

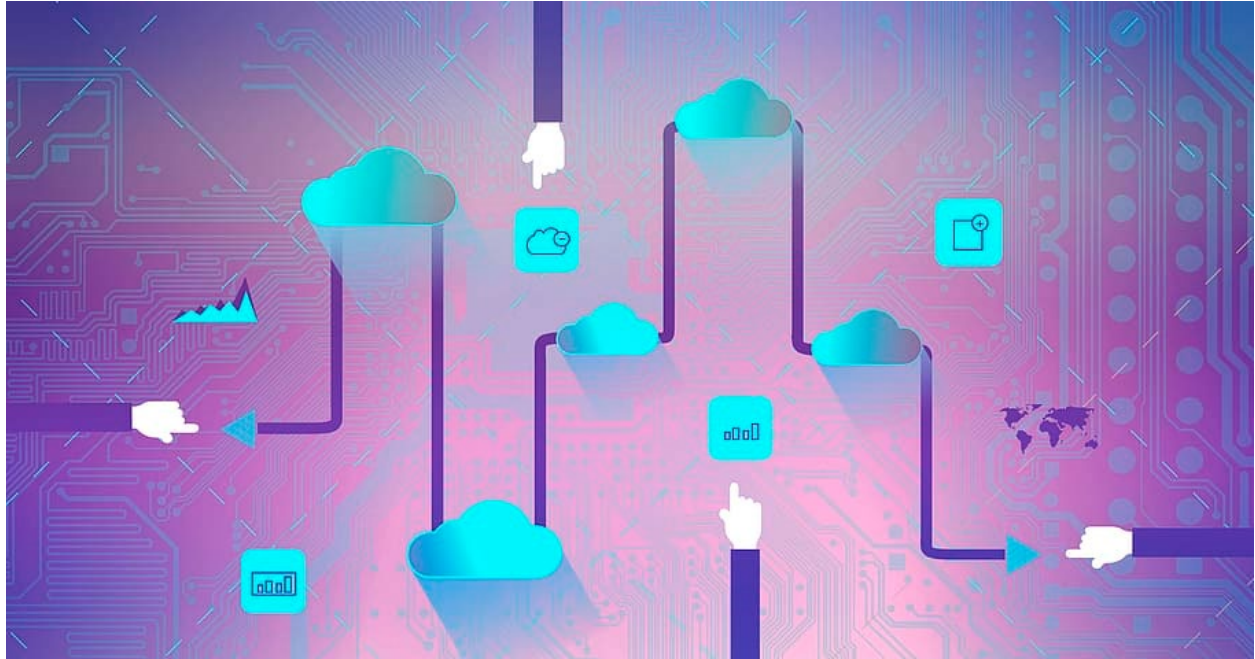


 WTIA

2022 Cloud Computing Skills Demand Analysis

WASHINGTON TECHNOLOGY INDUSTRY ASSOCIATION

CLOUD COMPUTING SKILLS DEMAND ANALYSIS



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Submitted by:



Submitted to:





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INTRODUCTION

Background and Purpose

The Washington Technology Industry Association (WTIA) has commissioned this report to provide a detailed, data rich assessment of the key skills, expertise, and experience in highest demand for cloud computing occupations in Washington state. Existing data sources on occupational demand do not adequately represent or illustrate the kinds of specific attributes cloud computing employers are looking for. Moreover, federal and state data sources on employment and occupations do not sufficiently map to cloud computing activities.

This report identifies, primarily through primary data gathering from cloud computing providers and cloud services clients, the specific types of skills and experience most important to employers. This information will help both educational institutions refine curricula and training programs to further align graduate training with industry and specific cloud computing activity requirements. Moreover, workers will gain a clearer understanding of the kinds of hard and soft skills and attributes they will need to compete in the labor market for cloud computing positions.

Findings highlight the essential skills to support cloud computing and provide critical information for hiring managers and labor market participants.

Methods and Definitions

This report relies heavily on primary information and data collection, including qualitative analysis. We conducted interviews with industry stakeholders from cloud service providers, cloud services clients, and educational institutions. Interview findings informed the development of a more comprehensive and broad-reaching electronic survey of technology firms in Washington state, drawing on WTIA's membership and networks as a base for this outreach. Interview and survey findings are also augmented with literature and reports on the cloud computing sector.

DEFINITION OF CLOUD COMPUTING AND CLOUD ACTIVITIES IN WASHINGTON STATE

What is Cloud Computing

Cloud computing refers, in broadest terms, to the movement of many traditionally on-site data servers to offsite servers, enabling users to access and run software applications, data storage, and other processes over the Internet instead of through onsite physical infrastructure. The cloud makes it possible for any organization, company, or developer to run their technology applications on top of the cloud service provider's technology infrastructure platform, or what is referred to as "infrastructure as a service" (IaaS).

More and more, businesses and organizations across the economy, except for those with critical onsite data server needs, e.g., hospitals, are shifting to cloud servers and dramatically reducing their investments in onsite data centers and servers. The demand for cloud services increased at a rapid pace during the pandemic, as more and more organizations shifted to remote work environments, necessitating the use of videoconferencing platforms and online collaboration products.

Cloud computing has grown at a rapid pace in recent years. Organizations, facing rapid or even exponential increases in business and customer data, are leveraging the cloud to host and process data in lieu of in-house services and software platforms. The advent of the pandemic has served as *force function*, prompting more and more organizations to embrace remote or hybrid work models; the cloud accommodates these shifts and an increasingly mobile workforce. Cloud computing enables these businesses to achieve economies of scale (efficiencies) in their operating and business models, including “increased computing power, lower capital and operational costs, better security, higher uptime and reliability, better quality control and an overall competitive edge, as well as being more environmentally sustainable” (PR Newswire, 2021).

A core feature of cloud computing is **elasticity**, or the expanding and shrinking of computer resource usage based on cloud tenant resource demands. Cloud computing enables businesses and teams of all sizes to “provision and then decommission compute, network, and memory resources, all of which are physical, in an automated way, which means that you can now scale up your resources just in time to serve the traffic spike and then wind down the additional provisioned resources, effectively just paying for the time that your application served the spike with increased resources” (Zafar Gilani, 2015). Development and operations (“DevOps”) personnel or teams on the cloud computing client side determine when peak usage will occur (e.g., Black Friday) and provision additional virtual services for these periods.

Cloud computing services can be disaggregated into three main categories:

- **Infrastructure**, e.g., servers, storage, and networking. Leading providers of cloud infrastructure include Amazon Web Services, Microsoft Azure, Google Cloud, as well as Alibaba (China), IBM (specializing in artificial intelligence applications), and Cisco Systems (for networking), and many others. Cloud infrastructure is commonly referred to as “Infrastructure as a Service” (IaaS).
- **Platforms**, such as databases, operating systems, and development tools.
- **Software**, including applications hosted on cloud servers (Eastwood, 2020).

Origins of Cloud Computing

The global technology evolution of cloud computing began in Washington state in the early 2000s. As early as 2003, Amazon recognized it had extensive inhouse expertise in managing complex networks and “running infrastructure services like compute, storage and database (due to those previously articulated internal requirements)” and “become highly skilled at running reliable, scalable, cost-effective data centers out of need [and] had to be as lean and efficient as possible” (Miller, 2016). Amazon was also in possession of an enormous amount of surplus computing server capacity, shaped by the ebb and flow of consumer traffic, just as many other firms were having scaling needs. A few years later, in November 2016, Amazon Web Services (AWS) was born, becoming the first cloud services provider in the world. Since then, there’s been proliferation of cloud providers and cloud-based services, including, in addition to AWS, Microsoft Azure, Google Cloud, IBM Cloud, and Alibaba Cloud.

Advantages of the Cloud for Businesses and Organizations

Using the cloud offers several key advantages for businesses. First and foremost is scalability and optimization of capacity. Most businesses and organizations experience peaks and valleys in server usage throughout the day. Investing in onsite servers and data centers is a costly capital expenditure, and due to these ebbs and flows in usage will result in periods of underutilization.

The cloud offers a solution to this problem of inefficiency by enabling businesses to use data servers *on-demand*, and often on a pay-as-you-go model for usage above and beyond monthly allocations. Virtual machines hosted on the cloud can scale up or scale down automatically based on customer usage and traffic.

The option to use cloud services reduces the need for onsite IT staff, as many of the administration and maintenance tasks associated with onsite servers can now be provided by the cloud service provider (though this scenario also creates new types of jobs at the customer's location).

Businesses and organizations in the cloud computing space can also be categorized between those who provide cloud-based services, e.g., AWS, and those who are users, or clients, of cloud computing services.

SKILLS NEEDED IN CLOUD COMPUTING

Talent is the most critical input into the information & communication sector (ICT), of which cloud is a major component both as a provider and critical infrastructure. A recent report by Gartner (2021) found that the most significant barrier for 64% of emerging technologies was lack of talent. "Talent availability" was cited by tech executives as a leading factor inhibiting adoption across all six technology domains analyzed—compute infrastructure and platform services, network, security, digital workplace, IT automation, and storage and databases. According to Gartner's research vice president, "The ongoing push toward remote work and the acceleration of hiring plans in 2021 has exacerbated IT talent scarcity, especially for sourcing skills that enable cloud and edge, automation and continuous delivery" (Gartner, 2021).

Specific tasks associated with cloud computing work range across cloud computing infrastructure as a service (IaaS) providers and cloud computing customers and users. Eastwood (2020) differentiates between fundamental "core" versus "advanced" cloud computing skills. **Core skills** refer to skills important to day-to-day work of a cloud engineer or cloud architect. These include programming (Java, JavaScript, Python, and emerging languages such as Go and Scala, as well as Linux, SQL, and NoSQL for database programming); platform expertise (i.e., understanding how platforms such as AWS, Google Cloud, MS Azure work and service offerings); how to select the right service (since each cloud provider has specific strengths, such as IBM for AI applications); managing an integrated environment; maintaining databases; cloud environment security; and adapting to new roles and technologies as they emerge.

Advanced skills include how to migrate data; automating key tasks; designing distributed systems; managing change (e.g., plans for migrating data, bringing new databases online, creating a new network connection, or introducing changes to the cloud environment); estimating costs and workload (since cloud costs can constitute a significant business expense, thereby necessitating planning to avoid overage costs); measurement and analysis to monitor cloud-based application performance; and communication and soft skills, especially when working in a customer-driven environment.

Forbes (2021) describes six key areas of cloud skills:

- **Cloud security and compliance.** Cybersecurity, data protection, and compliance risks.
- **Machine learning and artificial intelligence.** Businesses increasingly require data science professionals.

- **Multi-cloud deployment and migration.** Using the cloud and cloud strategies for better disaster recovery, portability, regulatory compliance and to offset vendor lock-in. They need professionals who have deep expertise in multi-cloud platforms and architectures.
- **Platform as a Service (PaaS) and Cloud-Native Architecture.** Working with PaaS to enable organizations to scale dynamically without worrying about maintaining basic infrastructure to create high-value applications.
- **Chaos Engineering and Development Security Operations (DevSecOps).** Skills to build and support a safe, controlled experimentation environment.
- **Cloud Optimization and FinOps.** Cloud financial management discipline to optimize control over the cloud spending and continually refine cloud utilization.

DevOps

Cloud computing has given rise to the DevOps model. DevOps can refer to a team structure or a specific role or occupation within a firm. Within the DevOps model, two traditionally siloed teams within a technology firm—development and operations—work together to “optimize both the productivity of developers and the reliability of operations.” Quality assurance and security teams may also become tightly integrated with these teams. Within the DevOps model, organizations, regardless of their structure, “have teams that view the entire development and infrastructure lifecycle as part of their responsibilities” (AWS, 2022).

Amazon Web Services delineates several key attributes and tasks associated with DevOps. These are also best practices for successful DevOps teams, and include both technical skills, such as software development and coding, and a shift in cultural norms and teamwork (**Exhibit 1**).

Exhibit 1. DevOps Best Practices

DevOps Practice	Description
Continuous Integration	A software development practice where developers regularly merge their code changes into a central repository, after which automated builds and tests are run. The key goals of continuous integration are to find and address bugs quicker, improve software quality, and reduce the time it takes to validate and release new software updates.
Continuous Delivery	A software development practice where code changes are automatically built, tested, and prepared for a release to production. When continuous delivery is implemented properly, developers will always have a deployment-ready build artifact that has passed through a standardized test process.
Microservices Architecture	A design approach to build a single application as a set of small services. Each service runs in its own process and communicates with other services through a well-defined interface using a lightweight mechanism, typically an HTTP-based application programming interface (API).
Infrastructure as Code	Infrastructure is provisioned and managed using code and software development techniques, such as version control and continuous integration.
Monitoring and Logging	By capturing, categorizing, and then analyzing data and logs generated by applications and infrastructure, organizations understand how changes or updates impact users, shedding insights into the root causes of problems or unexpected changes. Active monitoring becomes increasingly important as services must be available 24/7 and as application and infrastructure update frequency increases. Creating alerts or performing real-time analysis of this data also helps organizations more proactively monitor their services.
Communication and Collaboration	The use of DevOps tooling and automation of the software delivery process establishes collaboration by physically bringing together the workflows and responsibilities of development and operations. These teams set strong cultural norms around information sharing and facilitating communication through the use of chat applications, issue or project tracking systems, and wikis. This helps speed up communication across developers, operations, and even other teams like marketing or sales, allowing all parts of the organization to align more closely on goals and projects.

Source: Amazon Web Services (2022).

Cloud Computing Certifications

Cloud service-specific certifications are also increasingly in demand, especially among businesses cloud clients, but also for customer-facing employees within cloud service providers. Certifications are applicable both among cloud clients and providers. Among cloud clients, certifications provide skills ranging from foundational understandings of the services and offerings available through a cloud provider to development and security. Cloud providers also often require staff, particularly those interfacing with customers, to similarly acquire certifications. This improves the sales engineer's ability to understand and recommend cloud-based services most suitable to the client's needs.

Some of the most common certifications include:

- Amazon Web Services (AWS) certification
- Certified Cloud Security Professional
- CompTIA Cloud+
- Google Cloud Associate and Professional Certifications
- IBM Certified Solution Architect
- Microsoft Azure Cloud Certification

Exhibit 2. Top-paying IT Certifications in the U.S., 2021

Certification	Average Salary, 2021
Google Certified Professional Data Engineer	\$171,700
Google Certified Professional Cloud Architect	\$169,000
AWS Certified Solutions Architect - Associate	\$159,000
CRISC - Certified in Risk and Information Systems Control	\$152,000
CISSP - Certified Information Systems Security Professional	\$151,900
CISM – Certified Information Security Manager	\$149,200
PMP® - Project Management Professional	\$148,900
NCP-MCI - Nutanix Certified Professional - Multicloud Infrastructure	\$142,800
CISA - Certified Information Systems Auditor	\$134,500
VCP-DVC - VMware Certified Professional - Data Center Virtualization 2020	\$132,900
MCSE: Windows Server	\$126,000
Microsoft Certified: Azure Administrator Associate	\$121,400
CCNP Enterprise - Cisco Certified Network Professional - Enterprise	\$118,900
CCA-V - Citrix Certified Associate - Virtualization	\$115,300
CompTIA Security+	\$111,000

Source: Global Knowledge (2021).¹

Despite the rapid growth and demand for workers in the cloud computing sector, cloud computing-specific skills remain largely indistinct within information & communication (ICT) sector occupations. According to labor market data analysis platform Burning Glass, the 10 most common job postings with reference to required “cloud skills” include data engineers, computing systems engineer/architect, and database architect (**Exhibit 3**). However, among these occupational job postings, mention of cloud skills appeared in at most 11% of postings (data engineers).

Exhibit 3. Common Cloud Computing Positions and Share of Job Posting Requesting “Cloud Skills”

Occupation	Associated Education Level	Job Postings Requesting Cloud Skill(s)
Data Engineer	Bachelor's	11%
Computer Systems Engineer / Architect	Bachelor's	9%
Database Architect	Bachelor's	9%
Network Engineer / Architect	Bachelor's	8%
Cyber / Information Security Engineer / Analyst	Bachelor's	5%
Web Developer	Bachelor's	5%
Software Developer / Engineer	Bachelor's	4%
Business Intelligence Architect / Developer	Bachelor's	4%
Network / Systems Administrator	Bachelor's	3%
IT Project Manager	Bachelor's	2%

Source: Burning Glass data, reported in Kolakowski (2020).

¹ According to Global Knowledge, “the list of the top-paying certifications in the United States is based on data from more than 3,700 U.S. respondents who participated in the Global Knowledge 2021 IT Skills and Salary Survey.”

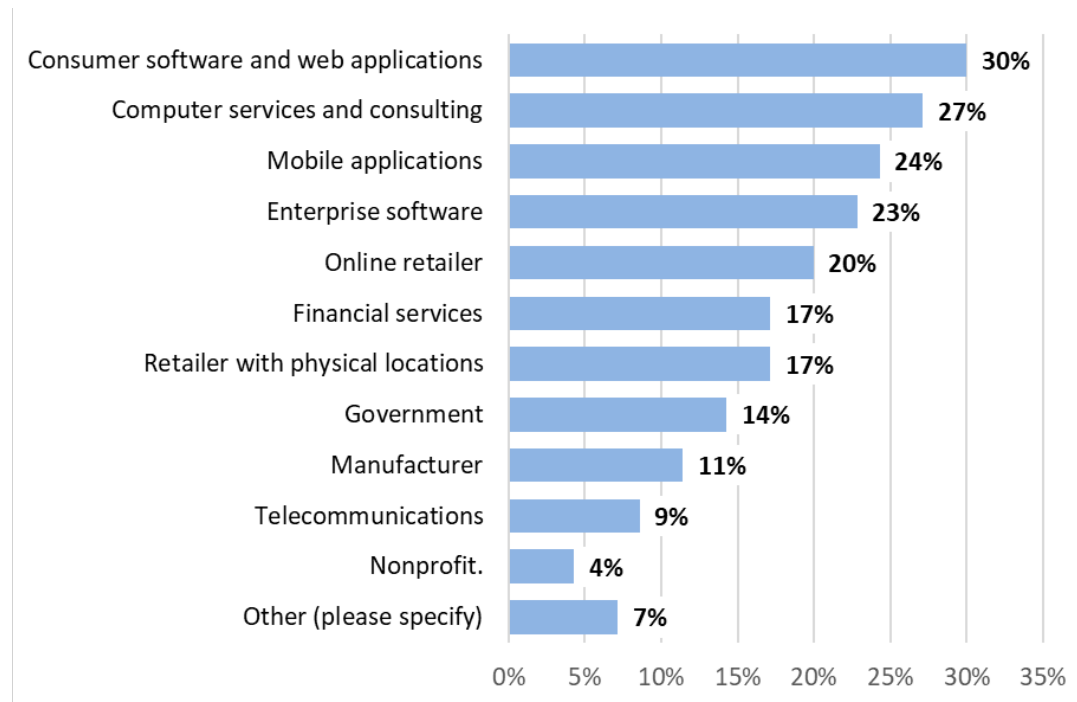
SURVEY RESULTS

In March and April 2022, we surveyed technology businesses and organizations across the state. The survey was deployed electronically and distributed through email lists and various online platforms, including LinkedIn. A total of seventy (70) businesses and organizations responded to the survey, through response rates varied by question.

The survey probed a series of issues related to cloud computing, including the development and use of cloud services and technology solutions among both businesses engaged in cloud product development and clients of cloud services.

Among the seventy (70) respondents, global headquarters included Seattle, Olympia, Boston, San Francisco, and Mountain View. These companies and organizations managed payrolls in Washington state of all sizes, from less than 50 to in the tens of thousands. Respondents were given the option to identify with more than one business area or sector. Twenty-one respondents (30%) identified “consumer software and web applications” as among their primary focus areas, followed by “computer services and consulting” (27%), “mobile applications” (24%) and “enterprise software” (23%) (**Exhibit 4**).

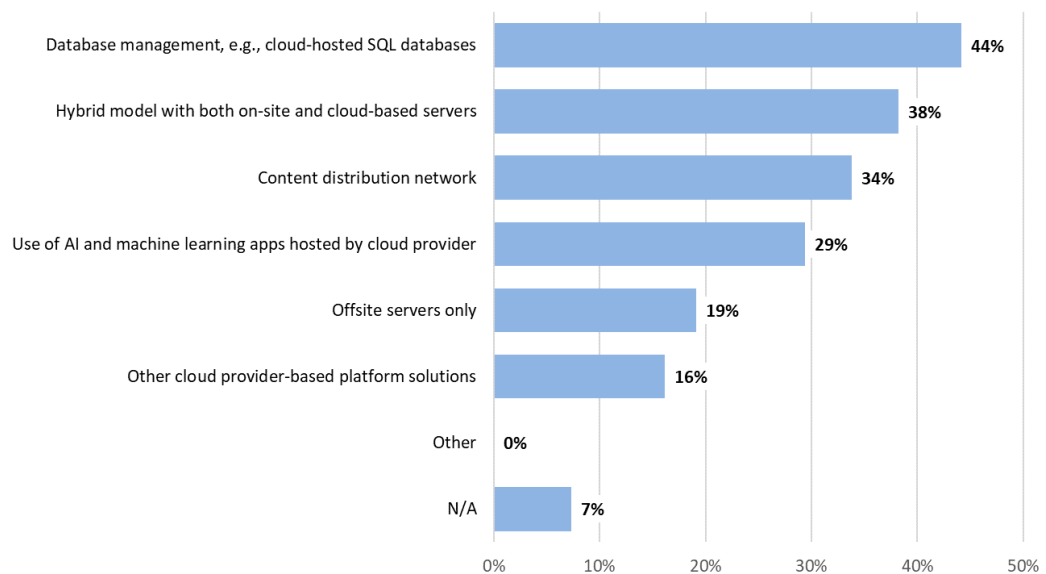
Exhibit 4. Primary Focus Area(s) of Respondents



Relationship to the Cloud

Approximately 61% of respondents identified as “cloud services customer, i.e., use cloud computing services as part of your infrastructure,” followed by “cloud computing support and consulting.” Nine businesses identified as a cloud service provider, while four did not identify as having a significant relationship with the cloud. Respondents were then asked to identify, as a cloud services client, the ways in which they use the cloud as a client, with the option of choosing more than one category. Database management was the most commonly identified use of the cloud (44%), followed by those use hybrid model with both on-site and cloud-based servers (38%).

Exhibit 5. If Your Organization is a Cloud Service Customer, Which of the Following Best Describes Your Use of the Cloud? (Check all that apply.)



Since the pandemic, nearly half of all respondents (N = 69) indicated they had migrated more data to the cloud. This is consistent with the broad shift in services delivered increasingly via remote or mobile platforms during the pandemic, including remote work solutions, food delivery, and education. The most common cloud services used by respondents included Amazon Web Services (AWS), Microsoft Azure, and Google Cloud, but some respondents also indicated their use of IBM Cloud, Alibaba Cloud, Salesforce, and backend support from Facebook and Twitter.

Entry-Level Hiring for Cloud-based Positions

Respondents were next asked about their hiring practices and needs. On a weighted average, based on responses, close to half of all positions currently open and actively being recruited for require some background or familiarity with using the cloud and a cloud-based development environment. Put differently, respondents were asked to identify how many current openings for entry-level positions require some level of cloud certification. Among these openings, approximately 94% required such certifications (based on a weighted average of responses).

Among technology-specific entry-level hires over the last five years, all respondents (N = 44) indicated they have recruited from Washington-based educational institutions or training programs. Nearly all respondents (95%) also recruited from other firms and programs.

Based on interviews and existing literature, we identified several important skills germane to cloud-based entry-level positions. These were Python or JavaScript; Linux; SQL; ability to work within a team and communication skills; experience/knowledge of multiple cloud platforms and strengths and weaknesses of each; database management; managing an integrated environment; and cloud environment security. Respondents were then asked to indicate first the level of importance and then level of difficulty recruiting for specific cloud skills in entry-level positions (**Exhibit 6** and **Exhibit 7**).

Interestingly, skill or background deemed most important was not a “hard” or technical skill, but teamwork and communication—more than 20% (10 of 49 responses) indicated this was “Most Important” (5), the highest among the skills and backgrounds presented. Nine out of 47 respondents (19%) indicated experience/knowledge of multiple cloud platforms was the most important (5).

Exhibit 6. Level of Importance to Your Organization for the Following Skills and Backgrounds for Entry-Level Positions

	Importance (1 = Least Important, 5 = Most Important)					Total
	1	2	3	4	5	
Python or JavaScript	19%	38%	19%	13%	13%	100%
	9	18	9	6	6	48
Linux	13%	13%	44%	19%	13%	100%
	6	6	21	9	6	48
SQL	19%	19%	21%	26%	15%	100%
	9	9	10	12	7	47
Teamwork and communication skills	10%	20%	24%	24%	20%	100%
	5	10	12	12	10	49
Experience/knowledge of multiple cloud platforms and strengths and weaknesses of each	9%	21%	36%	15%	19%	100%
	4	10	17	7	9	47
Database management	15%	27%	29%	19%	10%	100%
	7	13	14	9	5	48
Managing an integrated environment	13%	25%	17%	29%	17%	100%
	6	12	8	14	8	48
Cloud environment security	8%	21%	29%	29%	13%	100%
	4	10	14	14	6	48

Note: some percentages do not sum exactly to 100% due to rounding.

Respondents were then asked about the difficulty recruiting for the skills and backgrounds presented. While teamwork and communications skills were deemed most important by 20% of respondents, more than 60% of respondents felt that recruitment was either average or easy (difficulty level between 1 and 3). Difficulty finding entry-level candidates was most difficult for those with a background in cloud environment security (18% for level 5 among respondents).

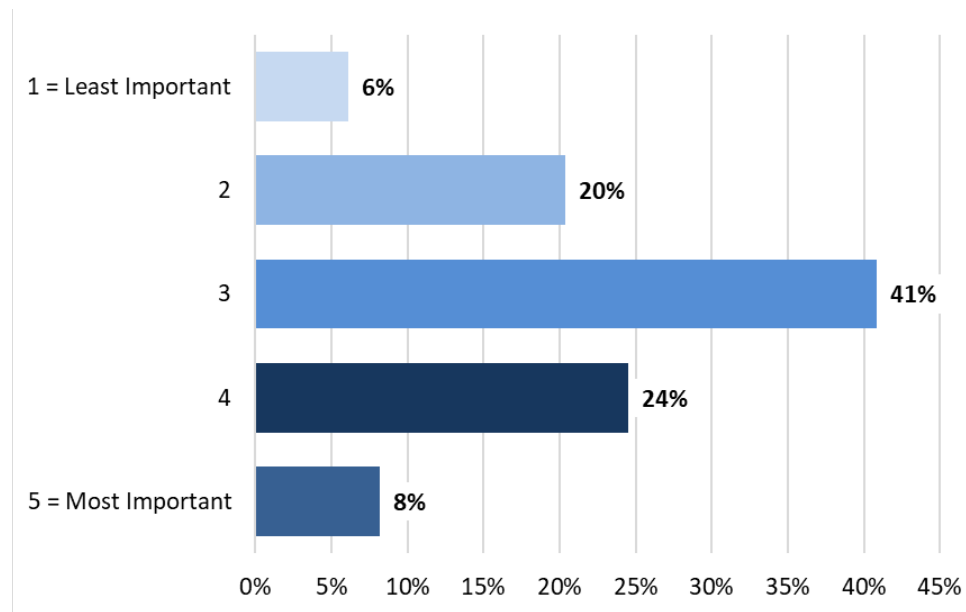
Exhibit 7. Level of Difficulty Recruiting for the Following Skills and Backgrounds for Entry-Level Positions

	Difficulty Recruiting (1 = Least Difficult, 5 = Most Difficult)					Total
	1	2	3	4	5	
Python or JavaScript	24%	16%	37%	18%	5%	100%
	9	6	14	7	2	38
Linux	26%	29%	24%	16%	5%	100%
	10	11	9	6	2	38
SQL	11%	29%	29%	16%	16%	100%
	4	11	11	6	6	38
Teamwork and communication skills	16%	18%	26%	29%	11%	100%
	6	7	10	11	4	38
Experience/knowledge of multiple cloud platforms and strengths and weaknesses of each	8%	24%	32%	24%	11%	100%
	3	9	12	9	4	37
Database management	16%	29%	29%	24%	3%	100%
	6	11	11	9	1	38
Managing an integrated environment	18%	21%	37%	18%	5%	100%
	7	8	14	7	2	38
Cloud environment security	16%	8%	29%	29%	18%	100%
	6	3	11	11	7	38

Note: some percentages do not sum exactly to 100% due to rounding.

For entry-level hires, 8% of respondents (4 out of 49) indicated cloud-based certifications were “most important.” Roughly 41% of respondents indicated certifications were somewhat important (level 3) (**Exhibit 8**). Examples of cloud-based certifications employers are looking for ranged from cloud environment security (three responses), Google Drive (two responses), and “AWS Certified Solution Architect – Professional.” Forty-five (45) out of 49 respondents indicated that they sometimes pay all or part of the cost of cloud-based certifications for their workers.

Exhibit 8. Importance of Cloud-based Certifications (across any platform) for New Entry-Level Hires



We then provided respondents with a list of cloud-based roles within an organization, based on interviews and review of existing literature and research. These included DevOps; SysOps;

development security operations (DevSecOps)/cloud security specialist; solutions architect/cloud architect; network administrator; and data analyst/data scientist. Compared with the previous list above, these are actual occupational titles commonly found in businesses who work with—and are customers of—cloud services. Respondents were similarly asked to rate both the importance and difficulty recruiting for these cloud-specific positions (**Exhibit 9 and Exhibit 10**).

Network administrator and data analyst/data scientists were the most important occupations. Approximately 47% of respondents ranked data analyst/data scientist as either 4 or 5 in terms of importance; for network administrator, this was 44%. However, these two positions did not appear to be as difficult to hire, at least as relates to their level of importance. For data analyst/data scientist positions, 36% of respondents deemed the difficulty recruiting as either 4 or 5, and for network administrators 33%. Forty-four percent of respondents indicated DevSecOps/cloud security specialist roles as either least difficult or not difficult (level 1 or 2) to recruit.

Exhibit 9. Level of Importance to Your Organization for the Following Cloud-Specific Roles (N = 47)

	Importance (1 = Least Important, 5 = Most Important)					Total
	1	2	3	4	5	
DevOps	15%	33%	30%	9%	13%	100%
	7	15	14	4	6	46
SysOps	11%	25%	41%	20%	2%	100%
	5	11	18	9	1	44
DevSecOps/cloud security specialist	21%	23%	26%	23%	6%	100%
	10	11	12	11	3	47
Solutions architect/cloud architect	13%	17%	37%	22%	11%	100%
	6	8	17	10	5	46
Network administrator	13%	22%	20%	27%	18%	100%
	6	10	9	12	8	45
Data analyst/data scientist	13%	18%	22%	29%	18%	100%
	6	8	10	13	8	45

Note: some percentages do not sum exactly to 100% due to rounding.

Exhibit 10. Level of Difficulty Recruiting for the Following Cloud-Specific Roles (N = 38)

	Difficulty Recruiting (1 = Least Difficult, 5 = Most Difficult)					Total
	1	2	3	4	5	
DevOps	16%	30%	24%	19%	11%	100%
	6	11	9	7	4	37
SysOps	8%	25%	28%	33%	6%	100%
	3	9	10	12	2	36
DevSecOps/cloud security specialist	24%	16%	32%	16%	13%	100%
	9	6	12	6	5	38
Solutions architect/cloud architect	8%	27%	22%	30%	14%	100%
	3	10	8	11	5	37
Network administrator	8%	19%	39%	31%	3%	100%
	3	7	14	11	1	36
Data analyst/data scientist	11%	19%	33%	22%	14%	100%
	4	7	12	8	5	36

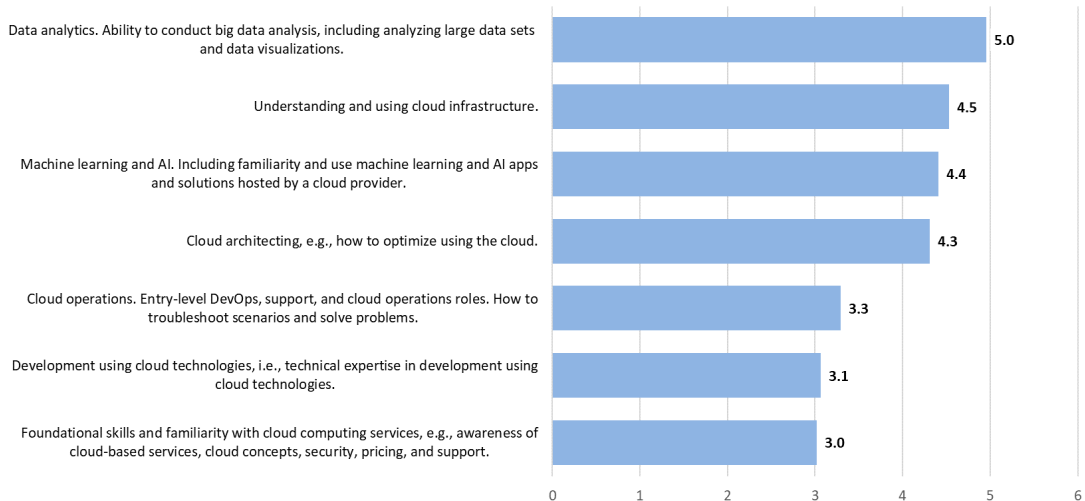
Note: some percentages do not sum exactly to 100% due to rounding.

In addition to the options presented above, there are many other specific titles used by employers for cloud-specific roles and occupations. Some of these provided by respondents included Full stack engineers- M.E.R.N; Google Certified Professional Data Engineer; Management Integration Environment; Senior Cloud Systems Engineer - Remote Role; Site Reliability Engineer, cloud infrastructure, continuous integration, systems administrator, systems engineer, platform, infrastructure; and cloud architecture.

Exhibit 11 presents the average level of skills “need” for entry level positions. For each cloud-based skill, respondents were asked to rank the level of need from 1 to 7, with 1 being the lowest need and 7 the greatest need. “Data analytics” showed highest level of need among respondents; the average score was 5.0. This was followed by “understanding and using cloud infrastructure,” with an average score of 4.5. “Foundational skills and familiarity with cloud computing services” ranked the lowest, on average, for need (an average score of 3.0). However, this may in part due to this skill be implicit in all the other available skills presented in this question.

Respondents were also asked to list out examples of roles/titles that interact most heavily with cloud technologies (open-ended question). Examples of answers provided included “cloud data engineer,” “risk control,” “cloud environment security,” “cloud security officer,” and “DevOps cloud engineer.”

Exhibit 11. For Entry-Level Positions, Average Ranking of Need for Cloud-Oriented Skills (1 – Least Need, 7 = Most Need)



SUMMARY AND CONCLUSION

The advent and growth of cloud computing is spurring the demand for new types of skills, roles, and work and project teams in the economy, including DevOps, SysOps, and cloud security. More and more, businesses are migrating data to the cloud to take advantage of infrastructure as a service (IaaS) and the efficiencies and economies of scale available through cloud services. The pandemic has served as an accelerator in the use of cloud services, particularly with the shift to whole or partial (hybrid) remote work models that rely on cloud-based enterprise services platforms and a greater share of household consumption transacting through mobile apps.

A survey of employers pointed to several key findings in the cloud computing labor market and skills demand:

- **The cloud is instigating new types of project teams and structures.** One of the most notable developments in cloud computing is the emergence of DevOps as both a concept and occupation. DevOps and SysOps were two roles frequently identified by interviewees and survey respondents as core to cloud-based operations, especially on the client side.
- **Not all cloud computing skills are “hard skills.”** When asked about the level of importance, the highest response rate for “most important” was for teamwork and communication skills. This aligns with interview feedback that also emphasized the essential role of project teams in cloud-based work.
- **Cloud security.** In both structured and open-ended questions, cloud security surfaced as a critical, in-demand skill and role. When asked about the level of difficulty in recruiting entry-level workers with cloud environment security capabilities, 18% of respondents (out of 38 responses) indicated this was “most difficult,” more than any other skill presented.
- **Cloud certifications are relatively important in the hiring process.** Regardless of the platform, e.g., AWS, Azure, Google Cloud, 74% of respondents indicated that entry-level job candidates with at least cloud certifications, if even the most basic level, was important or very important (importance level of 3 to 5).

APPENDIX: INTERVIEWS

Name	Title	Affiliation	Category
Andrew Fischer	Dept Chair of Computer Security and Network Technology	Lake Washington Technical College	Education
Steven Hanks	Professor and Amazon.com Chair, Department of Computer Science	Seattle University	Education
Kelsey Hightower	Principal Engineer	Google Cloud	Company
Jinhee Kuhl	VP, Talent Acquisition	F5 Networks	Company
Jesse Low	CTO	placements.io	Company
Scott McKinley	Partner	McKinley Hodge Group	Industry Expert
Jon Mott	Founder and CEO	Aspirability	Industry Expert
Tony Mullen	Professor	Northeastern University Khoury College of Computer Science	Education
Jason Strickland	Education to Workforce Program Manager	AWS	Company
Mary Trimarco	Business & Outreach Director	Northeastern University	Education

WORKS CITED

- Aggarwal, G. (2021, June 23). *11 Steps To Unlock Cloud Potential With The Right Skills And Talent*. Retrieved from <https://www.forbes.com/sites/forbestechcouncil/2021/06/23/11-steps-to-unlock-cloud-potential-with-the-right-skills-and-talent/?sh=3b8192114a82>
- AWS. (2022). *What is DevOps?* Retrieved from AWS: <https://aws.amazon.com/devops/what-is-devops/>
- Eastwood, B. (2020, September 4). *15 Key Skills for a Career in Cloud Computing*. Retrieved from Northeastern University: <https://www.northeastern.edu/graduate/blog/top-cloud-computing-skills/>
- Gartner. (2021, September 13). *Press Release: Gartner Survey Reveals Talent Shortages as Biggest Barrier to Emerging Technology Adoption*. Retrieved from Gartner: <https://www.gartner.com/en/newsroom/press-releases/2021-09-13-gartner-survey-reveals-talent-shortages-as-biggest-barrier-to-emerging-technologies-adoption>
- Global Knowledge. (2021, August 17). *Get the skills. Get the certifications. Get the higher salary*. Retrieved from Global Knowledge: <https://www.globalknowledge.com/us-en/resources/resource-library/articles/top-paying-certifications/>
- Kolakowski, N. (2020, May 7). *Can Cloud Computing Skills Boost Your Job Security?* Retrieved from Dice: <https://insights.dice.com/2020/05/07/cloud-computing-skills-boost-your-job-security/>
- Miller, R. (2016, July 2). *How AWS came to be*. Retrieved from TechCrunch: https://techcrunch.com/2016/07/02/andy-jassys-brief-history-of-the-genesis-of-aws/?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xLmNvbS8&guce_referrer_sig=AQAAAM29Yau3ZPxMcAtqRz7ewjEs5P3GVJoOHDhmrJRrN-zBwA6hzDYveThpq4m-MbX2VHsL8Z1IMfh8B-Kv5VsyhhucZd
- PR Newswire. (2021, January 23). *Up and Running Software Brings Cloud Computing Expertise and Custom Software Development Skills Together To Drive Business Agility*.
- Zafar Gilani, A. S. (2015). *Deploying and Managing a Cloud Infrastructure : Real-World Skills for the CompTIA Cloud+ Certification and Beyond: Exam CV0-001*. New York: John Wiley & Sons, Inc.