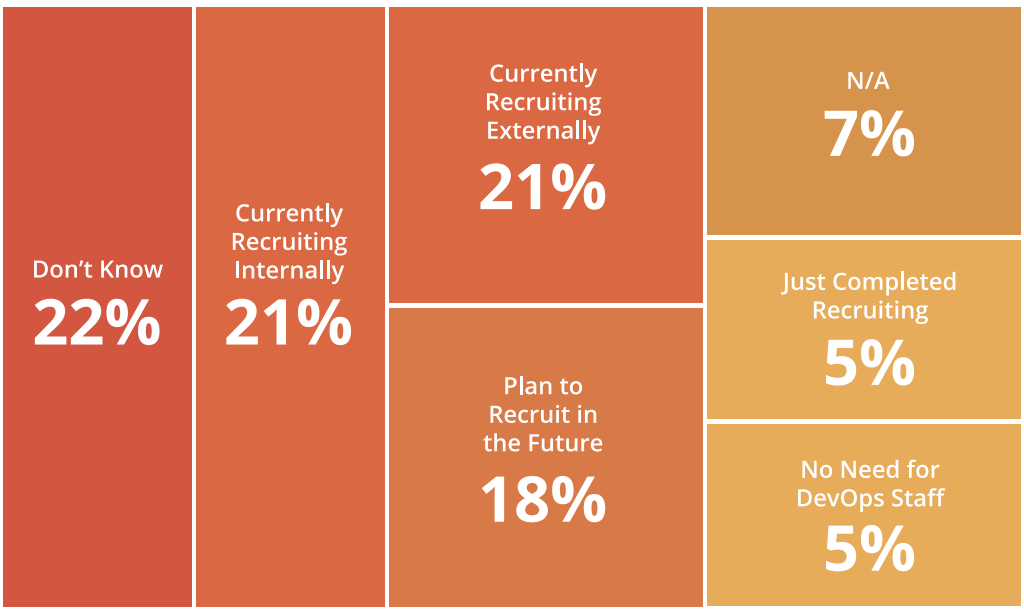


FIGURE TWENTY-TWO

60% of Organizations are Recruiting Now or in the Future, with the Trend to First Look for Team Members Internally

What steps does your organization currently take, or plan to take, relative to staffing DevOps team(s)?

Recruiting Heat Map



Which statement reflects (or reflected) your thinking relative to the hiring of DevOps team members?

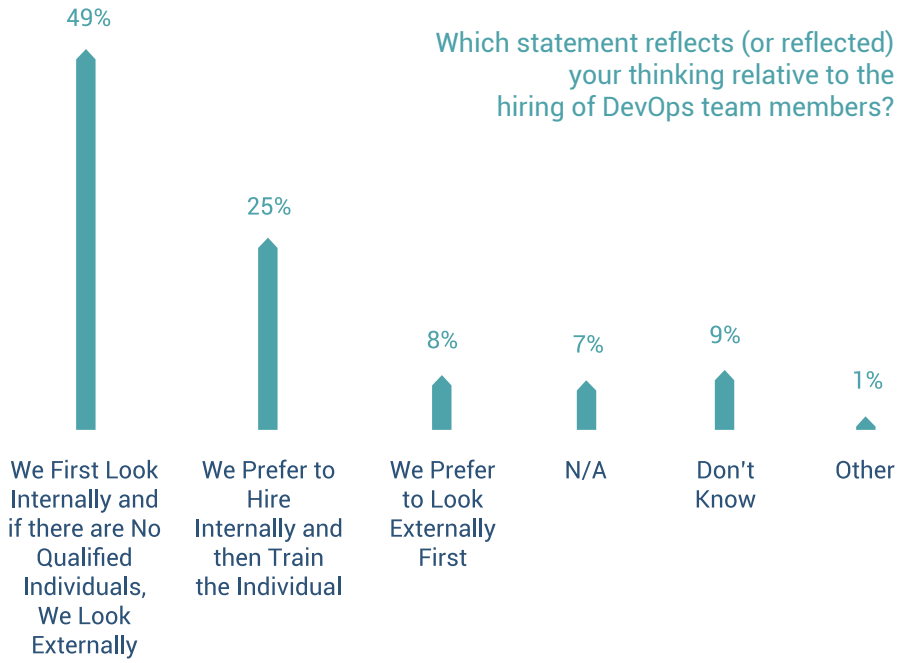


FIGURE TWENTY-THREE

Certifications are Desirable and Important

How would you describe your overall opinion around persuing certain certifications (e.g. AWS certified, DevOps certified, SRE certified, etc.)?

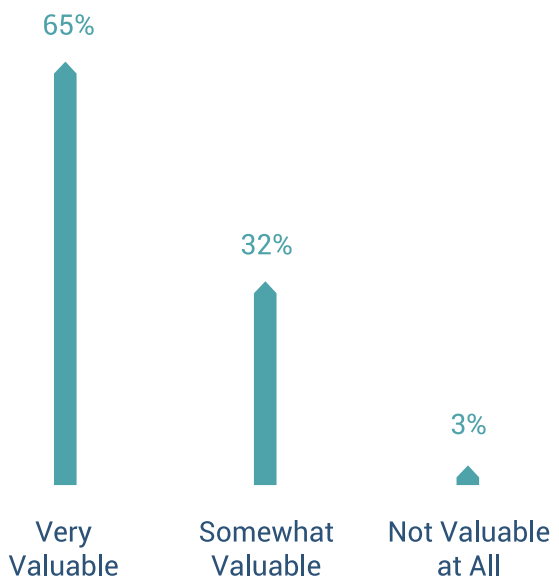


FIGURE TWENTY-FOUR

Learning Organization and Safety Culture are the Two Most Adopted DevOps Ways of Working

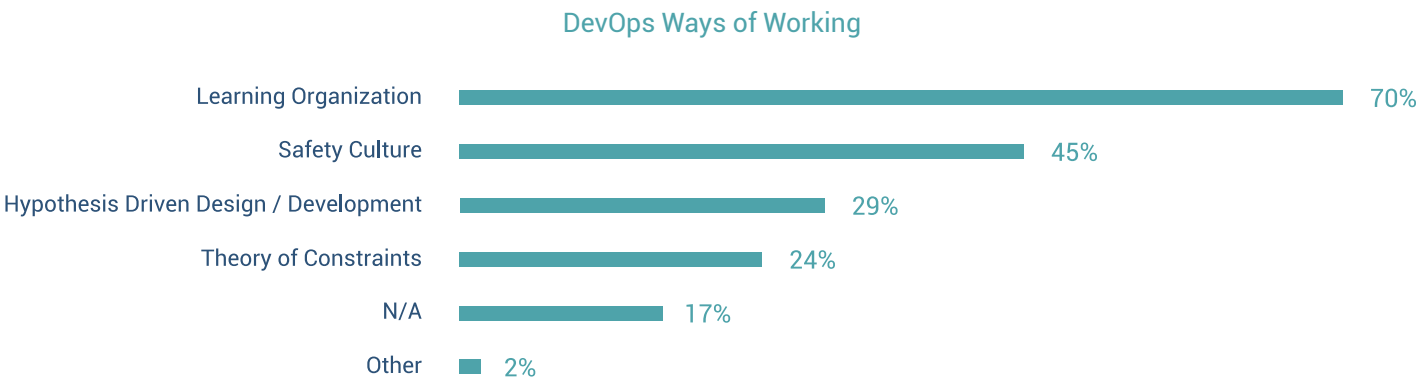


FIGURE TWENTY-FIVE

A Multitude of Engineers are in the Top 5 Roles which are Hired Across the Globe

For which job title(s) have you recently hired (or are planning on hiring)?

FIGURE TWENTY-SIX

Upskilling During the Next Normal

How has COVID-19 changed the priority of your organization or team upskilling program?

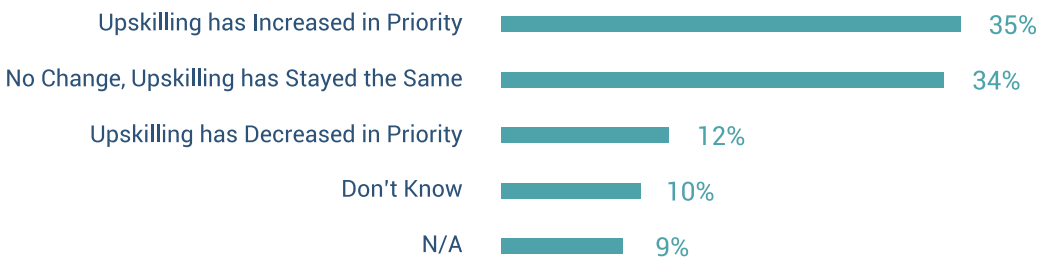
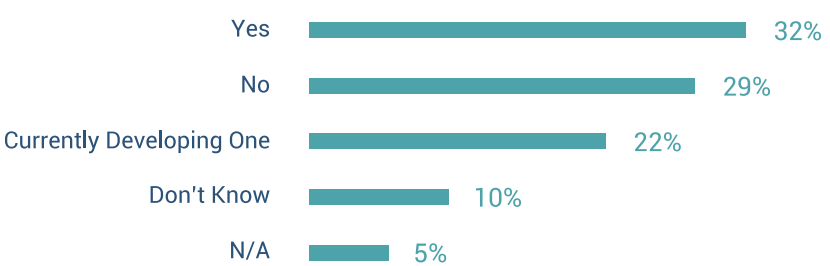


FIGURE TWENTY-SEVEN

Upskilling Programs are Still Weak:

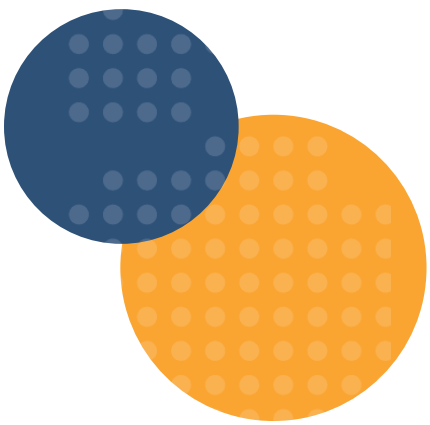
52% Don't Have or are Still Planning a Formal Upskilling Program

Does your organization have a formal upskilling (training) program for IT/DevOps staff members?



Thank You!

Romnick Acabado
Helen Beal
Eric Chapman
Niladri Choudhuri
Marco Coulter
Rose Dyson
Shivagami Gugan
Isha Gupta
Marc Hornbeek
Donna Knapp
Jeremy Morgan
Leonardo Murillo
Siddharth Pareek
Steve Pereira
Mark Peters
Peter Waterhouse
Don White



Sponsors

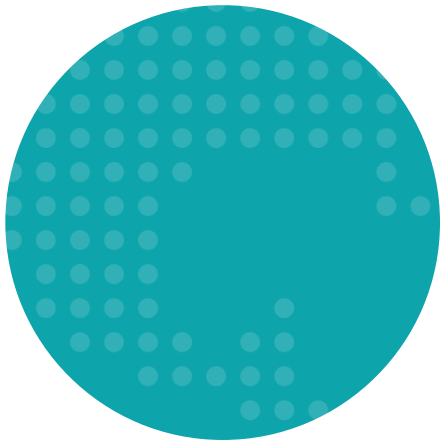
DevOps Institute extends a special thank you to the following partners for helping make this year's survey possible: GitLab, Platinum Sponsor; CloudBees, Gold Sponsor; Tricentis and UrbanCode, Bronze Sponsors.

Acknowledgments

DevOps Institute would like to thank the many people who have provided their thoughts, ideas, inputs, and guidance on this year's report. This work is not possible without including and connecting with subject matter experts, partners, and friends around the world. We are incredibly grateful to them for their willingness to share, collaborate, discuss, critique, and contribute to this report. Here we want to thank a few individuals who went above and beyond to help us: who have helped with the report. Thank you to DevOps Institute Chief Ambassador, Helen Beal, for her contributions to this report. Also, a big thank you goes to DevOps Institute's language editor Karen Skiles, director of marketing, Ingrid Sides, and creative designer, Christina Majic. And finally, a huge thank you to all the people who have completed our survey which is the foundation of our work.

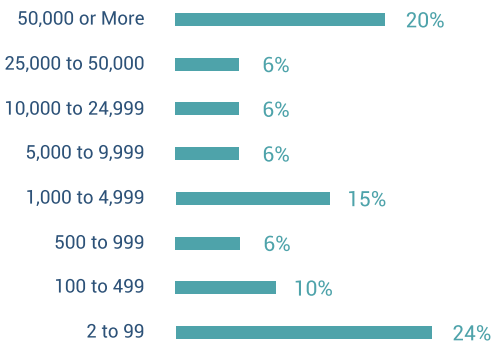
Demographics

The following figures will describe the demographics of the 2021 Upskilling The Global DevOps Human. We had a total of 2,069 survey respondents with good distribution across the globe, across verticals and enterprises. We also had a good representation of organizations with a hybrid infrastructure environment and modern infrastructures. Our survey respondents came from the key roles within IT organizations.

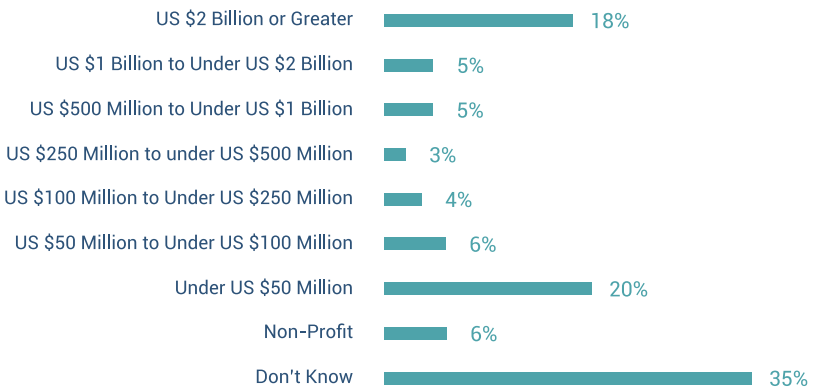


Demographics

Employee Count

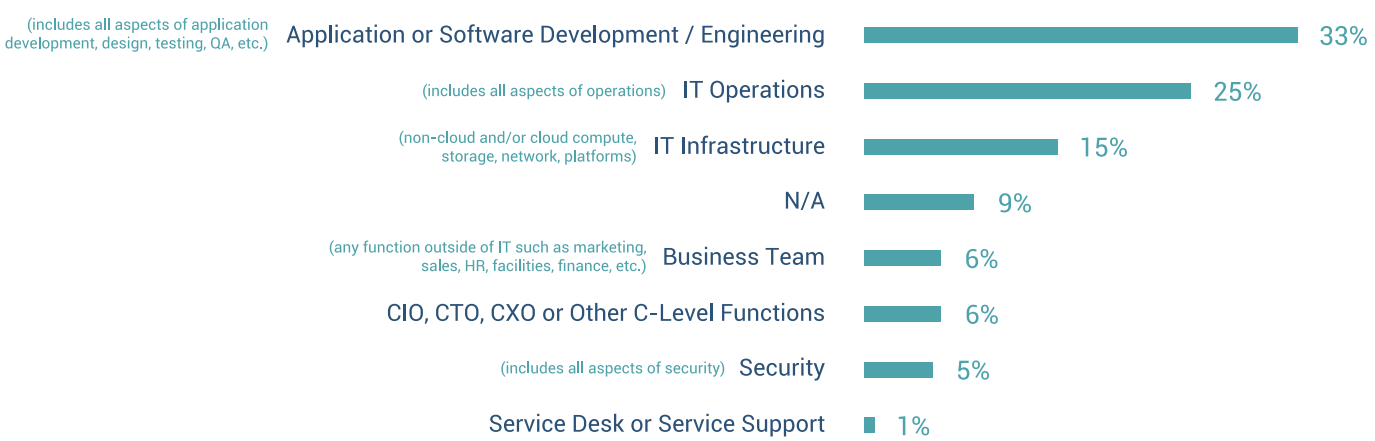


What is your company's yearly revenue?



43% Enterprise Size
in People and Revenue

What is your type of work?

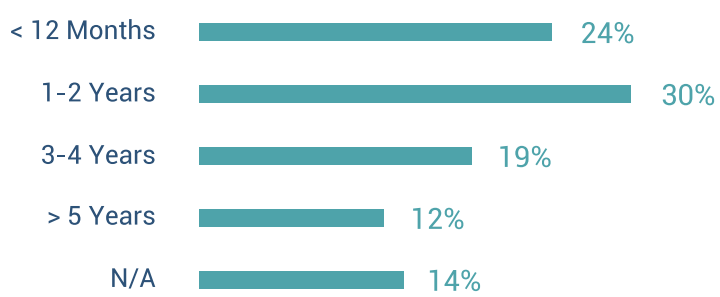


Good Balance Between
Dev and Ops

Which title best describes your role within your company/organization today?

30% Management
52% Practitioners

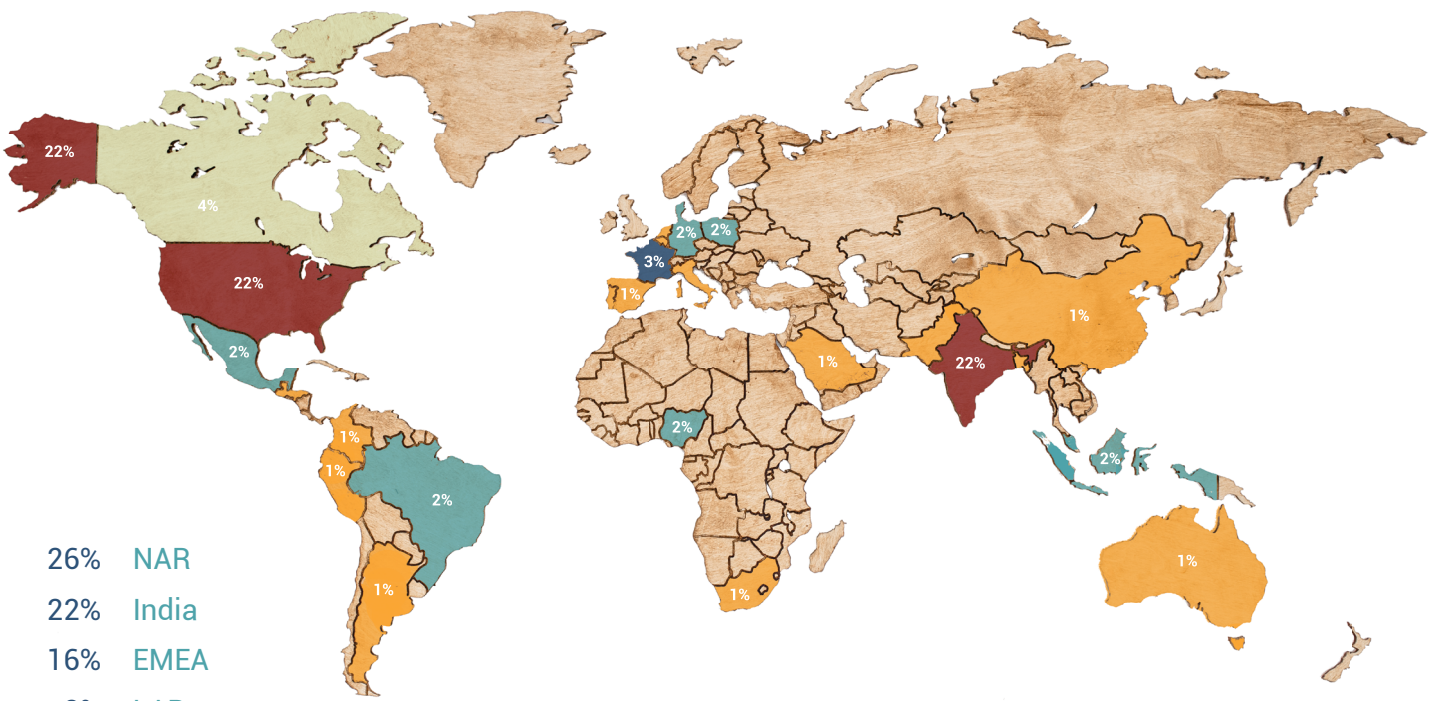
How long have you, your team, or your company leveraged DevOps?



54% DevOps Beginners
31% Advanced DevOps Folks

Geographies

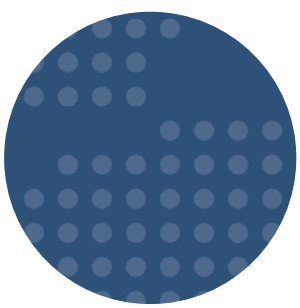
Respondents
within Countries



26% NAR
22% India
16% EMEA
8% LAR
31% RoW

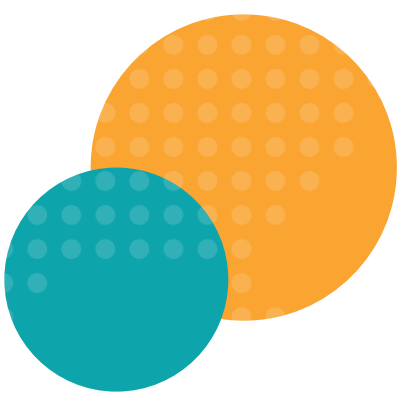
Research Methodology

The 2021 Upskilling: Enterprise DevOps Skills report is the third report capturing the perspectives of a variety of roles that are involved in recruiting, hiring, or working within DevOps initiatives. We set out to understand the must-have, nice-to-have, and optional skills within key skill domains (categories). After extensive research around skill domains, we determined the following skill categories: Automation, Human skills, Technical skills, Functional skills and knowledge, Process skills and framework knowledge, Business skills, and leadership skills.The target population for this survey was the community of DevOps practitioners, hiring managers, team leaders, consultants, human resources, and other individuals who are familiar with DevOps. We targeted all industry verticals and all company sizes. We promoted the survey via online promotions, short research webinars, social media, communication during major events, press releases, and through our network of people who helped us to share the survey with their network. Our sample is limited to individuals that are familiar with DevOps. We designed our survey questions with input from a variety of team members and experts. We tested our survey questions extensively to ensure good constructs and we leveraged SurveyMonkey Enterprise as our survey and design instrument.We collected primary data from our survey respondents. Our goal was to achieve a sample size of 2,000 individual responses targeting key geographic areas such as North America, Europe, Asia Pacific, and Latin America.



Interviews

We also leveraged personal interviews as a complementary research method to provide us with additional in-depth details. The interview scripts consist of brief, but open questions. The results from the interviews are not generalizable because of the subjectivity of data obtained. On the other hand, their flexible format contributed to a deeper explanation and understanding and allowed us to augment our report with interesting details.



Instrument Design

For the purposes of this research, the writer designed one questionnaire script and one brief interview script. The questionnaire for the survey takers from the companies consisted of 29 closed questions, related to DevOps skill priorities and importance within their teams or jobs. The first part of the survey focused on the key skill domains and detailed skills within the domains. The second part of the questions focused on DevOps topologies, hiring situations, and challenges. The last part of the questionnaire consisted of demographic questions, related to company size, region, the professional role of the participants, and the IT environment.

If you have questions on our survey methodology, please contact:
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Author and Biographies

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Eveline Oehrlich is Chief Research Officer at DevOps Institute. As former VP and Research Director at Forrester Research, Eveline led and conducted research around a variety of topics including DevOps, Digital Operational Excellence, Cognitive Intelligence, and Application Performance Management for 12 years. She is the author of many research papers and thought leadership pieces and a well-known presenter and speaker. She has more than 25 years of experience in IT. Her passion is to help companies transform their IT organization, processes, and tools towards high-performing teams enabling their business partners to achieve better business results. She has helped some of the largest enterprises across the world to adopt new strategies, workflows, and automation within their journey towards a digital business.

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Jayne Groll is Co-Founder and CEO of DevOps Institute. Her IT management career spans over 25 years of senior IT management roles across a wide range of industries. Her expertise spans multiple domains including DevOps, Agile, ITIL, and Leadership. Jayne is a recognized and respected IT thought leader and influencer. In addition to authoring the Agile Service Management Guide, Jayne has co-authored several IT position papers including "Modernizing IT Operations in the Age of DevOps" was published in 2018 by IT Revolution. Jayne is very active in the global DevOps, ITSM, and Agile communities and is a frequent presenter at local, international, and virtual events.

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Jean-Pierre (JP) Garbani has extensive experience as an industry analyst through his research at Forrester and Giga Information Group where he was the Research Director of the computing infrastructure group. JP started his career in early 1968 as a software engineer working on the automation of nuclear power plants in France. After joining Bull General Electric in Paris, subsequently Honeywell Bull, JP designed and implemented very large projects including network infrastructures in France, Scandinavia, and the United States. At Bull, JP occupied several positions in software development and marketing before moving to the United States in 1984 where he filled several engineering and marketing positions at Bull Information Systems. In 1994, JP created Epitome Technology Corporation, a middleware software company focused on Manufacturing Execution systems. Prior to joining Giga, JP worked as an IT management consultant for very large financial institutions in the US.

JP graduated from Ecole Superieure d'Electricite (Supelec-Mehari) in France and was granted the equivalent of an MS in Computer Science in the US.

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Appendix

Business Understanding	Includes seeking and working for and with the business to solve business problems
Career Development	Includes coaching others or oneself for ongoing development of all skills
Collaboration and Cooperation	Includes working with others to achieve common goals
Communication Skills	Includes the effective communication across functional and leadership stakeholders
Creativity	Includes taking responsibility of new ideas and solutions to solve problems
Customer Experience Skills	Includes a understanding of how customers interact with the business
Diversity and Inclusion	Includes the accommodation and inclusion of multiple lifestyles and needs, and to accept the viewpoints and expertise of others
Empathy	Includes understanding and taking different backgrounds, ideas and styles into consideration when working
Flexibility & Adaptability	Includes adapting easily to change, remaining flexible and open to change
Interpersonal Skills	Includes communication, relationship building, listening
Multi-Tasking	Includes the ability to focus resources and activities on multiple tasks while achieving key goals and/or desired results
Personal Value Commitment	Includes trustworthiness, respect of others, ethics, integrity
Problem Solving	Includes showing good judgment, focus on the right thing, high quality decision making, accept feedback to strengthen further improvement
Product Thinking	Is defined as the thinking of "building the right thing, the right way"
Risk-Taking	Includes making decisions taking risks into consideration, possibly without supervision
Sharing and Knowledge Transfer	Includes effective transfer of acquired knowledge to others
Strategic Thinking	Includes comprehensive and holistic thinking, developing a bigger paradigm
Technical Writing	Includes capability to author and edit technical content for others to consume
Thought Leadership and Innovation	Includes knowledge on industry innovation, trends and practices, ability to accelerate adoption of best practices

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