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2019

Upskilling:
Enterprise DevOps Skills Report

Presented by DevOps Institute

Contents

A Note from Jayne Groll, CEO, DevOps Institute

I have had the privilege of watching the growth of the DevOps movement from my first DevOps Days in Mountain View, California in 2012. Since then, the focus has been gradually shifting away from "What is DevOps?" to "How do we do DevOps?" Well "how to" requires "know-how." And "know how" requires a new set of skills. But which skills? While the need to reskill, upskill or cross-skill teams and individuals has become clear, there has been little data to validate and prioritize the range of skills that are the most important. Until now.

DevOps Institute is delighted to have partnered with Eveline Oehrlich, a well-respected and seasoned IT analyst, on this important research project. With the support of our sponsors, industry influencers and our global DevOps community, we intend to make this a year over year event to provide current data on skilling trends. We hope this data will help shrink the skills gap and support the career growth of the humans of DevOps.

The day of the specialist is gone as the future requires human capital which is "T-shaped." This is a human with disciplinary depth, in the cloud for example, but with the ability, or arms, to reach out to other disciplines. Let's work together to help people fill the top of their T.

Introduction

Between October 2018 and January 2019, the DevOps Institute surveyed more than 1,600 people to identify which skills are considered critical to DevOps and digital transformation. While DevOps is a popular movement, the dearth of DevOps skills and talent is significant. More importantly, there is a lack of clarity regarding the skills individuals should be honing or organizations should be hiring for. This global research project and resulting report is intended to provide critical insight and benchmark data on the state of DevOps skills so that we can measure trends and progress year over year.

The DevOps Institute fielded the "UpSkilling: Enterprise DevOps Skills Report" to help the IT community and the community as a whole understand what new skills IT practitioners should develop as either deep or general knowledge to meet the growing demand for well-balanced "T-shaped" professionals. T-shaped individuals supplement their depth of specific knowledge (the deep stem of the T) with a wide range of general knowledge (the general top of the T). The need for T-shaped talent is being driven by the increasing requirement for speed, agility and quality software from the business.

The report leveraged a sample size of professionals representing enterprises worldwide. We organized the skills into the following five focus areas: process skills, soft skills, functional skills, technical skills and automation tool skills. The skill priority results are posted in the context of all survey takers—both the hiring leaders as well as the individual contributors.

Additionally, a variety of attributes are included that provide insight into the demographics of the survey respondents, such as industry, revenue, function and job title. From the survey we understand that the importance of crucial skill categories differs significantly by role, so we have created the following groups and the respective results:

Entire sample size includes all respondents regardless of their role, function, company size and DevOps organizational model.

- **C-level executives** are C-level positions responsible for driving organizational strategy, such as a CEO, CIO, CTO or CMO.

- **Management** are VP-level or project or program leads responsible for driving efforts across specific departments and functions and are hiring DevOps individuals into their teams.

- **Individual contributors** are team members or practitioners who are already part of or want to move into DevOps teams.
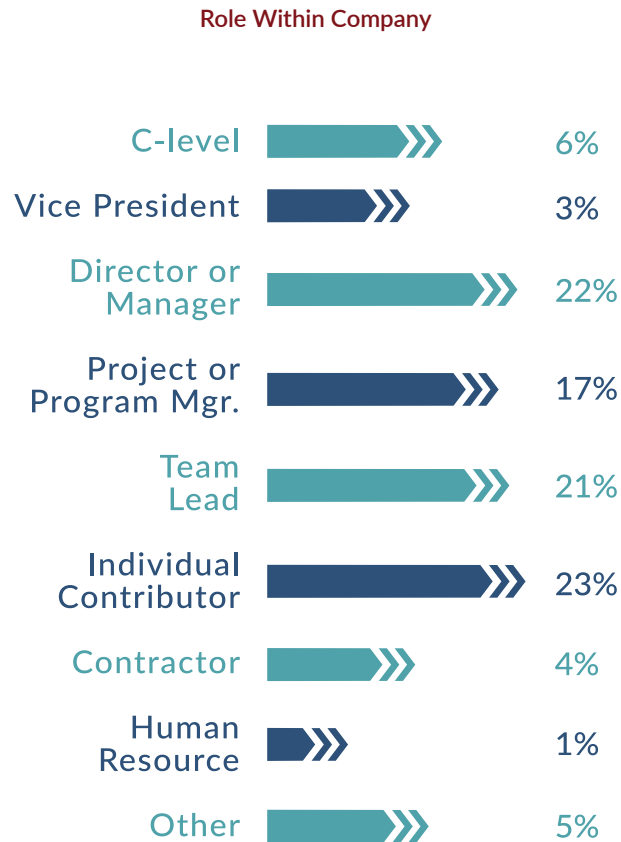
The following figures describe the respondents' geographical distribution, company size in revenue, number of employees and the roles of the survey respondents.

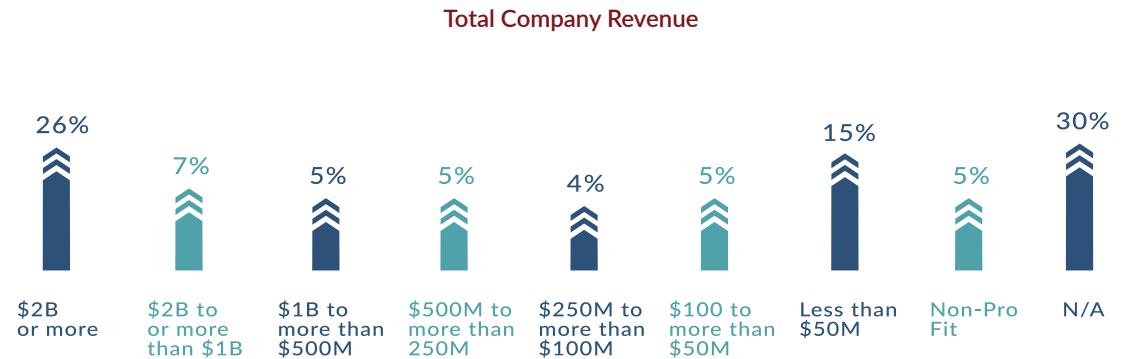**Figure 1: Respondents Profile - Geographical Coverage**

30% NAR

23% Europe

1% China

8% APAC

17% India

8% LAR
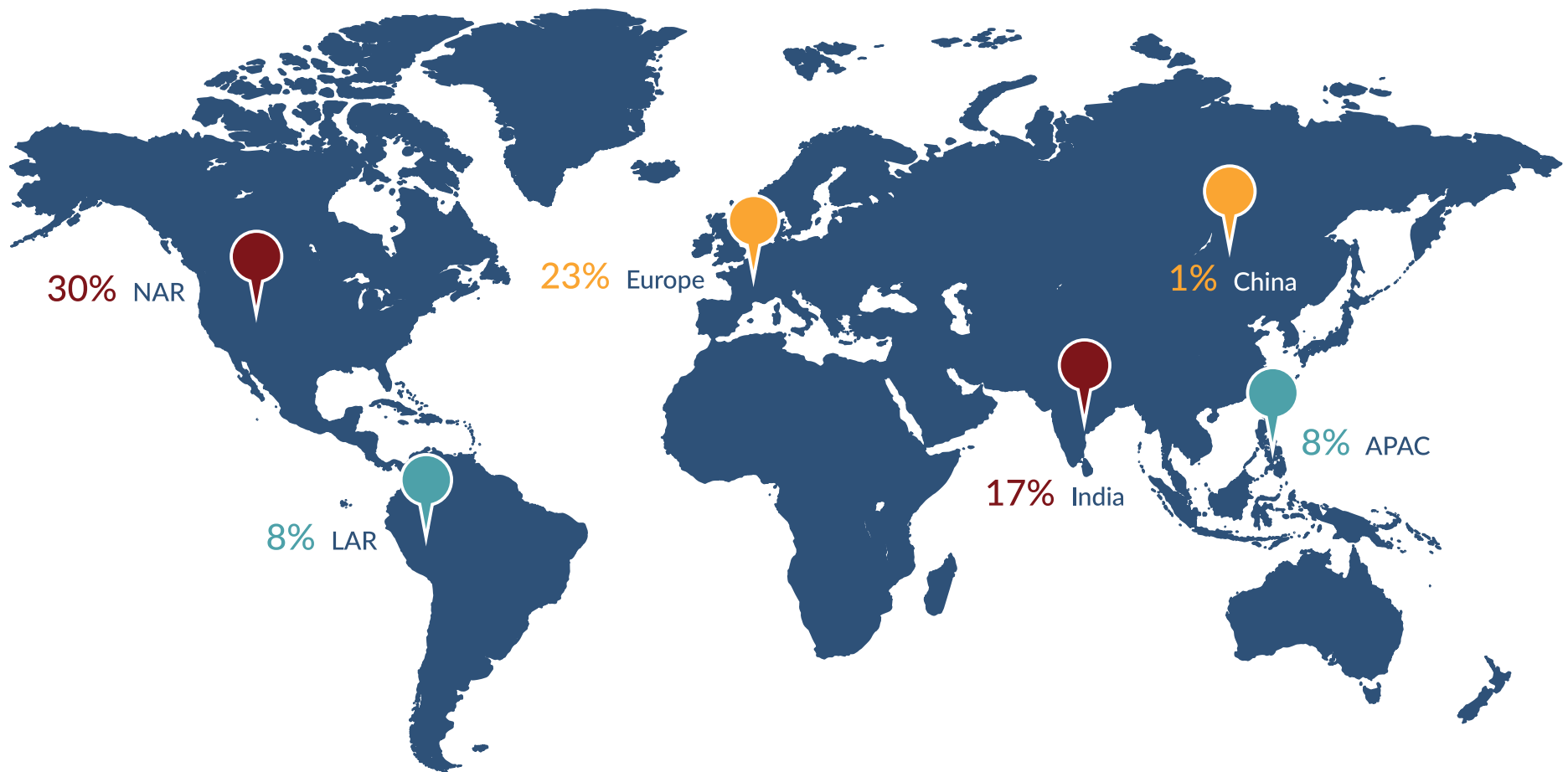
Respondent Profile N=1,085
Question: In what country are you located?
N/A: 13%

Figure 2: Survey Participants Represent a Mix of Company Sizes and Roles

Role Within Company

Role	Percentage
C-level	6%
Vice President	3%
Director or Manager	22%
Project or Program Mgr.	17%
Team Lead	21%
Individual Contributor	23%
Contractor	4%
Human Resource	1%
Other	5%

Respondent Profile: Role Within Company N=1,024
Question: Which title below best describes your role within your company/organization today?

Total Company Revenue

Category	Percentage
$2B or more	26%
$2B to or more than $1B	7%
$1B to more than $500M	5%
$500M to more than 250M	5%
$250M to more than $100M	4%
$100 to more than $50M	5%
Less than $50M	15%
Non-Pro Fit	5%
N/A	30%

Respondent Profile: 2017 Total Company Revenue (N=1,024)
Question: What was your company's total revenue in 2017? (or fiscal year 2017)

Employees Worldwide

Category	Percentage
20,000 or more	28%
5,000 to 19,999	13%
1,000 to 4,999	14%
Less than 1,000	41%
Don't Know	2%

Respondent Profile: Employees Worldwide (N= 1,244)
Question: Using the best estimate, how many employees work for your company/organization worldwide?

Figure 3: Survey Participants Represents a Mix of IT Environments and Teams

Current state of IT Environment

Category	Percentage
N/A	2%
We Are Almost All Modern (e.g. cloud, serverless, etc.)	14%
70% or More of Our Environment is Modern (e.g. cloud, serverless, etc.)	16%
We Have a Hybrid Environment (some legacy / some modern e.g. cloud, serverless, etc.)	45%
70% or More of Our Environment is Legacy	18%

Respondent Profile: Current state of IT Environment (N=993)
Question: How would you describe the current state of your IT environment?
NOTE: independent of what you are moving towards

IT Role

Role	Percentage
Human Resources	1%
Business Team	6%
Project Management Office (PMO)	4%
Office of CIO or CTO	5%
Quality Assurance	3%
Security	1%
Service Desk or Service Support	2%
Mainframe	1%
Cloud	10%
Infrastructure (network, storage, servers, etc.)	8%
Application Design & Development (including testing team)	27%
IT Operations	19%

Respondent Profile: IT Role (N=993)
Question: To which specific role or team do you belong to?

Top Takeaways

Here's what we discovered:

Yes, there are three key categories of skills that are very important.

The results from our data set support the notion of "must-have" and "nice-to-have" skills. The respondents agreed that automation skills (57%), process skills (55%) and soft skills (53%) are the most important must-have skills. Functional skills such as knowledge within infrastructure and operations, application design and development, security and others are also rated high in the "must-have" category. Other functional areas such as testing and enterprise/business architecture did not receive high "must-have" ratings but high in the "nice-to-have" category.

Respondents across key roles agree on the most important skills for DevOps.

Across three types of roles (C-level executives who are leading the business or IT strategy, management and IT leaders who are in charge of teams and projects, and individual contributors who are contributing with their skills) all agree that automation skills, process skills and soft skills are the most important must-have skill categories.

Automation makes DevOps a success.

IT organizations and their business partners have adeptly navigated many revolutions over the last 30 years, from mainframes to personal computers, cloud and artificial intelligence. The pursuit of a digital business presents different challenges and the the goal of automation is to reduce waste and improve speed, velocity and quality to continually enhance customer experience. This requires a new set of skills. For 57% of our survey takers, automation is a must-have skill.

Process skills are essential for intelligent automation.

Automation is important but only useful if the process (which will be automated) has been streamlined for maximum efficiency, optimization to achieve value. Our survey respondents rated the following skills as the top five must-have skills within the category of process skills: software development life cycle (47%); understanding of process flow and analysis (46%); Agile (42%); experience with test-driven deployment concepts and methods (40%); and system thinking (39%). When asked about program management or project management, 35% of respondents agree that both of these skills are "don't cares."

Soft skills and technical skills are equally important.

There is an equal balance between those who look for soft skills and those who seek technical skills when hiring externally or internally. About 30% of our survey respondents said they look for soft skills first, as they believe they can always train or educate on the process and technical skills. And 32% looked first for technical skills to get benefits from the new hire.

IT Operations is a key functional skill ... but security comes in second.

The conversation around DevOps and its makeup is 10 years old this year. The combination of the terms Dev and Ops are perfect to reflect the key functional areas involved. IT operations knowledge received the most "must-have" votes (52% of respondents) as a functional skill. However, security incidents and breaches still happen far too often. Our survey respondents told us that security is the second must-have skill (47%). Additional must-have functional skills are IT infrastructure (44%), application design and development (42%), quality assurance (34%) and testing (31%).

Business skills are most important to leaders.

C-level executives and IT management are rating business skills — defined as communication, influencing, negotiation, strategic thinking and leadership skills — as most important (43% of C-level and 47% of other IT leaders respectively), whereas only 22% of individual contributors said these skills are very important.

Hiring from within is the most predominant thinking.

A vast majority (55%) of respondents said they first look for internal candidates when searching for DevOps team members and will look externally only if they have not identified an internal candidate. Other responses worth highlighting are that 18% would hire internal and train the individual, while 13% would hire external and train the individual.

Vertical skills are a plus, but only necessary within specific industries.

More than half (57%) of respondents agree that vertical skills are a plus when they evaluate candidates. A team lead within a large retailer concurs. Jason Gould from Ikea put it this way: "It depends on where you are: If you are responsible for customer-facing services and products, I want somebody who knows how to measure success. In other verticals where it is more of a general capability such as working on products and services which includes financial transactions, this skill is certainly teachable and can be picked up quickly by individuals." The following industries received high responses (more than 30%) from individuals who believe that vertical skills are important: Electronics, Media and Leisure, Telecom Services, Travel and Hospitality and Government.

> "It depends on where you are: If you are responsible for customer-facing services and products, I want somebody who knows how to measure success. In other verticals where it is more of a general capability such as working on products and services which includes financial transactions, this skill is certainly teachable and can be picked up quickly by individuals."

Jason Gould, Ikea

The following sections offer a deep dive into the numbers driving our conclusions, including data around specific questions and topics. The details will help you to develop a skilled enterprise DevOps organization or will help individuals to update their DevOps skill shelf.

Industry Outlook

The definition of digital business varies depending on a company's industry. However, the transformation into the digital world sometimes called the Digital Revolution, is the same for all, as it must include models leveraging physical and digital resources for employees, partners and customers. According to Gartner, "Technology will be embedded in everything in the digital business of the future. Rich digital services will be delivered to everything and intelligence will be embedded in everything behind the scenes." During the recent World Economic Forum Annual Meeting in Davos, Switzerland, world leaders discussed the Fourth Industrial Revolution which builds on the Digital Revolution. This Fourth Industrial Revolution will bring tremendous changes across areas of technology, society and to us humans.

Digital Business and Transformation

While our research focused on key DevOps skills, the topics of digital business and ongoing digital transformation across an organization's people, processes and technology are intertwined.

In fact, a study by MIT Sloan Management Review and Deloitte noted that "digital maturity … represents the degree to which organizations have adapted themselves to a digital business environment. For the first time, we observed a meaningful uptick in digital maturity. The percentage of respondents who report their company as being in the early stage of digital disruption has dropped nearly 9 points from last year, and the percentage of those reporting their company is either in the developing or maturing stage has gone up approximately 3 and 5 points, respectively."

From our work with executive leaders through the DevOps Institute (and in my past analyst experience), we know that successful digital transformations require a partnership between IT leaders and the business, and IT leaders must function as the catalyst within their IT organization to drive digital transformations. The DevOps movement is one evolution to change how IT organizations are delivering core technology, services and products to support the business's digital opportunities. From our data, the current states of DevOps journeys range from 15% in the planning or initial stage to 43% adopting DevOps at the project level. Another 19% of respondents leverage DevOps across their entire enterprise. (see Figure 4)

Figure 4: **The Current State of DevOps**

Planning or Initial Stage:
My company is at the planning and/or initial stage within our enterprise (planning horizon within the next 12 months)

Project Level:
My company is applying DevOps at one or multiple projects

Enterprise Adoption:
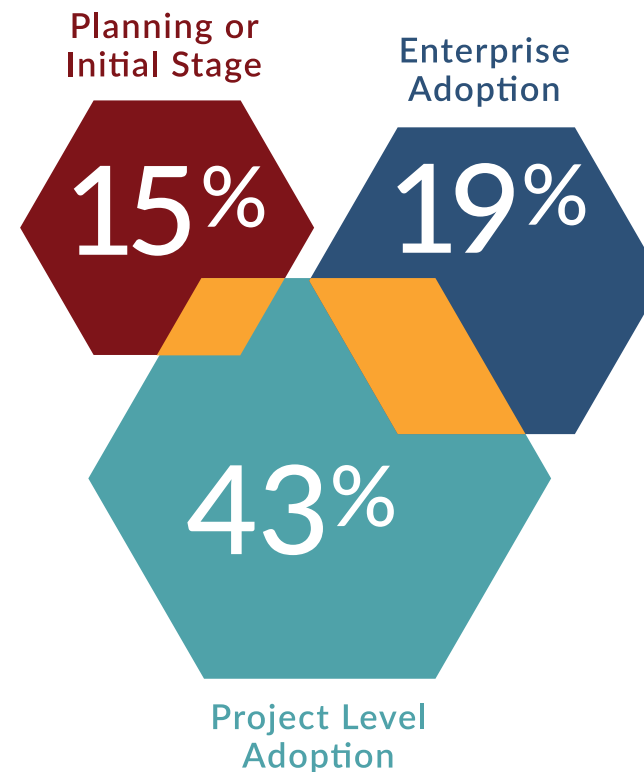We are applying DevOps across our enterprise at large

11% Plan to leverage DevOps in the future (planning horizon longer than 12 month)

1% Consciously Avoiding DevOps

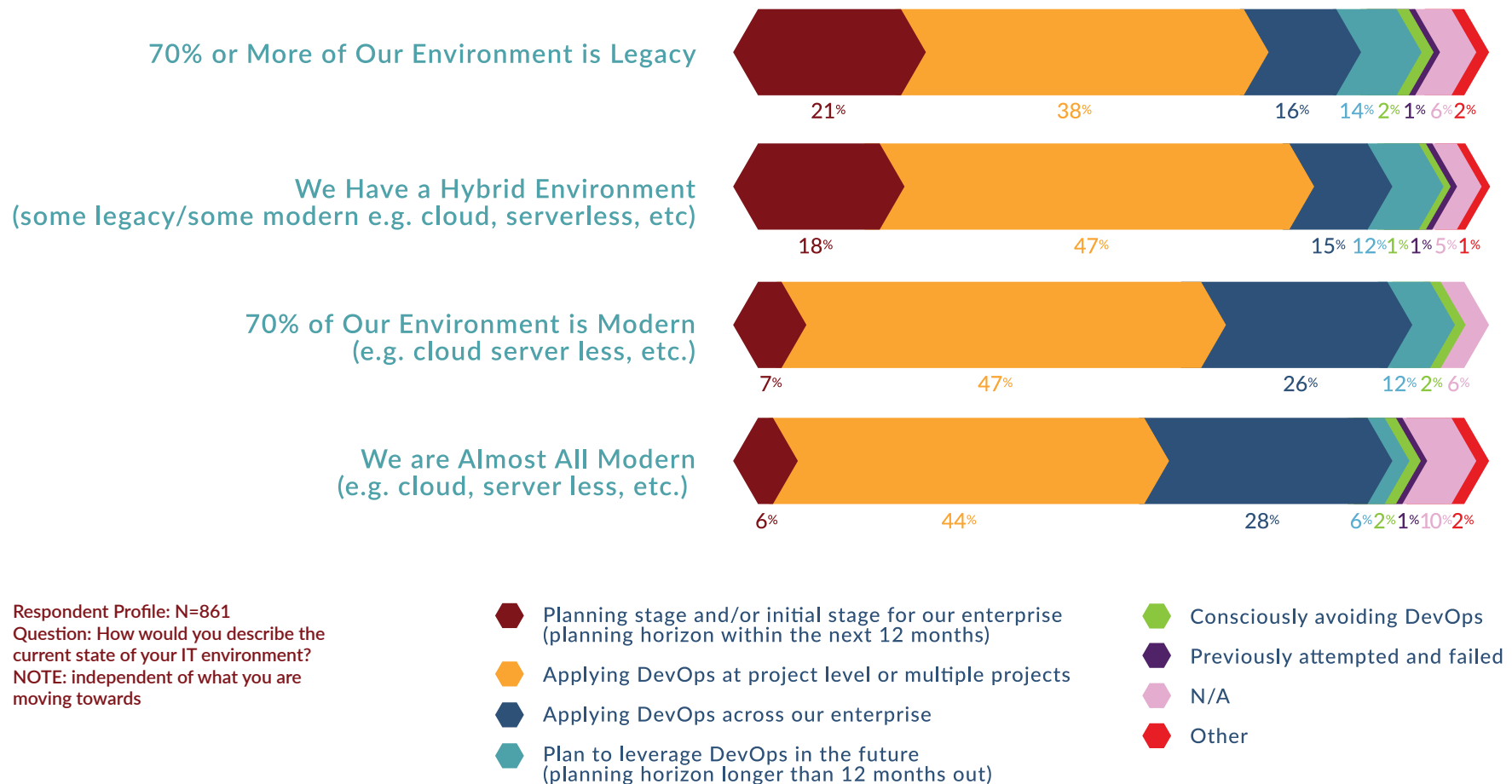1% Previously Attempted and Failed

8% N/A

Respondent Profile: N=914

Planning or Initial Stage

Enterprise Adoption

15%

19%

43%

Project Level Adoption

This amounts to 77% of respondents who are leveraging and adopting DevOps at different stages. It is important to note that the stage of DevOps adoption is a reflection of where the company stands relative to its investment of time, effort and discipline into the initiative. Also, not every organization must leverage DevOps across the entire enterprise. Some existing applications or services are not a necessary part of the digital business and might not require transformation or modernization. Some organizations adopt DevOps only for new initiatives or within modern IT environments. However, it's notable that no matter whether the environment is hybrid or modern, the adoption of DevOps happens in each environment. Happy 10th birthday DevOps! (see Figure 4.1)

Figure 4.1: All IT Environments Leverage DevOps

70% or More of Our Environment is Legacy
21% 38% 16% 14% 2% 1% 6% 2%

We Have a Hybrid Environment
(some legacy/some modern e.g. cloud, serverless, etc)
18% 47% 15% 12% 1% 1% 5% 1%

70% of Our Environment is Modern
(e.g. cloud server less, etc.)
7% 47% 26% 12% 2% 6%

We are Almost All Modern
(e.g. cloud, server less, etc.)
6% 44% 28% 6% 2% 1% 10% 2%

Respondent Profile: N=861
Question: How would you describe the current state of your IT environment?
NOTE: independent of what you are moving towards

- Planning stage and/or initial stage for our enterprise (planning horizon within the next 12 months)
- Applying DevOps at project level or multiple projects
- Applying DevOps across our enterprise
- Plan to leverage DevOps in the future (planning horizon longer than 12 months out)
- Consciously avoiding DevOps
- Previously attempted and failed
- N/A
- Other

We did not ask the question of DevOps success as we believe that measuring this is difficult, since those who own the initiative could bias the results. The real success is in understanding the company's customer experience, which is influenced heavily by the quality and speed in which products and services are delivered. Let's remember that the key purpose of adopting DevOps is to improve agility, speed and quality of software and service delivery to achieve better customer, employee and partner experience.

DevOps Makeup

Unfortunately, there is no playbook to follow to achieve a successful DevOps initiative. To understand our audience's DevOps makeup, we asked a variety of questions regarding how they are organized, their state of knowledge and the adoption of complementary best practices to complement our research.

DevOps Topologies

Effective team responsibility boundaries for DevOps depends on a variety of factors, according to Matthew Skelton and Manuel Pais, authors of the upcoming 2019 book, "Team Topologies," which describes team interaction patterns for software delivery at scale. Since 2013, Skelton and Pais have curated the well-known DevOps Team Topologies patterns, showing which topologies are effective for fast flow and which ones are ineffective.

Our survey respondents have indicated a variety of DevOps topologies within their organizations (see Figure 5).

Figure 5: The Majority Of DevOps Teams Leverage a Cross Functional Team as Topology

- Add-On Responsibility of One or More Members of IT (ad hoc and not formalized)
- On a Project-by-Project Basis via DevOps Service Team
- Via a Cross-Functional Team Distributed Among Different IT Teams and Business Units
- Via a Central IT Team Which Services Multiple AppDev Teams
- Via a Dedicated Central DevOps Team Which Owns Governance
- Other

19%   22%   24%   11%   10%   3%

Respondent Profile: N=941
Question: How is your DevOps organization (or organizations) structured today?
NOTE: 11% N/A (meaning none of the above met their organization structure)

DevOps Knowledge

The Merriam Webster dictionary definition of knowledge is "the fact or condition of knowing something with familiarity gained through experience or association," and "the fact or condition of being aware of something." To provide us with details about what skills are important, it is essential that our survey respondents have "knowledge" about DevOps. Our survey respondents are knowledgeable within the topic of DevOps; in fact, 77% of our survey respondents are familiar with the definition of DevOps we provided: "Working towards a common goal that enables the fast flow of planned work into production while achieving world-class stability, reliability, availability, and security." (See Figure 6)

Figure 6: Our Survey Takers Know What DevOps Means

DevOps Knowledge

Given the following definition of DevOps "Working towards a common goal that enables the fast flow of planned work into production while achieving world-class stability, realiabitly, availability, and security."

What is your familiarity of DevOps?

Respondent Profile: N=1,242
Question:Given the following definition of DevOps "Working towards a common goal that enables the fast flow of planned work into production while achieving world-class stability, reliability, availability, and security."
(Source: DevOps Handbook)
What is your familiarity with DevOps?

Very Little Knowledge

Very Knowledgeable

18%

22%

4%

55%

No Familiarity

Knowledgeable
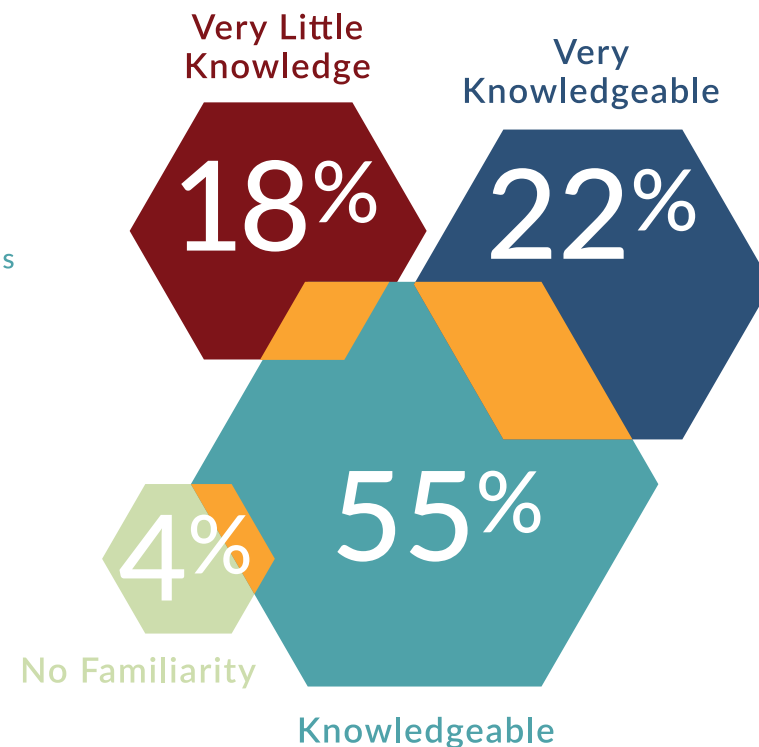
Adoption of Best Practices

Frameworks and best practices do exist to help organizations adopt new ways of working. A variety of best practices exist today, and their nature and which one to use is a much-debated topic. Analyzing the responses from our survey, the following results are the frameworks and best practices most used by the surveyed companies:

76% of survey respondents rely on Agile as a framework. Agile is used by software developers to improve the development process end-to-end. The Agile Manifesto was established in 2001. There are several Agile frameworks that have been derived from the Agile Manifesto.

66% are adopting DevOps. A variety of IT teams use DevOps to work towards a common goal that enables the fast flow of planned work into production while achieving world-class stability, reliability, availability, and security.

47% are applying ITIL as a best-practice framework that gives guidance on how to implement and manage quality IT services that meet the needs of the business. IT service management is performed by IT service providers through an appropriate mix of people, process and information technology.

10% use Site Reliability Engineering (SRE) practices, a method first used by Google to "protect, provide for, and progress the software and systems behind all of Google's public services — Google Search, Ads, Gmail, Android, YouTube, and App Engine, to name just a few — with an ever-watchful eye on their availability, latency, performance, and capacity."

There are other frameworks, processes and standards, and they all have their uses, but the above are the big four disciplines that our survey respondents indicate they primarily apply within their organizations today (see Figure 7). Please know that the survey respondents could select multiple frameworks in use.

Figure 7: Agile, DevOps and ITIL Together, with Some SRE Adoptions

DevOps 66%
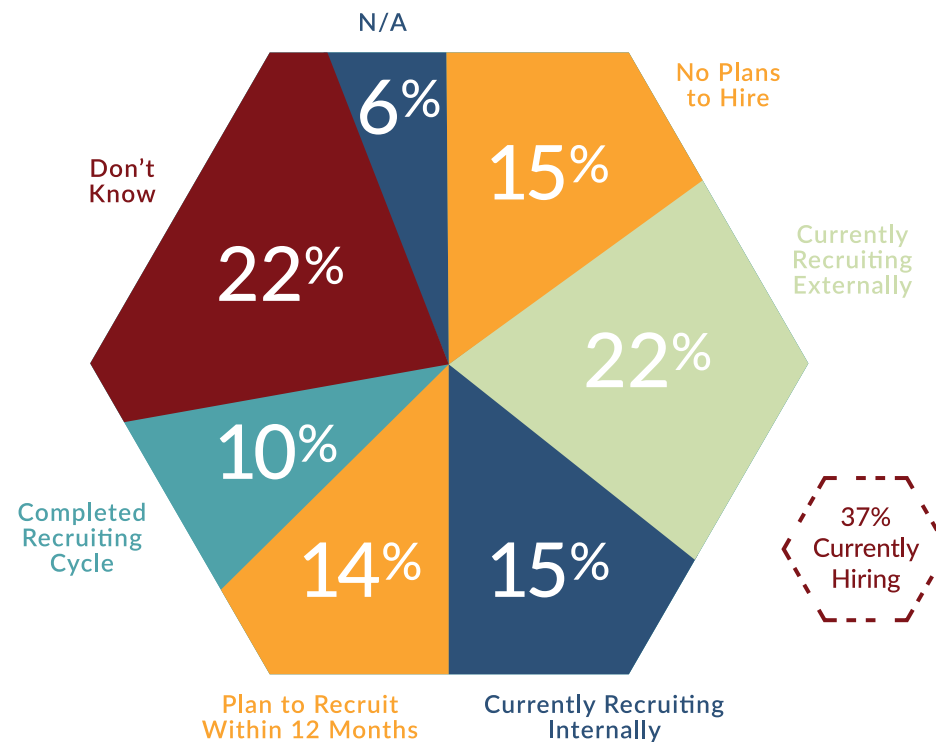**ITIL** 47%
76% **Agile**
10% **SRE**
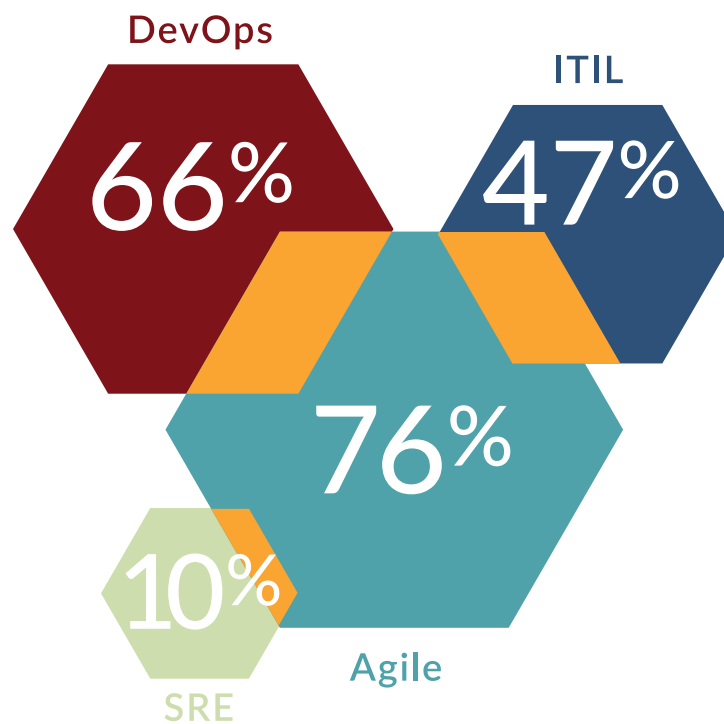
Respondent Profile: N=909
Question: Which discipline(s) do you primarily apply within your IT environment today? (Select all that apply)

DevOps Jobs, Recruiting and Challenges

As organizations are implementing the latest technical innovations while growing their IT staff in support of their digital transformations, they are in need of additional people resources. When asked about their hiring plans for DevOps, 37% of respondents say that they are currently hiring. An additional 14% indicate that they are planning to recruit within the next 12 months (see Figure 8).

Figure 8: The 2019 Race for DevOps Hiring is On

N/A 6%

No Plans to Hire 15%

Currently Recruiting Externally 22%

37% Currently Hiring

Currently Recruiting Internally 15%

Plan to Recruit Within 12 Months 14%

Completed Recruiting Cycle 10%
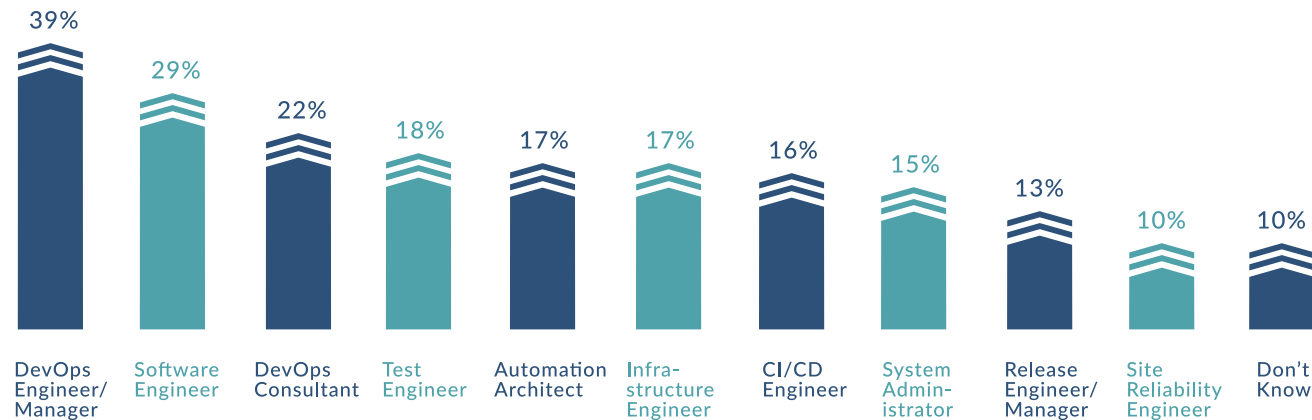
Don't Know 22%

Respondent Profile: N=872
Question: What steps is your organization taking, or planning to take, to expand the DevOps team(s)?

The large number of respondents looking for DevOps talent explains the fairly sizeable number of job openings within the role of DevOps. According to Glassdoor, DevOps Engineer was among the top 10 notable tech roles in demand for 2019. With a median base salary of $106,000 and more than 4,651 job openings in the United States alone, DevOps Engineers are the sixth most wanted professionals. In the "Robert Half Technology 2019 Salary Guide," DevOps engineer is listed as the seventh most popular job, with a median salary of $110,000. This, of course, creates a very competitive market: Erin Lovern, Talent Acquisition Director at CloudBees, says she must deal with numerous counter offers after extending an offer to prospective DevOps engineers.

In terms of hiring plans, the majority (52%) of companies are recruiting internally, whereas only 13% are recruiting externally. When it comes to the biggest DevOps recruiting challenges facing companies, finding skilled people and finding them in the right region top the list. To understand the different roles and titles being hired, we asked which roles these companies have hired into. We received the following roles which organizations are recruiting for: (see Figure 9)

Figure 9: The DevOps Engineer Title is a Popular Role to Recruit For

Percentage of Respondents
Who Hired for These Job Titles

DevOps Engineer/Manager	Software Engineer	DevOps Consultant	Test Engineer	Automation Architect	Infra-structure Engineer	CI/CD Engineer	System Admin-istrator	Release Engineer/Manager	Site Reliability Engineer	Don't Know
39%	29%	22%	18%	17%	17%	16%	15%	13%	10%	10%

Respondent Profile: N=812
Question: For which job title(s) have you recently hired (or are you planning on hiring)?
(select all that apply)

The Top 6 Roles Recruited Now and in the Future

When we asked which job title(s) companies recently hired (or are planning to hire), we received the following top six roles companies of any size and vertical are recruiting for: DevOps Engineer/Manager, 39%; Software Engineer, 29%; DevOps Consultant, 22%; Test Engineer, 18%; Automation Architect, 17%; and Infrastructure Engineer, 17%. Other recruits included CI/CD Engineers, 16%; System Administrators, 15%; Release Engineers/Managers, 13%; and Site Reliability Engineers, 10%. We asked an engineering lead from a large system integrator whether "DevOps Engineer" is a title at his company. "Yes," he replied. "Each person needs a title, but the ambiguity is the challenge. In our company, we use the title of DevOps Adviser. These are folks who are helping to improve the operating model as coaches. DevOps engineers are folks who are cutting code."

To see what titles are out there, we looked at the registrar data of a major DevOps conference and created a word cloud leveraging the list of titles attendees registered for DevOps World 2018 in San Francisco. The title "DevOps Engineer" was used most often; therefore, it appears bigger and bolder in the word cloud (see Figure 10).

Figure 10: DevOps Job Titles Word Cloud

Source: DevOps World 2018 Registration Titles

DevOps Recruiting Challenges

With all of the interest in DevOps talent, we wanted to understand the challenges of recruiting or hiring into this role. In general, when asked how difficult it was to hire and recruit, 62% of our respondents found their experience during the recent recruiting process difficult. A conversation with key recruiters also highlighted the challenge of not having a good definition of what DevOps means: Kenny Fitzgerald, a lead recruiter from TEKsystems, and CloudBees' Erin Lovern—two key individuals who are actively involved in recruiting DevOps talent into their companies—agree that DevOps means something different to each organization.

Additionally, they note that individuals market themselves as DevOps Engineers, yet many don't really have the skills and capabilities needed by the hiring organizations. When we asked if a skill matrix exists within our survey respondents organization, 32% said that they don't have a good list of DevOps skills or don't have any list whereas 27% of organizations continually update their existing DevOps skill matrix and 21% have a document list of key skills they leverage when hiring.

What To Look For When You Look or Recruit

We wanted to understand what the community looks for when recruiting into DevOps. Is it more important to look first for soft skills and then train or educate on the process and technical skills, or is it more important to first look for technical skills? The results: A small majority (32%) of respondents, recruiting internal or external, prefer to look first for technical skills, while 30% will look for soft skills first.

Future-Proof Your DevOps Skills

The digital transformation requires the reskilling of IT. According to Gartner: "70% of employees have not mastered the skills they need for their jobs today, and 80% lack the skills needed for both their current role and their future career." According to IDC, through 2022 "the talent pool for emerging technologies will be inadequate to fill at least 30 percent of global demand and effective skills development and retention will become differentiating strategies." This points to a huge opportunity for all current IT practitioners and individuals looking to develop or change careers. With DevOps in hot demand and the continuous drive to transform industries toward digital, it is essential for both management and individuals to know how to future-proof their DevOps skills and DevOps organizations.

The Knowledge, Skill, Ability Paradigm

Knowledge is the fact or condition of knowing something with familiarity gained through experience or association. The definition of skill is the ability to use one's knowledge effectively and readily in execution or performance. Ability is defined as the competence of doing something. Obviously, these three are related. The following section intends to share our survey findings relative to the importance of skills within DevOps. It is essential to reflect on the difference between knowledge, skill and ability before continuing. The following figure illustrates this:

Figure 11: Knowledge Can be Gained, Skills Can be Sharpened, Abilities are Natural

	Knowledge	Skills	Ability
Definition	Knowledge is the practical and/or theoretical understanding of a topic.	Skills are the things one learns through training and/or through experience.	Ability is the level of being able to perform, do or deliver a task.
Obtained Through	Learning, training, experience.	Practicing, learning.	Natural capability.

Source: DevOps Institute, 2019

The Top "Must-Have" Skill Categories For DevOps Individuals

DevOps practitioners do not all do the same things; however, the digital era introduces a set of continually evolving challenges across not just the technology topic, but also relative to the demographics of employees and customers. As millennials overtake baby boomers by 2019 in the United States and companies continually working on improving customer, employee and partner experience the adoption of DevOps will only rise.

While DevOps needs particular champions, excellence can be achieved only if the entire organization is on board, and that requires constant evangelism and training. But what are the key skills to look for when recruiting? What are the key skills to grow when you want to join the DevOps movement either inside or outside your company. To help you we have further analyzed the perspectives of our survey takers and their priorities across the following skill categories: automation, process, soft skills, functional, specific automation tools, business skills and certification.

The following figure shows the priorities across the top skill categories relative to the key roles we surveyed (see Figure12).

Figure 12: Differences of Perspectives of "Must-Have" Across Key Skill Categories

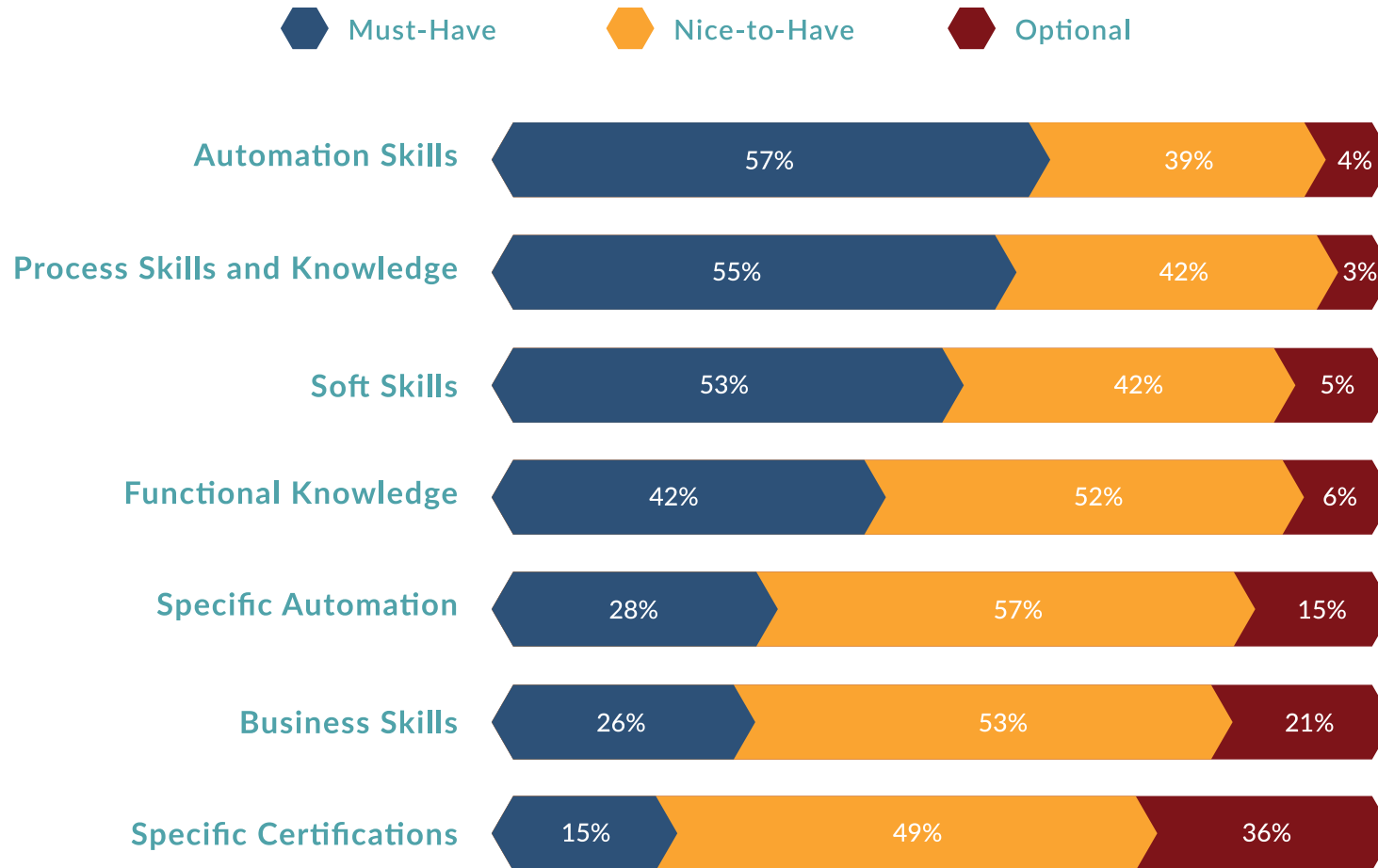| Skill Category	C-Suite Selected "Must-Have"	Management Selected "Must-Have"	Individual Contributor "Must-Have"
Process Skills and Knowledge	54%	58%	50%
Automation Skills	71%	58%	56%
Functional Knowledge	31%	35%	44%
Specific Automation Tools	29%	30%	20%
Specific Certifications	14%	16%	8%
Business Skills	43%	30%	22%
Soft Skills	69%	55%	44%

Respondent Profile: N=571

The following section highlights all six skill categories in further detail.

1 | DevOps As The Automator

A longtime friend (and former Forrester colleague Glenn O'Donnell) has always said: "Become the automator, not the automated." More than half (57%) of survey respondents agree that automation skills are a must-have. Automation has always been on the agenda of IT organizations—nothing new here, right? Well, yes and no. A word of caution, as John Willis—one of the founding and leading lights of DevOps—has said many times, "Culture: People and process first. If you don't have culture, all automation attempts will be fruitless." Our survey respondents agree that automation, process and soft-skills are the top three categories most important to DevOps. Forrester Research also recently published an automation framework which might be of interest. This framework describes the areas that are necessary to understand relative to people, the enterprise and the profile of the process to be automated. For further details, see the Forrester Research blog (see Figure 13).

Figure 13: DevOps as the Automator!

Legend: ⬡ Must-Have   ⬡ Nice-to-Have   ⬡ Optional

Skill Category	Must-Have	Nice-to-Have	Optional
Automation Skills	57%	39%	4%
Process Skills and Knowledge	55%	42%	3%
Soft Skills	53%	42%	5%
Functional Knowledge	42%	52%	6%
Specific Automation	28%	57%	15%
Business Skills	26%	53%	21%
Specific Certifications	15%	49%	36%

Respondent Profile: N=748
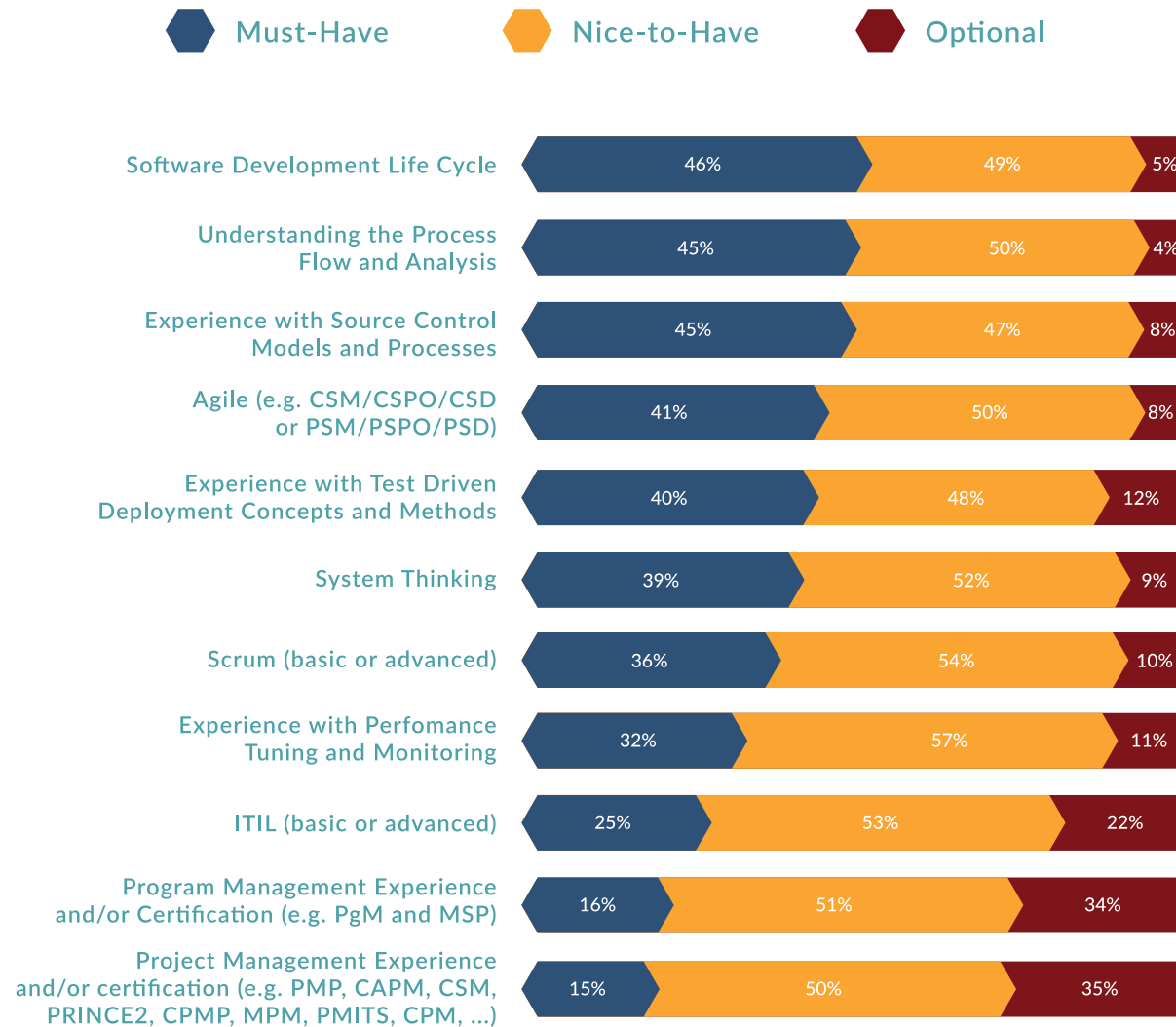Question: How would you rate the importance of the following categories of skills for your DevOps team member?

2 | No Intelligent Automation Without Process and Framework Skills

There are many different frameworks and process concepts throughout the DevOps life cycle to prioritize and to be marketable. Figure 14 shows the process and framework skill categories sorted from the most important to the least important. Skills in software development life cycle, understanding processes flow, experience with source control model process, Agile, experience with test-driven deployments all received high marks on the must-have skills spectrum. One surprise outcome: Project and program management is not perceived as a must-have skill; it received only 16% of our respondents' votes (see Figure 14).

Figure 14: Process Skills in Details:
SDLC knowledge, process flow and analysis, and experience with source control
models and processes are topping the must-haves within this category.

◆ Must-Have   ⬡ Nice-to-Have   ◆ Optional

Skill	Must-Have	Nice-to-Have	Optional
Software Development Life Cycle	46%	49%	5%
Understanding the Process Flow and Analysis	45%	50%	4%
Experience with Source Control Models and Processes	45%	47%	8%
Agile (e.g. CSM/CSPO/CSD or PSM/PSPO/PSD)	41%	50%	8%
Experience with Test Driven Deployment Concepts and Methods	40%	48%	12%
System Thinking	39%	52%	9%
Scrum (basic or advanced)	36%	54%	10%
Experience with Perfomance Tuning and Monitoring	32%	57%	11%
ITIL (basic or advanced)	25%	53%	22%
Program Management Experience and/or Certification (e.g. PgM and MSP)	16%	51%	34%
Project Management Experience and/or certification (e.g. PMP, CAPM, CSM, PRINCE2, CPMP, MPM, PMITS, CPM, …)	15%	50%	35%

Respondent Profile: N=748
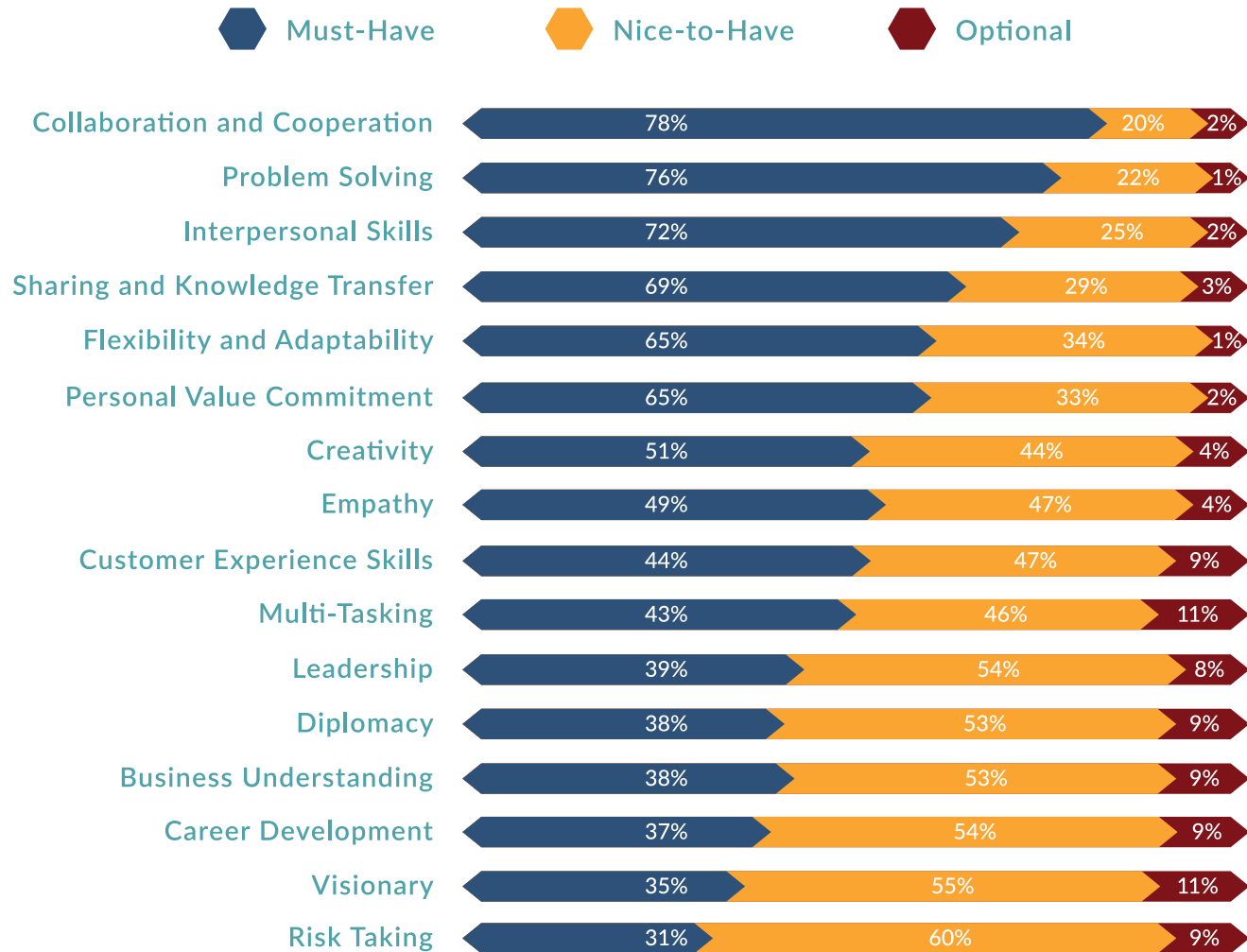Question: How would you rate the importance of the following categories of skills for your DevOps team member?

3 | Hire the Heart and Train The Brain: Which Soft Skills Matter Most

Klaus Schwab, founder of the World Economic Forum, said in his 2016 article describing the Fourth Industrial Revolution, "We stand on the brink of a techno-logical revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society." In light of this, one key category of skills today and in the future are soft skills. There are many discussions around the importance of soft skills, how to measure them, and whether they can be taught. The purpose of our analysis was not to explore these aspects, but rather to determine which soft skills are the must-haves (see Figure 15). We found that collaboration and cooperation, problem-solving, interpersonal skills, and shar-ing and knowledge transfer are the must-have soft skills for DevOps individuals. CloudBees' Erin Lovern says, "The reality of the DevOps world is one that is fre-quently changing. These engineers are continually challenged by new techs, dif-ferent problems, new dynamics within the projects and programs. This requires agile, curious and dynamic people." (See Figure 15)

Figure 15: Soft Skills Must-Haves:
You must-haves soft skills should include collaboration/cooperation,
problem solving, interpersonal skills and sharing and knowledge transfer.

⬡ Must-Have   ⬡ Nice-to-Have   ⬡ Optional

Skill	Must-Have	Nice-to-Have	Optional
Collaboration and Cooperation	78%	20%	2%
Problem Solving	76%	22%	1%
Interpersonal Skills	72%	25%	2%
Sharing and Knowledge Transfer	69%	29%	3%
Flexibility and Adaptability	65%	34%	1%
Personal Value Commitment	65%	33%	2%
Creativity	51%	44%	4%
Empathy	49%	47%	4%
Customer Experience Skills	44%	47%	9%
Multi-Tasking	43%	46%	11%
Leadership	39%	54%	8%
Diplomacy	38%	53%	9%
Business Understanding	38%	53%	9%
Career Development	37%	54%	9%
Visionary	35%	55%	11%
Risk Taking	31%	60%	9%

Respondent Profile: N=698
Question: How would you rate the importance of the following soft-skills?

4 | English Language Skills are Important

As language is a soft skill, we found that 61% of our survey respondents voted English language skills to be a must-have skill. This might not be important if you are a native English speaker. However, 41% of our survey respondents are working or living in regions of the world where this is not the case. Many teams are spread across different geographic regions and therefore must be able to converse in one common language.
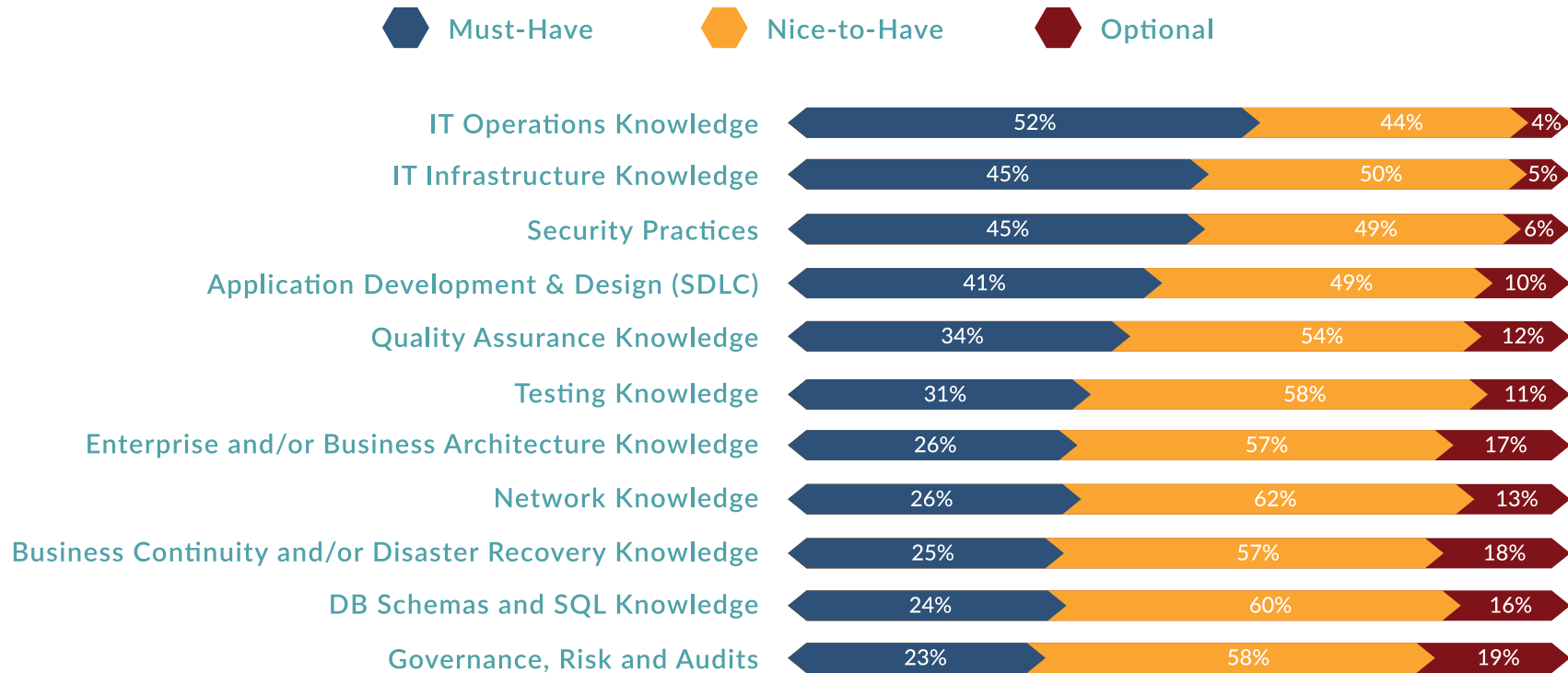
5 | Vertical Skills Don't Matter

As important as DevOps is to aid in the digital transformation of organizations across the globe, how important are vertical skills? When we asked, "Which of the following statements fits best relative to vertical industry skills for your DevOps team member?" 19% of respondents indicated that they required vertical skills within their industries and 11% said that they did not care about vertical skills. More than 54%, however, stated it is a plus to have vertical skills. When we explored this in follow-up interviews with individuals across large and small enterprises, all confirmed that vertical skills are a plus but not critical to have unless the individual is in a customer-facing position. As one interviewee states "Many tasks and activities which are performed by DevOps team members are not specific to a particular industry vertical so vertical skills are not really necessary."

6 | DevOps Functional Skills Must Include Security

The term "DevOps" refers to the combination of Development and Operations, so we were curious about which key functional skills are must-haves for DevOps professionals. We asked the question, "How would you rate the importance of the following functional skills for your DevOps team members?" The results: 52% of our respondents found operations a must-have functional skill, while application development was mentioned as a must-have skill by 41% of respondents. One key observation, however, is that 45% of our survey takers said security best practices are a must-have skill. Today there are many different terms used for how to name security within DevOps: DevSecOps, SecDevOps, DevOpsSec or rugged DevOps. Regardless of which word is used, a large sample size agrees that it is a must-have skill to apply within DevOps. Governance, risks and audits; enterprise architecture; business continuity; and disaster recovery are perceived as not-important skills, however (see Figure 16).

Figure 16: Functional Skill Must-Haves:
Security is the top must-have functional skill.

⬢ Must-Have ⬢ Nice-to-Have ⬢ Optional

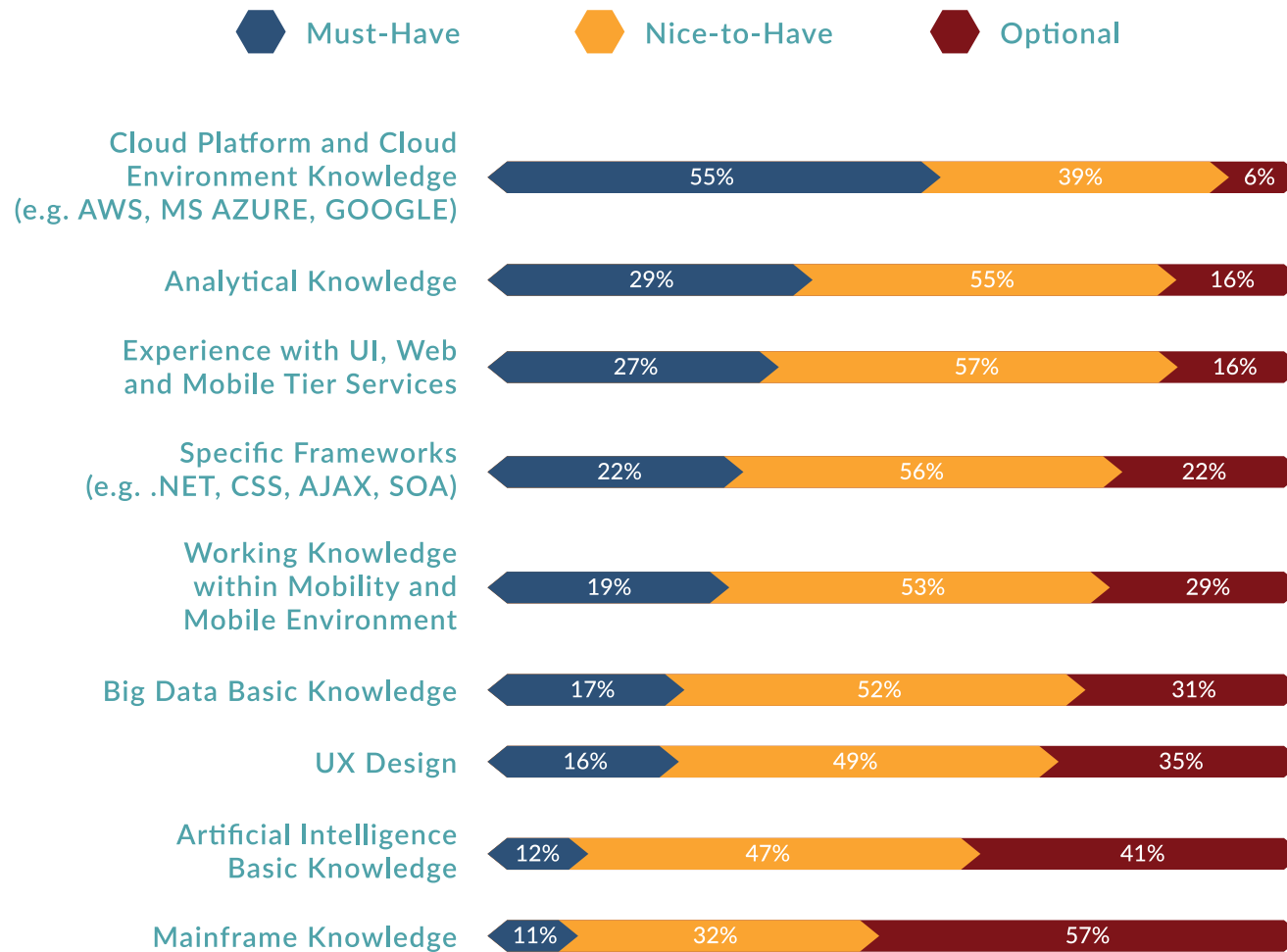| Skill	Must-Have	Nice-to-Have	Optional
IT Operations Knowledge	52%	44%	4%
IT Infrastructure Knowledge	45%	50%	5%
Security Practices	45%	49%	6%
Application Development & Design (SDLC)	41%	49%	10%
Quality Assurance Knowledge	34%	54%	12%
Testing Knowledge	31%	58%	11%
Enterprise and/or Business Architecture Knowledge	26%	57%	17%
Network Knowledge	26%	62%	13%
Business Continuity and/or Disaster Recovery Knowledge	25%	57%	18%
DB Schemas and SQL Knowledge	24%	60%	16%
Governance, Risk and Audits	23%	58%	19%

Respondent Profile: N=728
Question: How would you rate the importance of the following function skills for your DevOps team members?

7 | Cloud and Analytical Knowledge are Champion Technical Skills

The ongoing growth of cloud environments drives the champion must-have technical skill of having cloud knowledge. More than half (55%) of respondents perceive cloud to be the most important must-have technical skill. All roles we examined (including the mainframe team) believe it is the most important must-have technical skill. Second and third place respectively are analytical skills and experience with UI, web and middle-tier services. With all the hype around artificial intelligence, this skill is indeed a nice-to-have but not rated as a must-have skill yet (see Figure 17).

Figure 17: Cloud, Analytics and UI, Web, Middle Tier are Must-Have Key Technical Skills

⬡ Must-Have   ⬡ Nice-to-Have   ⬡ Optional

Skill	Must-Have	Nice-to-Have	Optional
Cloud Platform and Cloud Environment Knowledge (e.g. AWS, MS AZURE, GOOGLE)	55%	39%	6%
Analytical Knowledge	29%	55%	16%
Experience with UI, Web and Mobile Tier Services	27%	57%	16%
Specific Frameworks (e.g. .NET, CSS, AJAX, SOA)	22%	56%	22%
Working Knowledge within Mobility and Mobile Environment	19%	53%	29%
Big Data Basic Knowledge	17%	52%	31%
UX Design	16%	49%	35%
Artificial Intelligence Basic Knowledge	12%	47%	41%
Mainframe Knowledge	11%	32%	57%

Respondent Profile: N=711
Question: How would you rate the importance of the following technical skills for your DevOps team members?

Top 15 Automation Tools to Know

As automation is a key enabler throughout the DevOps journey, it is worth understanding which key automation tools are perceived to be most important. 20% of the respondents said that they would - when recruiting for DevOps - first look if the candidate has knowledge around key automation tools.

To find out which automation tools, we asked our survey respondents which one or two automation tools should their DevOps team members possess some know-how. We focused on the following automation tools: continuous automation; continuous delivery and release automation; and continuous monitoring.

The following figures show the top 15 vendors mentioned the most by our survey respondents. The vendors are sorted in alphabetical order to avoid any additional conclusions. The responses are not a reflection of these vendors' brand recognition nor any indication of which vendor is more popular than another. To investigate the large landscape of automation tools we separated them into the following three areas:

Continuous Integration

These automation tools are focused mainly on supporting the integration, building and testing of software frequently.

Continuous Delivery and Release Automation

These tools are focused mainly on automating software delivery through modeling applications, infrastructure and middleware and their supporting installation processes and dependencies.

Continuous Monitoring

These tools are focused mainly on automating the intelligent and proactive monitoring of services and resources being used by employees, customers and partners to conduct business or interactions.
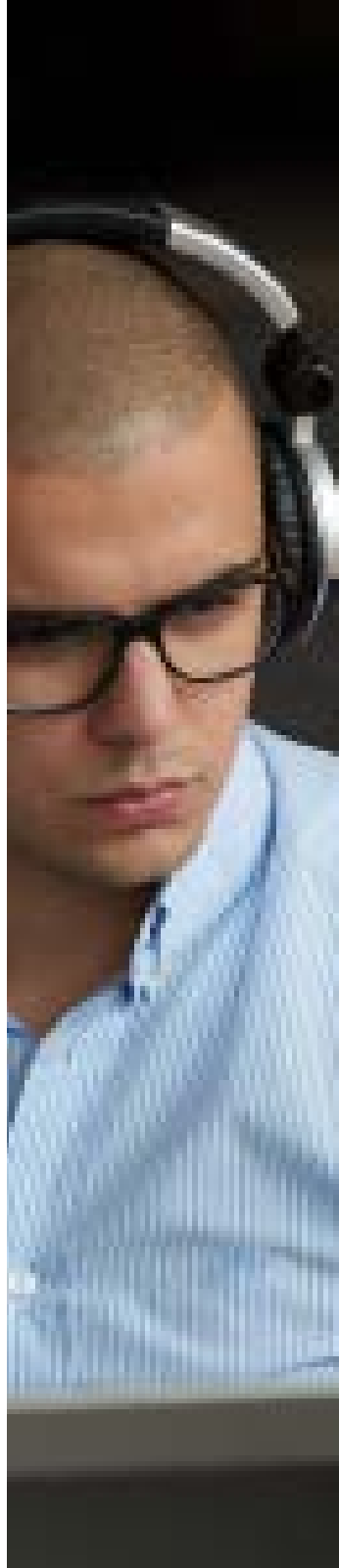
Figure 18: Top 15 Continuous Integration Automation Vendors to Know (alphabetical order):

Vendor Name	Solution Name
Amazon	AWS Code Build
Atlassian	Bamboo
Buddy	Buddy
Chef Software	Chef Software
Circle CI	Circle CI
CloudBees	CB Jenkins Enterprise
GitLab	GitLab
IBM	IBM UrbanCode Build
Micro Focus	Application Lifecycle Management
Microsoft	Visual Studio Team Services
Puppet	Puppet
Solano Labs	Solano Labs
TeamCity	Team City
Travis CI	Travis CI
XebiaLabs	XL Deploy

Respondent Profile: N=632
Question: In which one or two continuous integration tools should your DevOps team member possess some know how?

Figure 19: Top 15 Continuous Delivery & Release Automation Vendors to Know (alphabetical order)**:**

Vendor Name		Solution Name
AppZero	—	AppZero
BMC	—	Release Lifecycle Management
CA Technologies (now part of Broadcom)	—	CA Release Automation, Continuous Delivery Automation, Continuous Delivery Director
Chef Software	—	Chef Software
Clarive	—	Clarive
CloudBees	—	CloudBees Core
CollabNet	—	VersionOne
Electric Cloud	—	ElectricFlow
GoCD	—	GoCD
Honeycomb	—	Honeycomb
IBM	—	IBM UrbanCode Deploy
Micro Focus	—	Codar, Serena Deployment Automation
Microsoft	—	Visual Studio Team Services
Puppet	—	Puppet
Red Hat	—	Ansible Automation

Respondent Profile: N=632
Question: In which one or two continuous delivery & release automation tools should your DevOps team member possess some know how?

Figure 20: Top 15 Continuous Monitoring Automation Vendors to Know (alphabetical order)**:**

Vendor Name	Solution Name
AppDynamics (part of Cisco)	Application Performance Management
Avada Software	UR360
BMC	TrueSight Product Family
CA Technologies (part of Broadcom)	Application Performance Management, Nimsoft
DataDog	DataDog
Dynatrace	Dynatrace
IBM	Hybrid Cloud Management
ManageEngine	Applications Manager
Micro Focus	Operations Bridge
Microsoft	System Center Operations Manager
NewRelic	Application Performance Management
Oracle	Enterprise Cloud Control
ServiceNow	Application Performance Management
SolarWinds	Server and App Monitoring
Splunk	Enterprise

Respondent Profile: N=632
Question: In which one or two continuous monitoring automation tools should your DevOps team member possess some know how?

Different Roles Different Perspectives on Skills

Our survey respondents' roles ranged from individual contributors, contractors, program managers and leads to directors, vice presidents and C-level executives. We have analyzed their different perspectives independent of company size and revenue.. The most important conclusions from here are that there are a few key differences relative to the roles.

1. The categories of automation skills and soft skills are very important to the C-level respondents.

2. Both C-level and management indicate that certifications are a must-have.

3. Individual contributors see the functional skills as a must-have category whereas C-level and management don't rate functional as high.

Conclusion

The survey findings and data have led us to six essential conclusions that, when incorporated into hiring and team-building strategies, can help propel the DevOps community (individuals, leaders, consultants, vendors and recruiters) into a relevant, competitive, essential group or function in support of the digital transformation strategy within their respective organizations.

1. Professionals need to build their automation and process know-how.

For professionals looking to further develop their skills in DevOps, documenting and showing evidence of their process and automation capabilities are critical. This can be established via expanding their insight into areas outside of their process expertise (for example, as a software developer to understand key operational processes and operations folks to understand software development lifecycle process-es) or by leveraging Agile with documented results and improvements within a project or program they are driving. It is important to show results as evidence of their expertise and skills.

2. While soft skills and technical skills are important, they are not enough.

Individual contributors underestimate the need for business skills and business understanding. Both of these skills are essential must-haves for executives and hiring managers in organizations. Technical skills such as understanding cloud architectures and models, APIs and other skills such as artificial intelligence are only valuable when applied to solve business problems. As DevOps is not just an initiative within IT but rather in conjunction with the business, understanding the relative business is critical to developing and deploying the right software and services with the right speed and quality. You also must show some depth of business skills including communication, lead-ership and strategic thinking as daily interactions are no longer limited to the IT landscape, and these skills are key to success in the busi-ness world.

3. Soft skills development should revolve around six important skills:

Collaboration and cooperation, problem-solving, interpersonal skills, sharing and knowledge transfer, personal value commitment, and flexibility and adaptability. Experts have always noted in DevOps that culture is important, but what shapes culture are individuals who are part of a team. These soft skills are difficult to train or certify during the recruiting process. Including experts such as human resourc-es and people officers, who understand how to probe for such skills, and the observation and evidence of these skills, are critical for a su cessful hire.

4. One plus one is three:

Functional skills and key technical skills combined complement the soft skills to create the best DevOps engineer. The definition of DevOps engineer depends on the maturity, team topology and the person being asked to define the role. Important to note, however, are the top six functional skills that are essential for a DevOps engineer: IT operations, security, infrastructure, application design and development, quality assurance and testing. IT folks with functional expertise in these skills have great opportunity to join and participate as DevOps team members tomorrow.

5. Companies are cultivating their DevOps teams from within.

Leaders can be innovative in how they source talent and highlight pathways into the DevOps function to grow their pipeline of candidates. Recruiters agree that hiring from within is the most successful path toward extension.

6. It is all in your head.

Research from Dr. Carol S. Dweck, Ph.D., one of the world's leading researchers in the field of motivation and a Lewis and Virginia Eaton Professor of Psychology at Stanford University, indicates there are two mindsets to succeed and foster success: "In a fixed mindset, people believe their basic qualities, like their intelligence or talent, are simply fixed traits. They spend their time documenting their intelligence or talent instead of developing them. They also believe that talent alone creates success—without effort. They're wrong. In a growth mindset, people believe that their most basic abilities can be developed through dedication and hard work - brains and talent are just the starting point." Our guidance (and that of Dr. Dweck) is you must shift into "expandable" growth, in which you challenge yourself to increase your abilities across all skills you have or don't have.

Research Methodology

The *Upskilling: Enterprise DevOps Skills Report* is the first report capturing the perspectives of a variety of roles which are involved in recruiting, staffing or working within DevOps initiatives. We set out to understand what is very important (must-have), important (nice-to-have) and not important (optional) skills within key categories. After extensive research around skill categories, we determined the following skill categories: Automation, process and knowledge, soft skills, functional skills, and automation tool 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 Survey Monkey Enterprise as our survey and design instrument. We collected primary data from our survey respondents. Our goal was to achieve a sample size of 1,500 individual responses targeting key geographic areas such as North America, Europe, and India.

Interviews

We also leveraged personal interviews as a complementary research method to provide us with additional in-depth details. The interview scripts consist of six briefs, 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 27 closed questions, related to DevOps skill priorities and importance within their teams or jobs. The first part of the questionnaire consisted of demographic questions, related to company size, region, the professional role of the participants, the IT environment. The second part of the questions focused on DevOps topologies, hiring situations and challenges. The last and main part focused on the key skill categories.

If you have questions on our survey methodology, please contact oehrliche@devopsinstitute.com.

Author Biographies

Eveline Oehrlich, Independent Research Director, DevOps Institute

Eveline Oehrlich is an independent Research Director at the 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 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

Jayne Groll, Co-founder and CEO, DevOps Institute

Jayne Groll is co-founder and CEO of the DevOps Institute (DOI).   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" that 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, national and virtual events.

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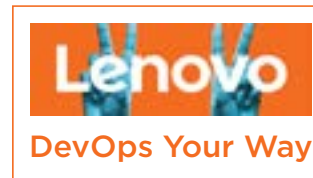
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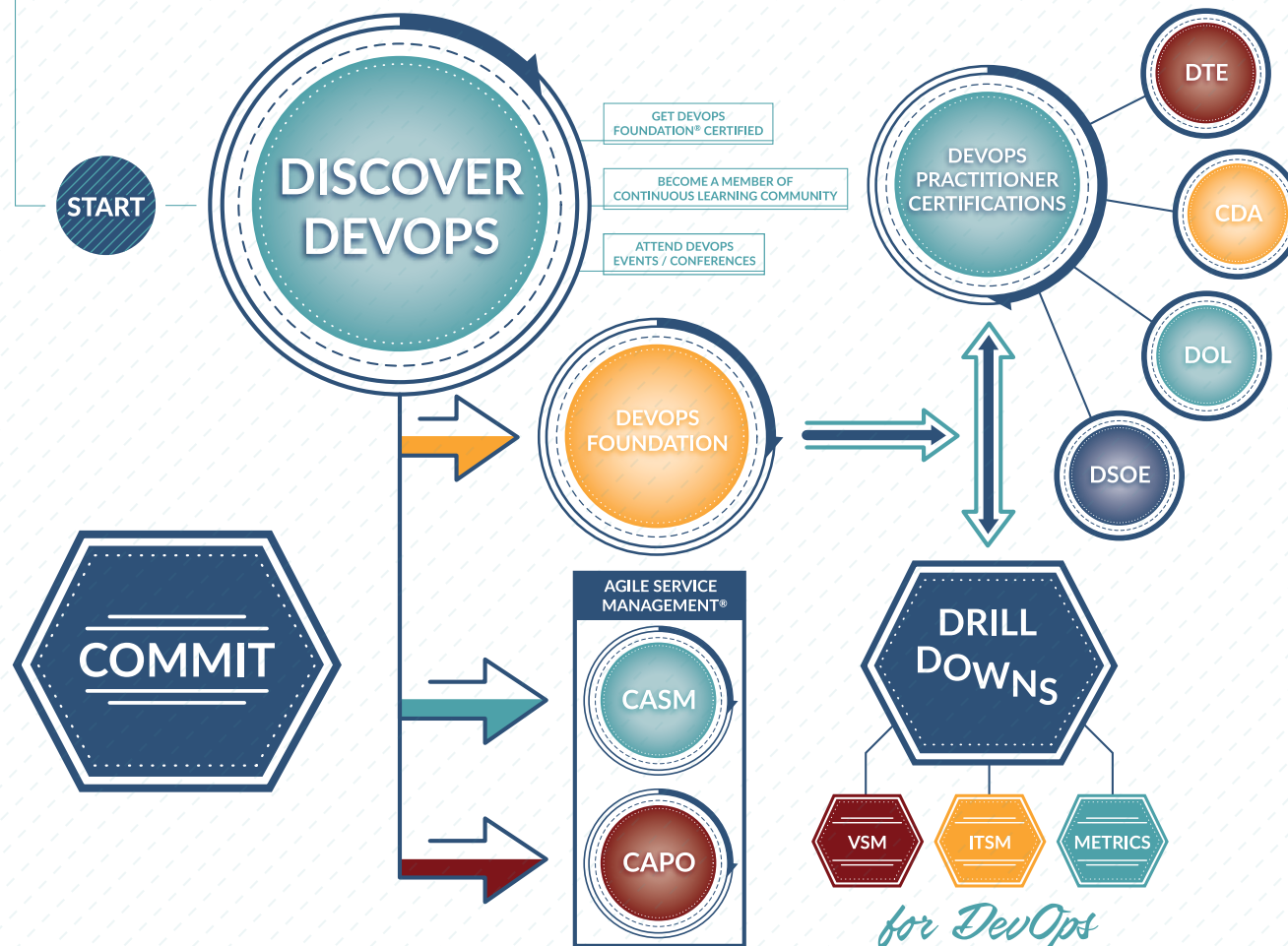
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