

The Future of Data Center Network Automation

February 2022 EMA Research Report Summary
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Introduction

To remain relevant in a cloud-centric world, data centers must be modernized. Enterprises and service providers need data center operations to be scalable, agile, and efficient. These requirements put pressure on the people responsible for data center networks because traditional network management is not agile or efficient, and its highly manual processes do not scale gracefully. This is where data center network automation comes into play.

Enterprises and service providers are investing heavily in network automation technology to ensure that the data center networks can support the demands of modern digital infrastructure. Data center networks must be secure, reliable, and responsive to change. A well-automated data center network can deliver on these requirements.

This summary of new EMA research explores the cutting edge of data center network automation. It draws on quantitative and qualitative research by EMA analysts to reveal how technology organizations are planning, implementing, and using data center network automation solutions today and into the future. This report identifies the technologies that these organizations are using. It explores the benefits and challenges associated with data center network automation, and it reveals some potential best practices that readers should consider for their own organizations.

Key Findings

- Technology organizations believe data center network automation can drive operational efficiency, security risk reduction and improve compliance and digital agility
- Nearly 77% of technology professionals see room for improvement in their data center network automation strategies
- 45% of organizations expect their data center network automation investments to earn an ROI within two years
- Organizations have multiple data center network automation tools
 - More than 48% use two tools and 34% use three
- Organizations are using a mix of commercial and homegrown data center network automation tools
 - Nearly 93% are developing their own software
 - 98% are using commercial solutions
- Nearly 93% of organizations are engaged with intent-based networking solutions
- 72% of organizations require their tools to orchestrate network automation across multiple, geographically dispersed data centers
- Nearly 78% of organizations require their data center network automation tools to be extensible to the public cloud
- Nearly 89% of organizations believe it is at least somewhat important for a data center network automation tool to have integrated monitoring and troubleshooting capabilities
- Nearly 48% of organizations have automation tools that require at least some manual data gathering before implementing a change
 - 51% of these organizations say manual data gathering has a negative impact on the effectiveness of their automation



Research Methodology and Demographics

Quantitative Research

During December 2021, EMA surveyed 359 technology professionals who are directly engaged in their employer’s data center network automation strategies.

Figures 1 and 2 reveal who EMA talked to, detailing their job titles and the functional groups in which they work. These charts reveal that most of these

people are IT or network architects, network engineers, technology executives, and technology group managers. Most of them work in a technology executive suite or within security, architecture, and engineering teams.

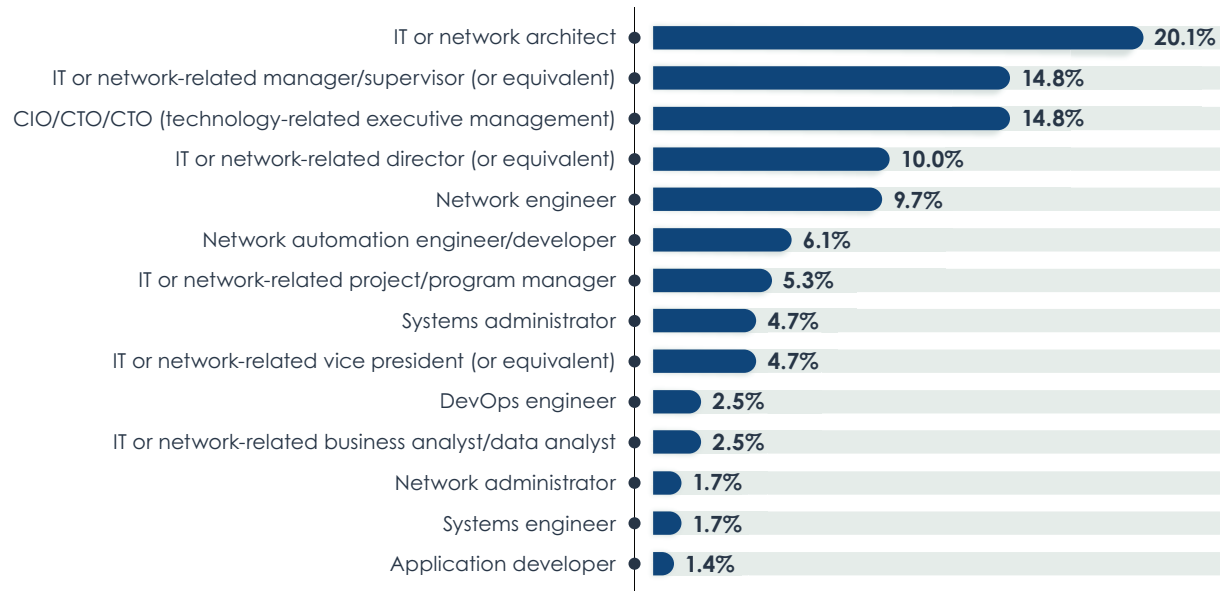
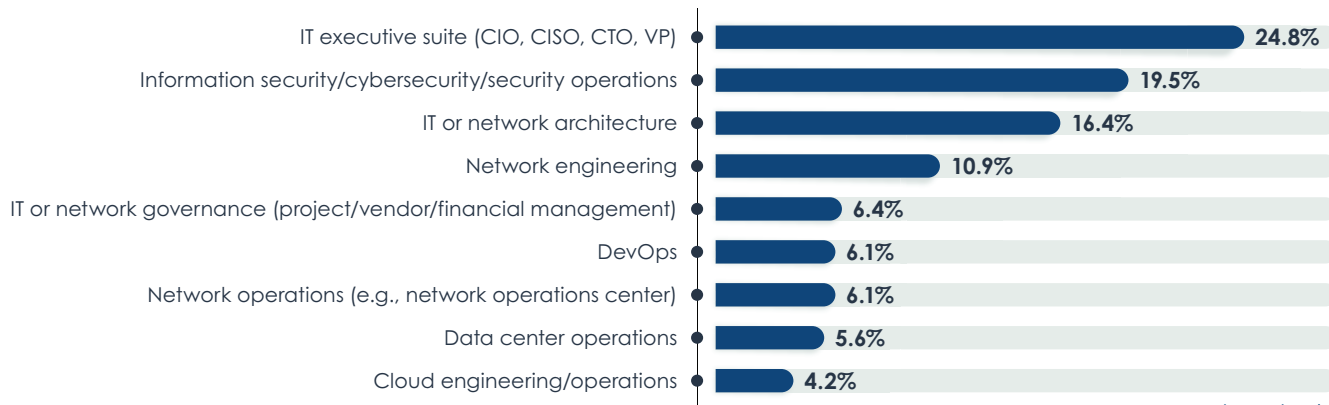


Figure 1. Job titles



Sample Size = 359

Figure 2. Functional groups within technology organizations

Figures 3, 4, 5, and 6 characterize the organizations that research participants work within. Figure 4 reveals that most of these companies are midsized enterprises, with a minority of large enterprises. Figure 5 shows that more than one-third of these organizations are billion-dollar companies, and more than half earn between \$100 million and \$1 billion annually. Figure 6 reveals

the industries represented in this survey. More than 19% are communications service providers and nearly 9% are cloud service providers. The rest are enterprises. Finally, Figure 7 reveals that most respondents are in North America. A large minority are in Europe, specifically France, Germany, and the United Kingdom.

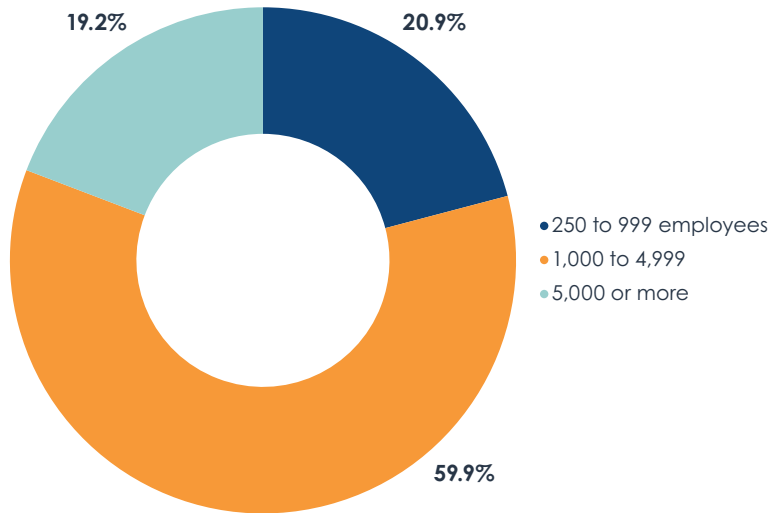


Figure 3. Size of company (employees)

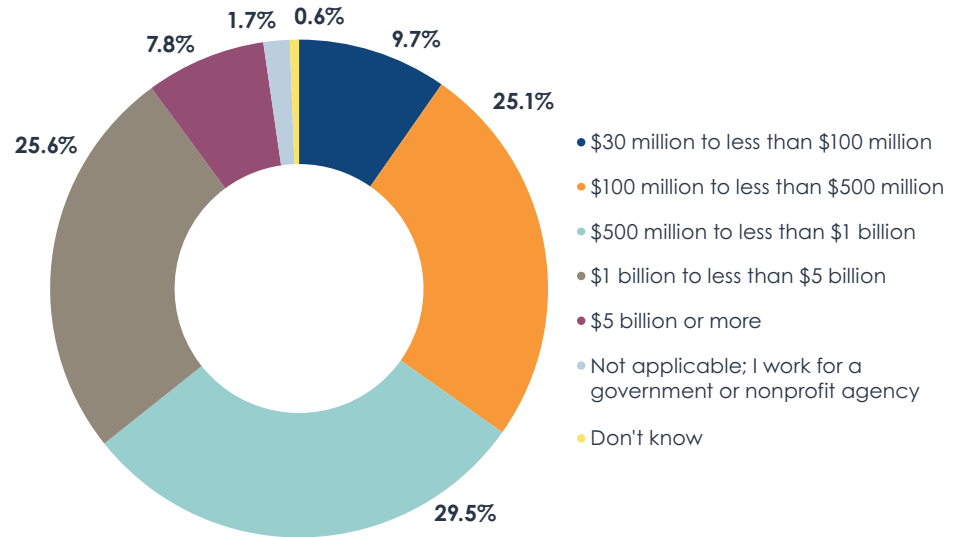


Figure 4. Annual sales revenue of organizations

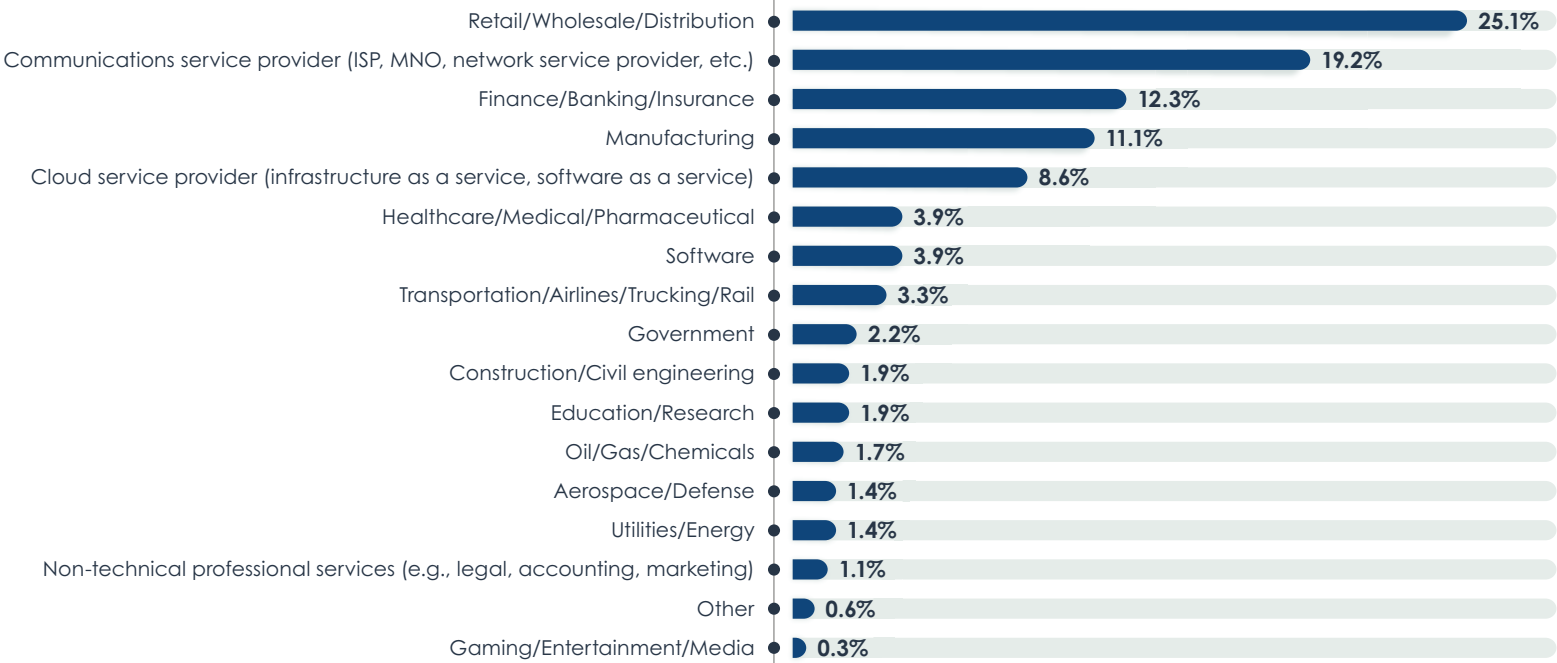


Figure 5. Industries

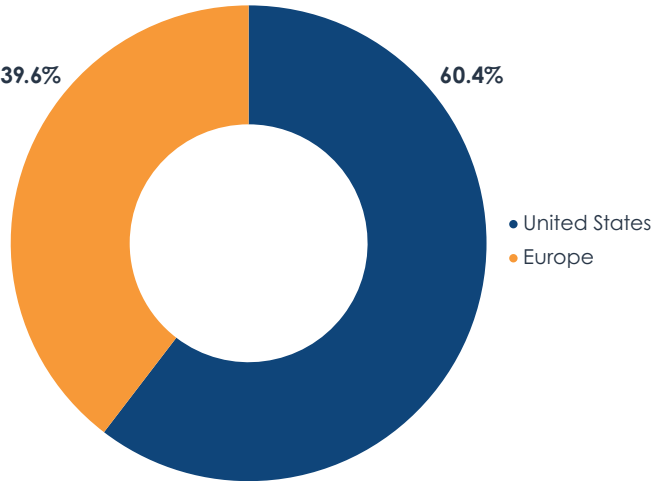


Figure 6. Region

Sample Size = 359

Qualitative Research

EMA analysts interviewed seven technology professionals about their employers' use of data center network automation. EMA used these interviews to enrich and contextualize its analysis of the quantitative data. These interviewees will be quoted anonymously throughout the report. The interviewees included:

- NetDevOps engineer, large European government agency
- Network architect, \$50 billion global consulting company
- Network automation engineer, \$3 billion North American cloud service provider
- Network automation engineer, \$3 billion North American retailer
- Network design engineer, \$25 billion global pharmaceutical company
- Network engineer, \$60 billion North American manufacturer
- Network engineer, \$3 billion North American medical research company



Benefits and Challenges

Most Automation Strategies are Good, not Great

If this research proves one thing, it will be that data center network automation is not easy. Most of the individuals in this survey believe that their overall data center network automation strategies could be better. **Figure 7** reveals that only 23% of individuals believe they have a very good approach to this automation. Nearly 62% believe their approach is somewhat good, meaning they see room for improvement. Only 6% believe they have a somewhat poor approach to automation, while no one claimed to have a very poor strategy.

EMA found that organizations that expect robust budget growth for data center network automation are more likely to have a positive assessment of their strategies. Larger companies also have a better outlook. Americans were more positive than Europeans.

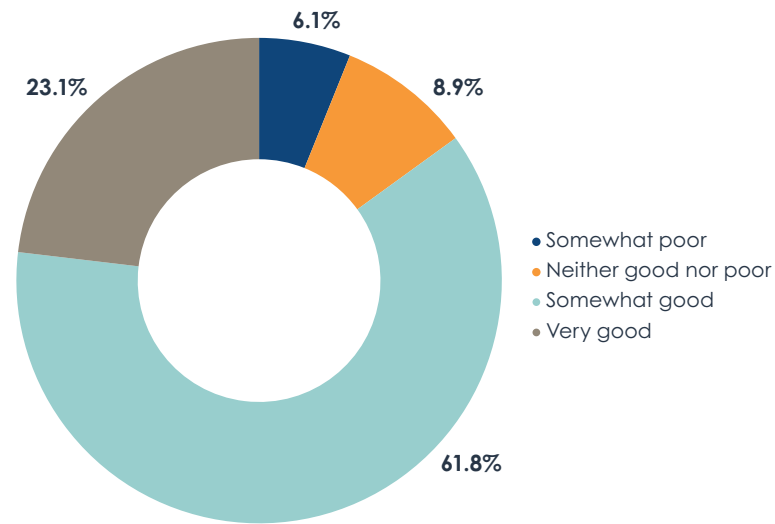


Figure 7. Assessing their organization's overall approach to data center network automation

Automation Benefits Sought by Organizations

Figure 8 reveals the benefits of data center automation that research participants consider most important to their businesses. Operational efficiency tops the list. Network teams want to spend less time on operational tasks.

Organizations with fewer data centers were more likely to prioritize this benefit.

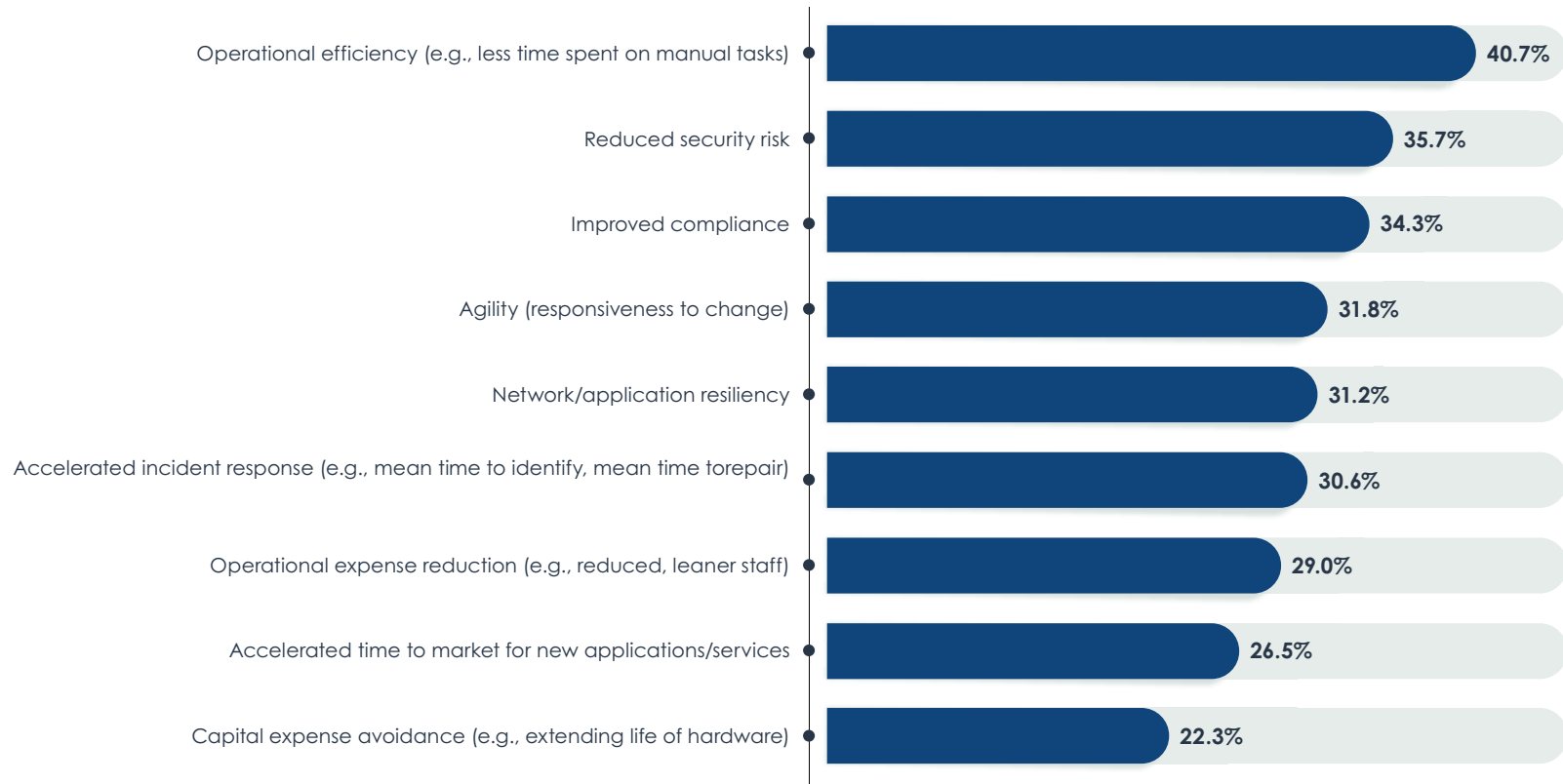


Figure 8. Most important benefits of data center network automation

Sample Size = 359, Valid Cases = 359, Total Mentions = 1,012

Success Tips for Technology Executives

Technology executives must lead from the top with data center automation. EMA asked respondents how IT and technology executives could best support the success of a data center network automation strategy. **Figure 9** reveals that CIOs and CTOs should be setting and enforcing policies that encourage or

require staff to actually use the automation once it is in place. Organizations with the most effective automation strategies were more likely to select this policy focus, which suggests that it is a best practice.

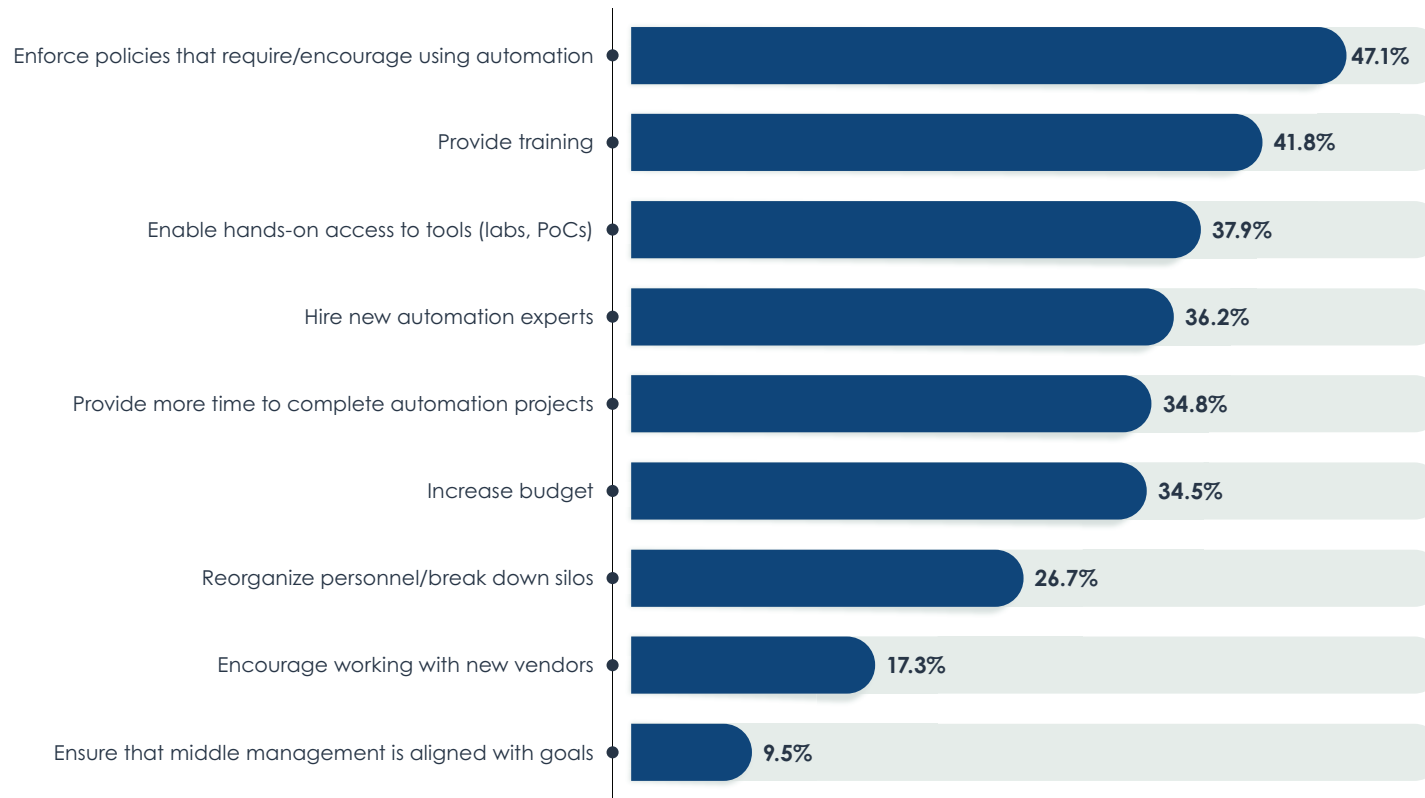


Figure 9. The best ways in which IT/technology leadership can support the success of a data center network automation initiative

Sample Size = 359, Valid Cases = 359, Total Mentions = 1,026



Investment in Automation

Data Center Network Automation Budgets are Growing

Overall, 86% of the organizations represented by this survey will increase their budget for data center network automation solutions over the next two years, and 35% are expecting that increase to be large. **Figure 10** breaks those budget expectations down by enterprise, cloud provider, and communications service provider. It shows that enterprises and cloud providers are planning to ramp up their spending more than telecoms.

Also, Americans are expecting more budget than Europeans. Executives are also expecting more budget growth, suggesting that people lower down in the organization aren't fully aware of upcoming spending plans.

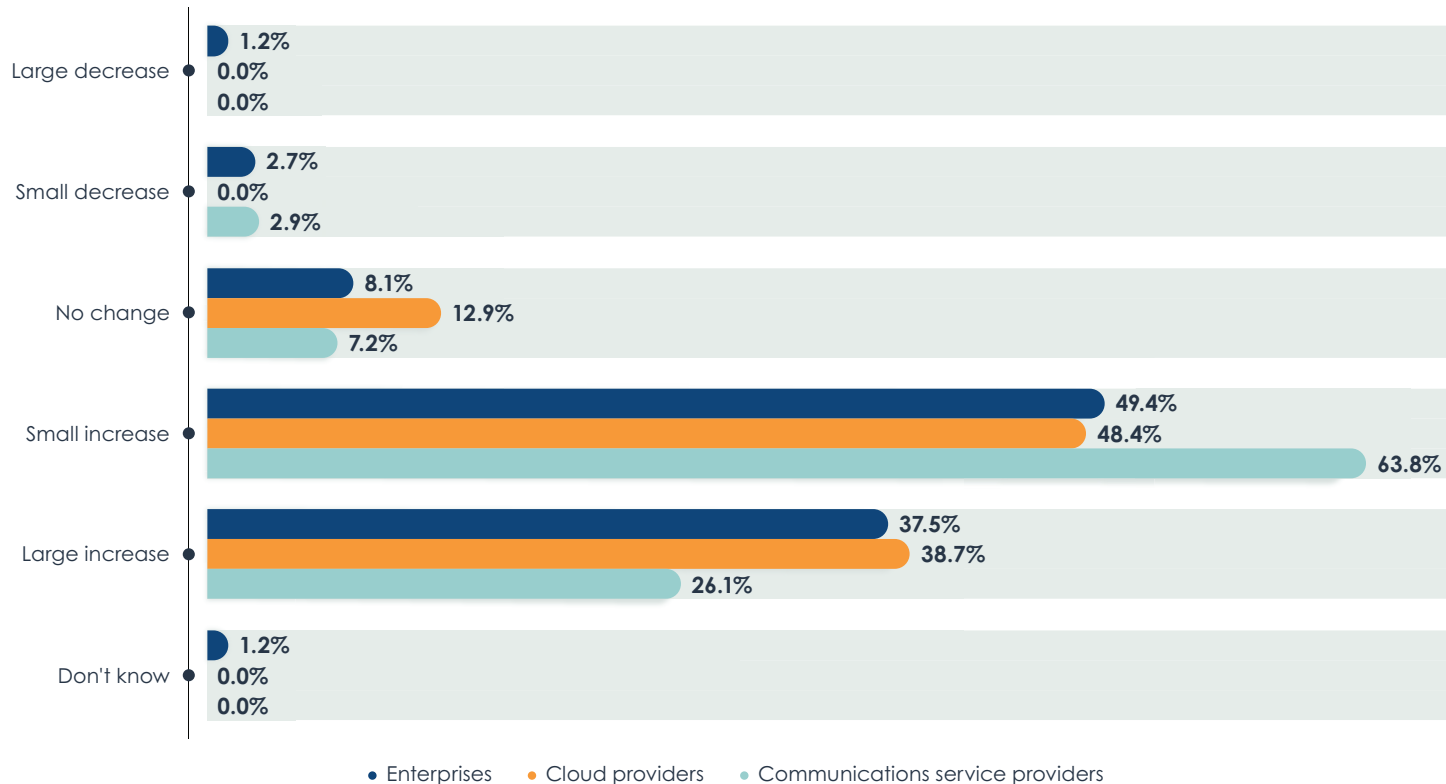


Figure 10. Expected changes in budget for implementing and maintaining data center network automation solutions over the next two years

Sample Size = 359

Half of Automation Projects Earn ROI Within Two Years

All this work will be worth it. The typical organization in this research expected its investments in data center network automation to pay for itself in a timely manner. Eighty-six percent of the organizations in this research try to measure their return on investment (ROI) in data center network automation. Of those, 51% expect to earn an ROI within two years. Another 37.5% expect an ROI within three years, according to **Figure 11**.

Best-in-class enterprises tended to expect an earlier return. More than one-quarter of them expect an ROI within one year, and another 30.8% expect a two-year ROI. None of the somewhat poor automation strategies expect an ROI within a year. The largest companies and the companies with the most data centers both expect a slower ROI, suggesting that complexity slows things down.

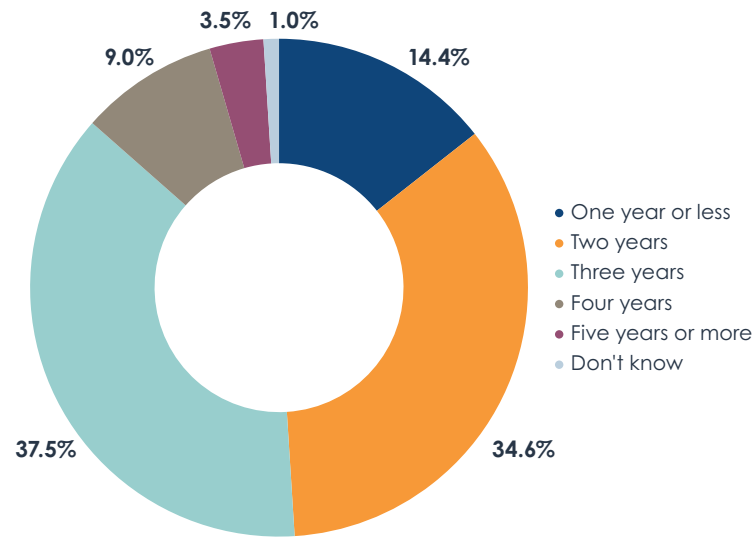


Figure 11. Expected timeframe for a return on investment in data center network automation



Technology Strategy

Classification of Automation Tools

Network automation is a fuzzy subject. The classes of tools in use often shift and evolve over time. A vendor will introduce a tool that manages configurations and network changes, but do little to support network design and performance assurance. Within a couple of years, the vendor will expand into those latter areas and rebrand their product entirely. It can be difficult for network managers to understand the differences between types of automation solutions.

More than 98% of the participants in this research were planning to use a network automation tool, as opposed to relying on individual scripts. EMA presented a list of tool classifications to that 98% and asked them which of these will be applied to data center network automation in their organization. Unexpectedly, the most popular tool type were solutions designed specifically for automating cloud infrastructure, rather than data center networks. Enterprises were more likely to use these solutions than communications service providers. Executives and middle managers were also more likely than subject matter experts to select cloud automation. The popularity of this technology suggests that data center network automation solutions are integrated with the technology that organizations are using for hybrid, multi-cloud

architectures. The solutions they are using to automate their public cloud footprint is also driving data center network automation, to some extent.

DevOps automation tools, integrated automation capabilities from hardware vendors, and network overlay software were all secondarily popular options for automation. The latter two options tend to be an either/or proposition for technology organizations, although EMA has seen some rare examples in which enterprises use both technologies in the same data center. Executives and middle managers were more likely to select integrated hardware capabilities. DevOps tools were used more often by organizations with more data centers.

Best-in-class organizations were more likely to use cloud infrastructure automation and integrated hardware capabilities.

Plenty of organizations also included monitoring tools, network orchestration and automation (NOA) tools (sometimes known as intent-based networking), and network change and configuration management tools in their overall data center network automation strategy. NOA solutions were more popular among organizations with the most data centers in operation. Americans were also more likely to select NOA solutions. Europeans were more likely to select monitoring tools.

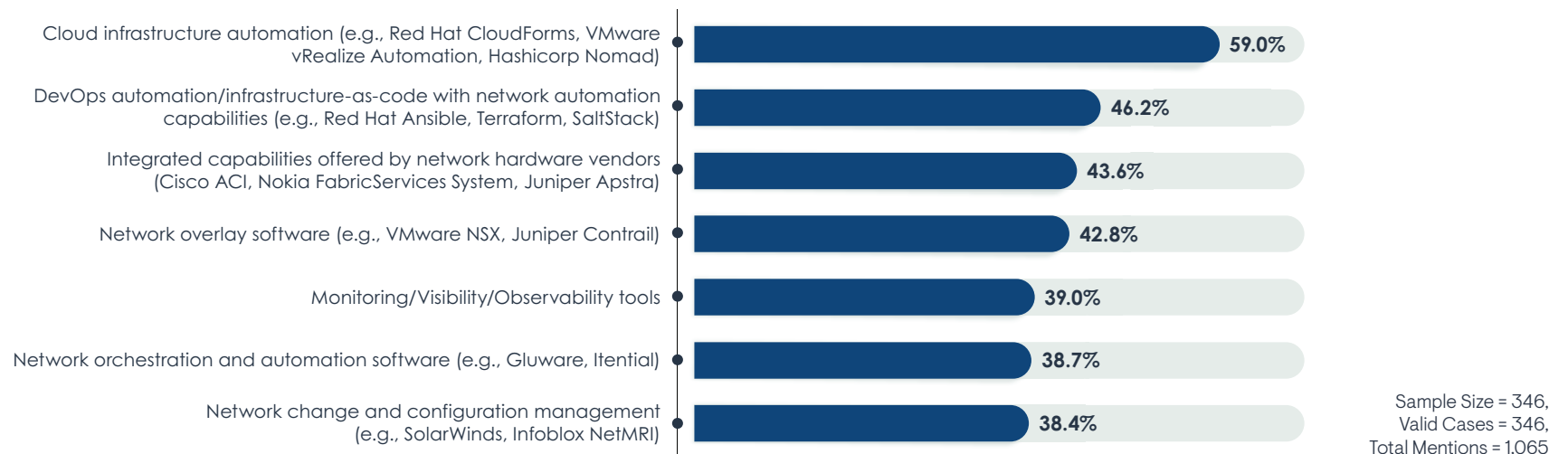


Figure 12. Types of solutions that organizations are using or planning to use for data center network automation

Most Organizations are Developing Their Own Network Automation Software

Figure 13 reveals that among the 98% of organizations that are going with individual scripts, almost 93% are developing some data center network automation software internally. Nearly one-quarter say this is their primary means of automation. Awareness of this internal software development is higher among subject matter experts, such as engineers and architects. It is lower among middle managers and executives, suggesting that this software development is sometimes a grassroots effort that is not immediately visible

to management. Organizations with more data centers are also more likely to develop their own software, suggesting that commercial solutions aren't addressing workflows that span multiple data centers.

“We have some in-house tools that we built several years ago, and we just keep adding features to them to completely automate the network,” said a network automation engineer with a \$3 billion North American cloud service provider.

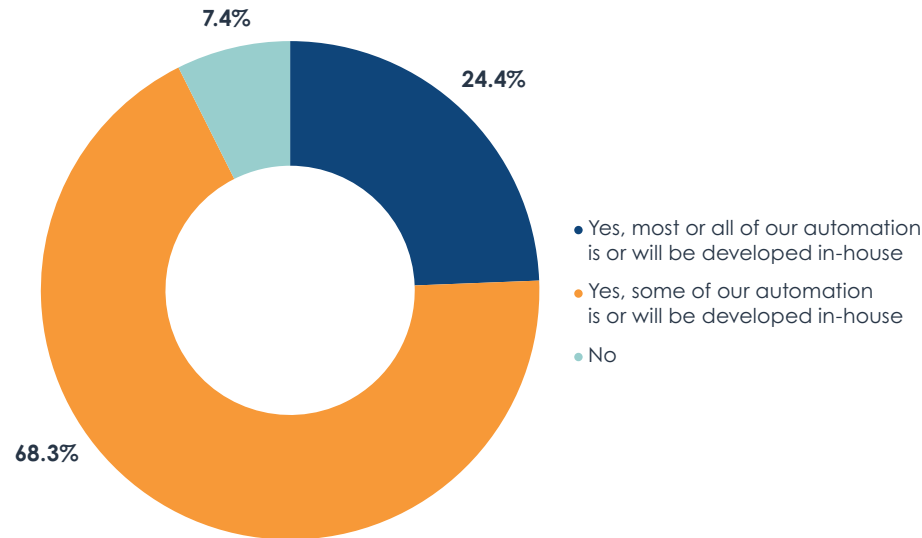


Figure 13. Does your organization develop its own software for data center network automation, not including individual scripts that are not integrated into an orchestration framework?

Drivers of Internal Software Development

There are two primary reasons why organizations develop their own automation software, as **Figure 14** reveals. First, nearly half have security and compliance requirements that drive this activity. Best-in-class organizations were more likely to cite this as a reason. Nearly as many also do this because they need automation functionality that is functionally aligned with their specific data center environments. This latter response suggests that many organizations have found limits to the customizability of the commercial solutions they have encountered. This reason was cited more often by organizations that have fewer data centers and by individuals who work within an IT governance group.

The secondary drivers of internal development are a desire to close functional gaps in commercial solutions and a desire to have total control over a tool’s roadmap. In recent years, worst-in-class organizations were the most likely to address gaps in commercial solutions, suggesting that internal development is a response to ineffective implementation of commercial software. Cloud operations or engineering professionals were also more likely to cite functional gaps.

“When I worked at [a \$110 billion retailer], we looked at vendor tools,” said a network architect with a \$50 billion global consulting company. “We quickly

found that the sheer size of our operations tended to max out the capabilities of the vendors. If you have a firewall with 60,000 rules and multiply that by 150 firewalls, you max out what their automation is intended to handle. The one thing that kept coming up in vendor meetings was that we were the only company that would hit their scalability limit.”

“We developed our own years ago because vendors didn’t have what we needed,” said a network automation engineer with a \$3 billion North American cloud service provider. “Our network is not a specific design. There are many different types of topologies in our network. Commercial products would work for one type of network, but not the other. They weren’t extensible to our needs. Nowadays, I’m sure we could find a commercial tool that could work for us, but it would be difficult to change direction now. Ours works very well for what I need.”

Cost savings and cultural reasons are the least popular drivers of internal development. However, organizations cite cost savings more often as the number of data centers they have goes up. People who work within a network or IT architecture group were more likely to cite cultural influence.

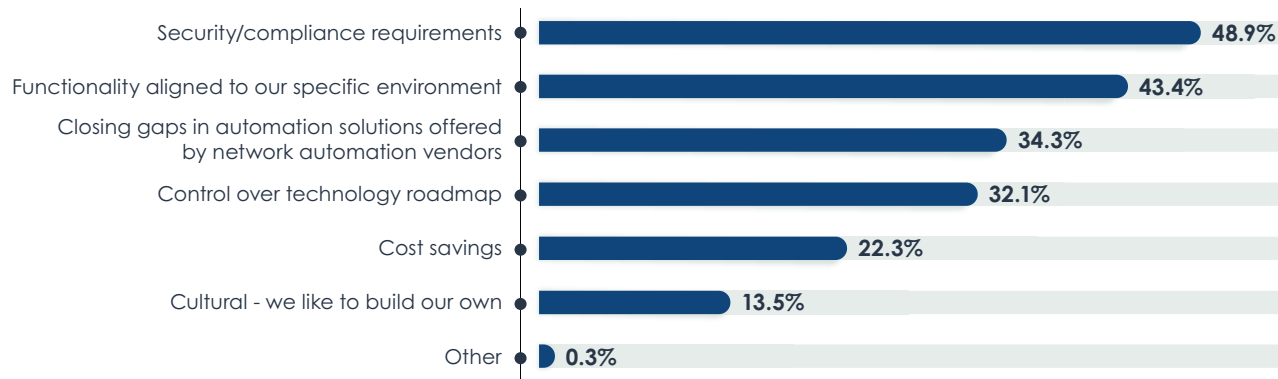


Figure 14. Top reasons why organizations are developing data center network automation software internally

Sample Size = 327, Valid Cases = 327, Total Mentions = 637

Nearly all Organizations are Using Commercial Automation Solutions

While many of these organizations are developing their own automation software, more than 88% are also adopting commercial solutions, as **Figure 15** indicates. More than 20% plan to use commercial technology for all or most of their data center network automation requirements. Enterprises were more likely than communications service providers to rely on a commercial solution for most or all of their automation needs. Europeans were also more likely to indicate this. IT executives expect this approach more than subject matter experts and middle managers.

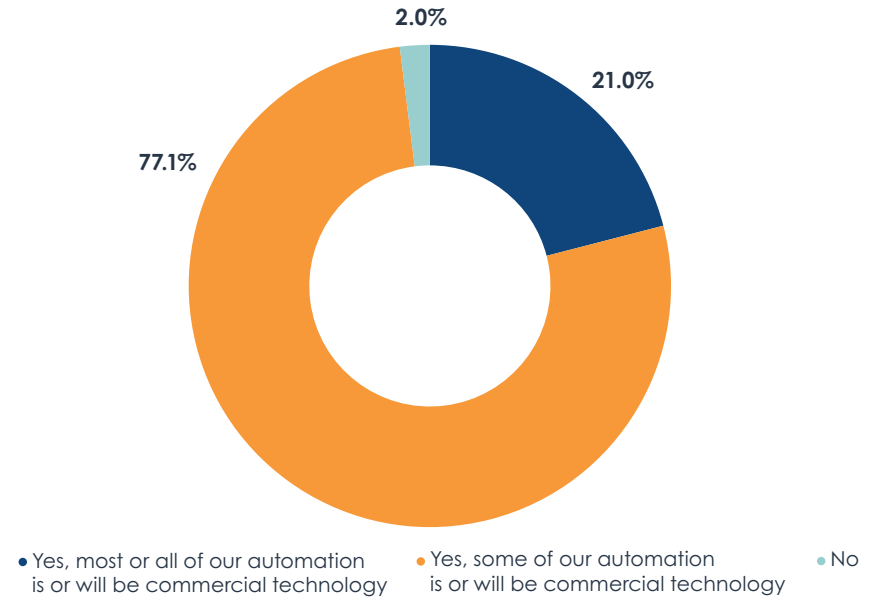


Figure 15. Does your organization use or plan to use commercial data center network automation solutions?

Drivers of Commercial Network Automation Solution Adoption

Figure 16 reveals why organizations adopt commercial data center network automation solutions. There are four primary drivers, led by security and compliance requirements and faster time to value. Executives and middle managers were more likely than subject matter experts to cite security and compliance requirements, as were respondents who have the fewest number of data centers. Enterprises also cite this as a driver more than communications service providers. Time to value is a bigger issue for Americans than for Europeans.

The other two major reasons for commercial tools are better cross-team visibility into network data and overall breadth and depth of functionality. Breadth and depth of functionality is a bigger driver for organizations with a larger number of data centers.

Other significant drivers of commercial tool adoption include customer support and services, platform requirements like scalability and stability, and preexisting vendor relationships. Issues like a lack of software development expertise and a cultural bias toward commercial solutions were relative nonfactors among these organizations. However, organizations with the largest number of data centers (11 or more) were more likely to be influenced by cultural drivers. Members of DevOps teams also cited culture more often.

A network engineer for a \$60 billion North American manufacturer said he prefers a commercial approach because it's hard to find people who can code and understand networking. "Earlier in my career, I would have thought that homegrown network automation would be more beneficial. But with high engineering turnover, I think commercial is the better approach now."

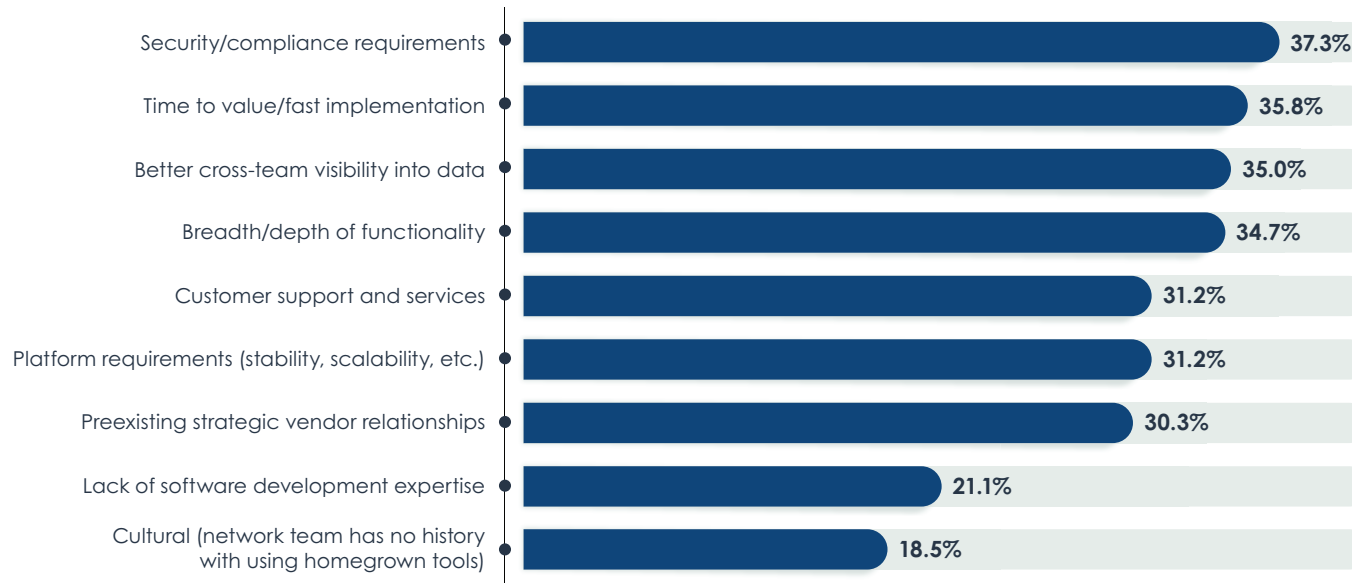


Figure 16. Top reasons why organizations are adopting commercial network automation capabilities

Sample Size = 346, Valid Cases = 346, Total Mentions = 952

Most Data Center Network Automaton Strategies are Multi-Tool

Figure 17 reveals that only 5% of organizations are able to achieve their data center network automation goals with a single tool. Instead, more than 48% use two tools and 34% use three. More than 11% use four or more. Network management professionals often complain of tool fragmentation when they rely on multiple tools, so this state of affairs could be problematic for some organizations. However, EMA detected no significant relationship between number of tools and level of success.

Organizations with 11 or more data centers are the most likely to have a larger set of tools. Americans tend to have more tools than Europeans. Communications service providers tend to have more tools than enterprises.

“We had five different automation tools that we would have to update to get automation done,” said a network design engineer with \$25 billion global pharmaceutical company. “So, it used to take me five or six hours to get something done with automation. Then we improved the process, used API calls to streamline things. It’s sped things up.”

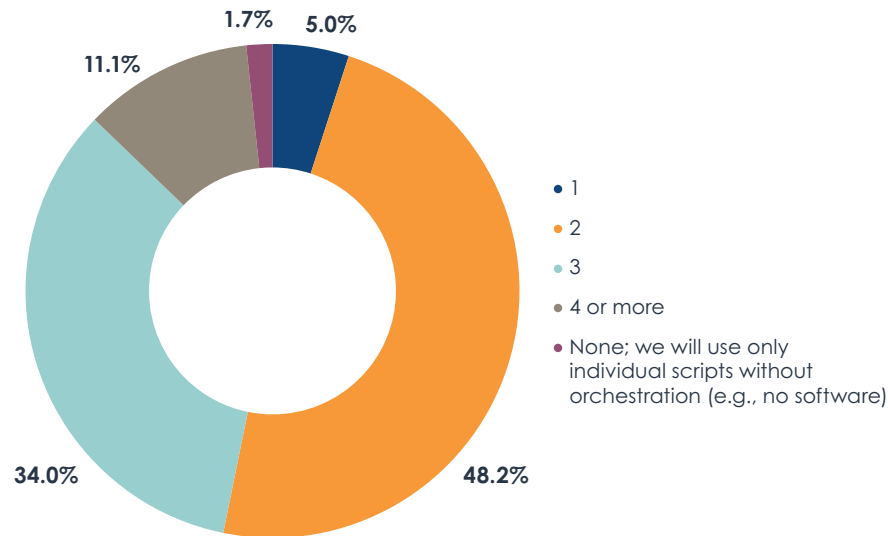


Figure 17. Number of data center network automation tools used by an organization (not including individuals that are not integrated into an orchestration framework)



Data Center Network Automation Technology Requirements

Figure 18 examines another platform requirement for data center network automation. Nearly 72% of organizations require their tools to coordinate automation across multiple, geographically dispersed data centers. Another quarter of organizations don't require it, but they do think it could prove helpful. Cross-data center automation can streamline operations. It can also enforce configuration compliance across sites. Organizations that are trying to enable highly available applications across multiple regions will find this useful.

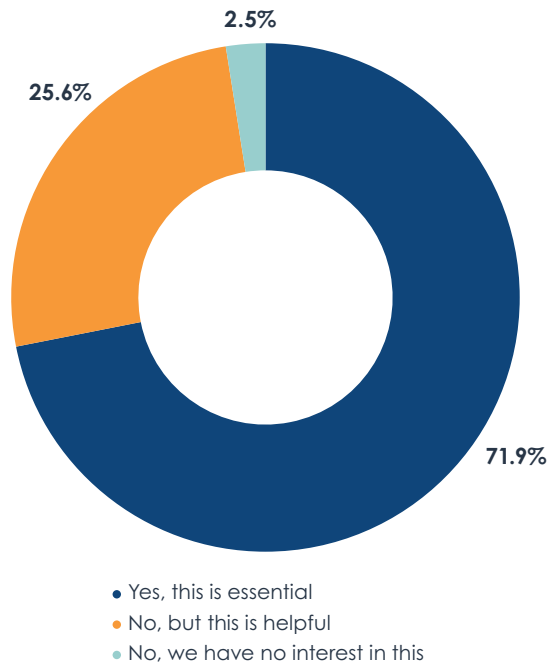


Figure 18. Do you require your data center network automation solutions to be able to orchestrate automation across multiple, geographically dispersed data centers?

Some data center network automation solutions focus solely on the data center network, as the name would imply. However, many organizations are thinking more expansively about network automation. **Figure 19** reveals that 86% believe that it is at least somewhat important for data center network automation solutions to plug into the automation of the rest of the network, whether it's an enterprise LAN, WAN, or service provider RAN. This allows organizations to orchestrate end-to-end network automation.

Best-in-class organizations are more likely to think this integration of end-to-end network automation is very important. Executives are also more likely than subject matter experts to want this.

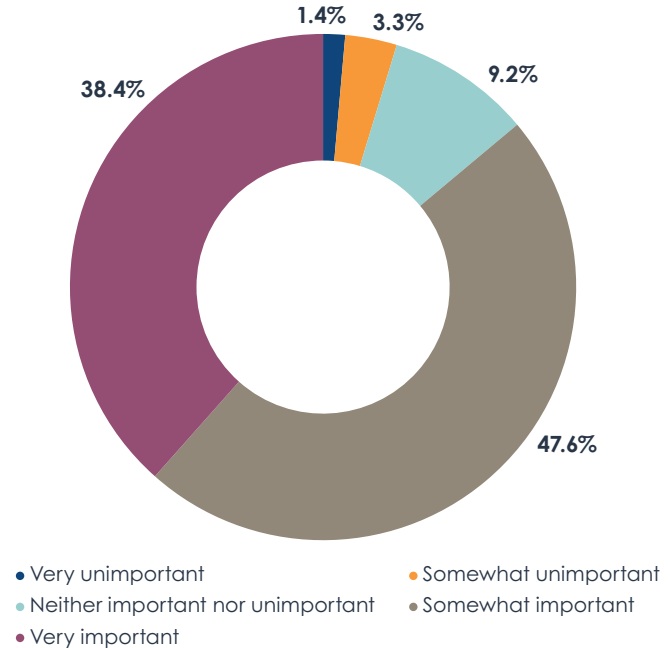


Figure 19. The importance of integrating data center network automation with automation of the rest of an organization's network (WAN, LAN, global backbone, RAN, etc.) to enable end-to-end network automation

Sample Size = 359

Feature Requirements

Figure 20 identifies the top feature requirements that organizations set for their network automation solutions. The chart reveals stark separation between the top five requirements and the rest. First, device lifecycle management and security policy features, such as design, implementation, and auditing, are the two most important features. Communications service providers were the most likely to select device lifecycle management. Enterprises were also quite interested. Cloud providers showed only minimal interest.

Change analysis/modeling, configuration compliance, and change management round out the top five features. Setting change analysis as a requirement is a best practice, given that best-in-class enterprises made it a higher priority. Change analysis is more important to subject matter experts and middle managers than it is to executives. It is also prioritized more often by telecoms and cloud providers than it is by enterprises, and organizations with more data centers also seek it more often.

“We have a huge emphasis on features for security compliance and implementation standards,” said a network automation engineer with a \$3 billion North American cloud service provider.

Device onboarding is a low priority, but organizations with more data centers tend to require it. It is also a feature sought by worst-in-class organizations, so readers should make sure they don’t neglect other critical features in favor of it.

Design and build features are a low priority, but enterprises were twice as likely as communications service providers to seek them out. Visibility into end-to-end service delivery is a very low priority, but organizations with the fewest data centers are more likely to look for it. This finding suggests that people in these organizations are less specialized for data center networking. They are probably also responsible for local- and wide-area networking, and they need to contextualize and orchestrate data center network operations with the broader network.

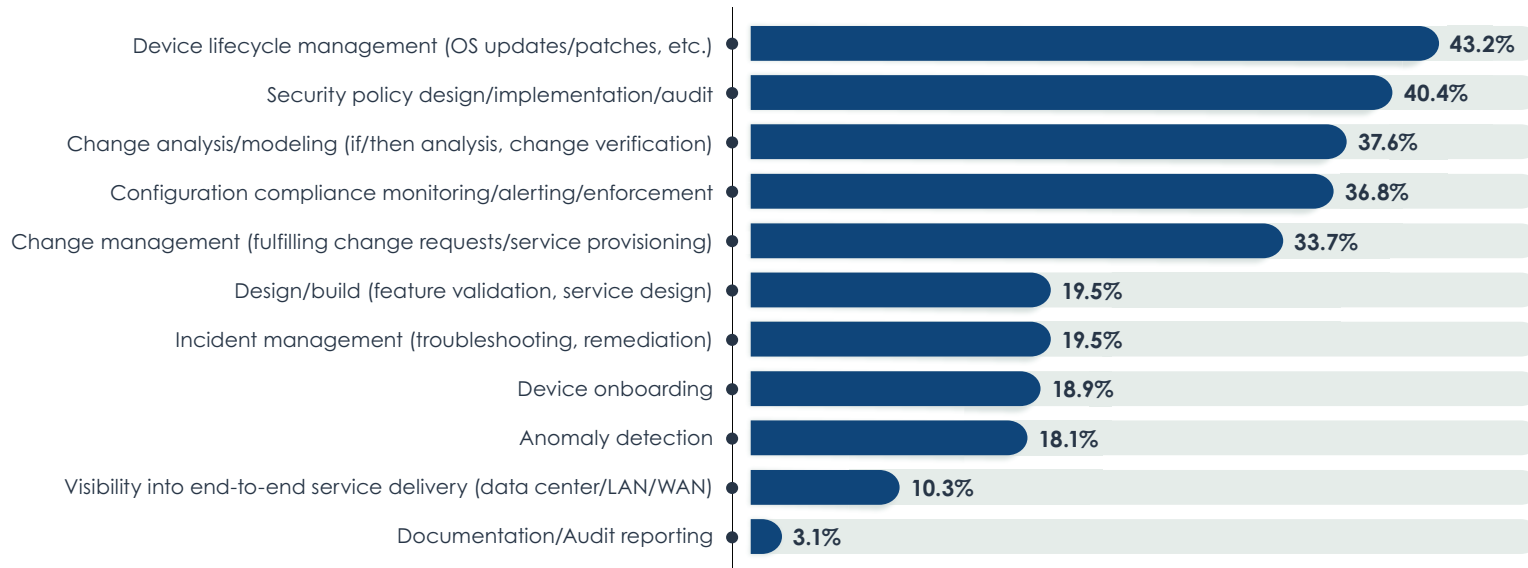


Figure 20. Most important feature requirements for data center network automation solutions

Sample Size = 359,
Valid Cases = 359,
Total Mentions = 1,009

Intent-Based Networking Engagement is High

Intent-based networking emerged several years ago as a popular marketing term for network automation solutions. Vendors use the phrase to differentiate themselves from older types of network automation solutions, like network change and configuration management. The phrase’s definition varies from vendor to vendor, but EMA defines intent-based networking as a class of network automation technology that abstracts the complexity of network management by allowing administrators to express their business intent for a network in a tool’s user interface. In the context of defining this technology in the survey for this research, EMA emphasized that intent-based networking requires a tool with the intelligence to interpret intent and implement a series of automated changes to a network.

Based on EMA’s definition, nearly 78% of research participants claimed that they are using intent-based networking, as revealed by **Figure 21**. However, less than 21% said that most of their data center network automation would qualify as intent-based networking. Best-in-class organizations were more likely to say their use of intent-based networking is this extensive.

Another 19% said they plan to adopt intent-based networking in the future. Only 3% claimed to have no plans for the technology. Cloud providers were less engaged with intent-based networking overall, versus communications service providers and enterprises. Americans were more engaged than Europeans with it.

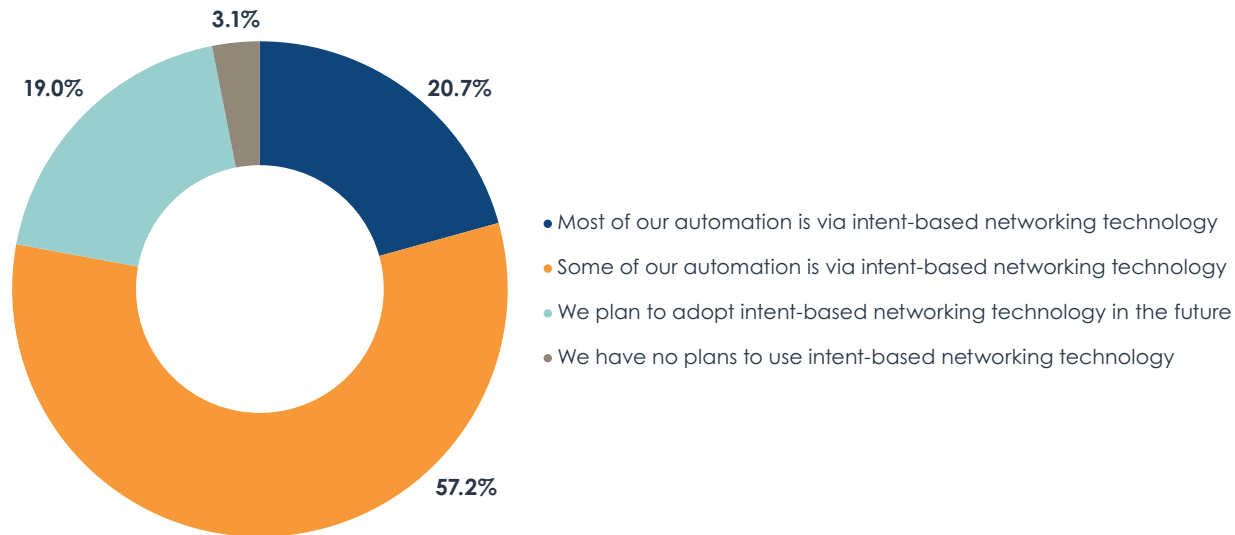


Figure 21. State of engagement with intent-based network automation in data centers

Network Automation Solutions as Network Assurance Tools

Many network automation solutions are primarily tools for provisioning, configuring, and making changes to network devices. Network teams rely on other specialized tools for monitoring and troubleshooting, such as network performance management. However, there is value to having a network automation solution that has integrated monitoring and troubleshooting capabilities.

Figure 22 reveals that the market agrees. Nearly 89% believe it is important

for network automation tools to have these features. Nearly 38% describe it as very important. Best-in-class organizations are even more sanguine about the importance of integrated network assurance capabilities. Executives are more convinced of this opportunity than middle managers and subject matter experts.

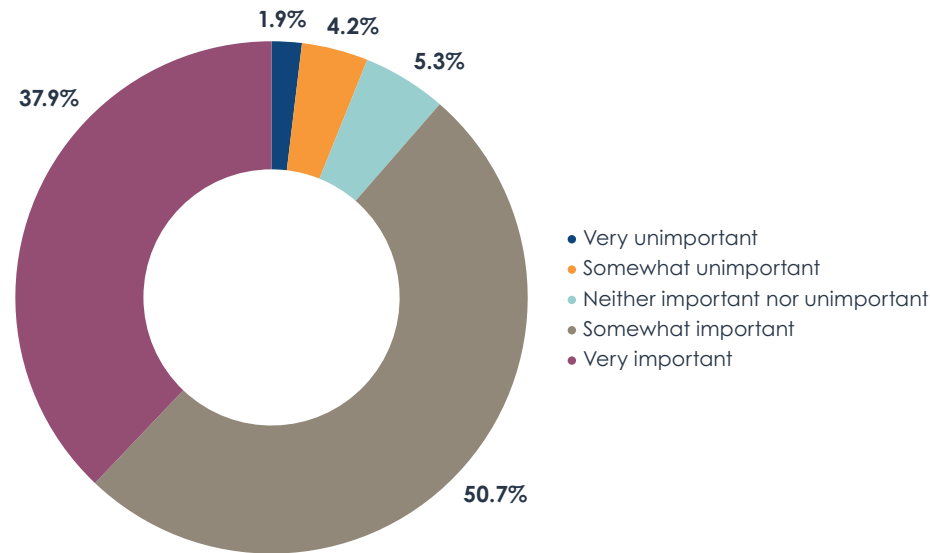


Figure 22. Importance of having network monitoring and troubleshooting capabilities integrated into a data center network automation tool

AIOps-Driven Network Automation is Required

EMA research recently found that enterprise network infrastructure and operations teams are extremely interested in applying AIOps technology to network management. Over 90% believe that AIOps-driven network management will lead to better business outcomes for their overall enterprises.¹ In the context of the survey for this data center network automation research, EMA defined AIOps (artificial intelligence for IT operations) as an emerging class of technology that applies artificial intelligence, machine learning algorithms, and big

data solutions to IT operations data to enable anomaly detection, predictive analysis, and intelligent automation. **Figure 23** reveals that nearly two-thirds of organizations require some kind of AIOps capability in at least one of their data center network automation solutions.

AIOps interest was highest among best-in-class enterprises. Cloud providers are more enthusiastic than enterprises. Interest goes up with a larger number of data centers in operation. Americans were more interested than Europeans.

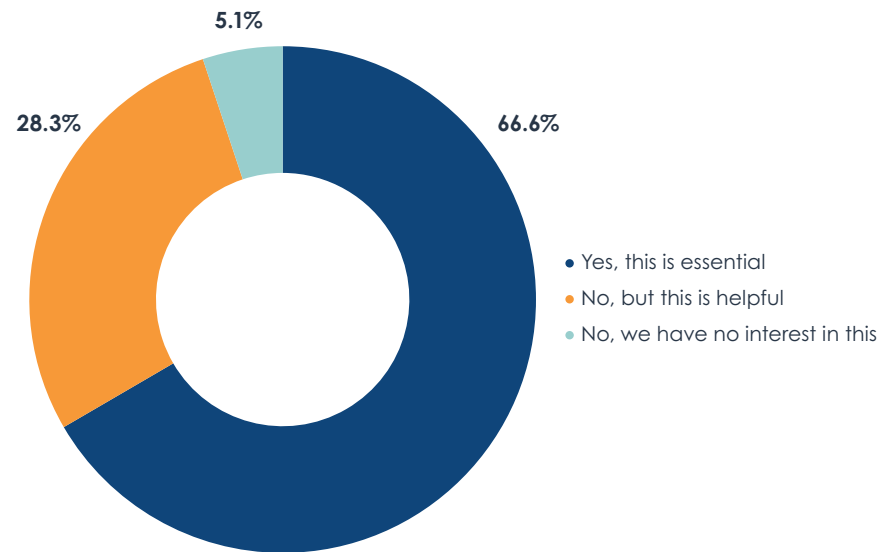


Figure 23. Does your organization require AIOps capabilities in one or more of its data center network automation solutions?

¹ EMA, “Revolutionizing Network Management with AIOps,” April 2021.



Network Data and Automation

Data is essential to network automation. Before a network manager executes an operation through a network automation tool, he or she must review network data and non-network data. The tools will require data entry, such as configuration information, to push a change into the network. The network manager will also need to review data to help inform his or her decisions about what automation to execute.

More and more, organizations have embraced the idea of establishing a network source of truth for automation. A source of truth is a central repository that a network automation solution can rely on for providing all required network data. While organizations have been moving toward establishing sources of truth, this research shows they have more work to do.

Manual Data Collection is Pervasive with Network Automation

Figure 24 reveals that nearly 48% of organizations are still relying at least partially on manual data gathering for their data center network automation tools. In other words, a network engineer may have to consult spreadsheets and log into the command line interface of individual devices to find the data that they must enter into an automation tool in order to implement a change to the network. Communications service providers were more likely than enterprises to rely on manual data collection. Organizations with fewer data centers were also more likely to rely on manual data collection.

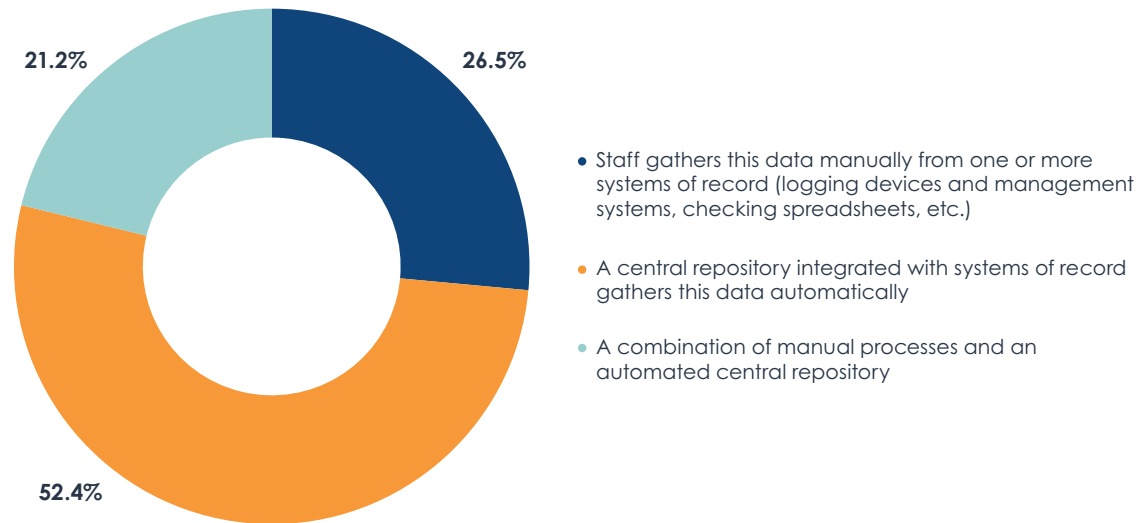


Figure 24. Primary data gathering techniques for data center network automation tools

More than 21% are in transition, using a combination of automated data gathering and manual processes. Some organizations consider this a hybrid approach.

“Today, it’s manual, but in an ideal world it would be a combination of both automated and manual. Automated for standard tasks and manual for more advanced tasks that need a more complex execution. It’s a little bit of a challenge,” said a network engineer with a \$3 billion North American medical research company

Overall, more than 52% primarily rely on a central repository that automatically gathers the data that a data center network automation solution will need to implement a change. Most of the individual technology professionals EMA spoke to for this research see this as an ideal approach, but most of them aren’t quite there.

“Our network automation tool holds all that information. It takes snapshots of switches every time you make a change, and it keeps it there,” said a network engineer for a \$60 billion North American manufacturer.

“We are somewhat manual. We just finished a proof of concept to use NetBox for a data repository. We have Infoblox, but it’s not fit for a purpose and it’s always out of date. So, engineers revert to using spreadsheets. NetBox easily integrates with Ansible,” said a NetDevOps engineering with a large European government agency.

Negative Impacts of Manual Data Collection

Figure 25 reveals that slightly more than half of the organizations that rely on manual data gathering believe that these manual processes have a negative impact on the effectiveness of their data center network automation. These negative impacts are felt most often by organizations that reported that their overall automation strategies are inferior, suggesting that this is a key issue that can upend a data center network automation strategy. On the other hand, executives were less likely than subject matter experts and middle management to recognize this problem, which points to a disconnect on this issue between management and technical staff.

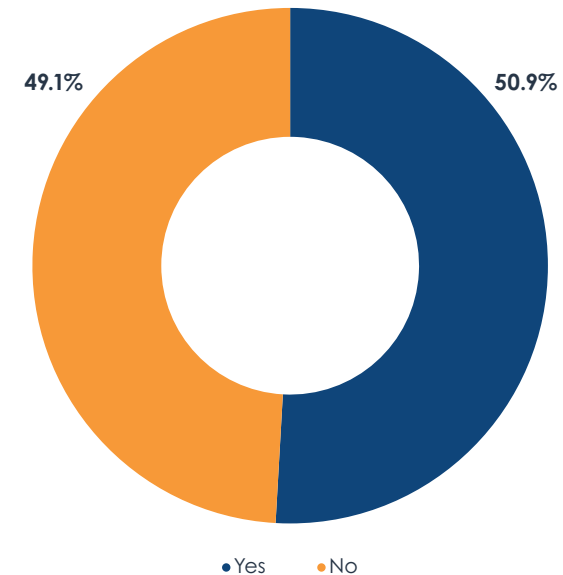


Figure 25. Do manual data gathering processes have a negative impact on the effectiveness of your data center network automation?

Data Most Essential to Automation

Figure 26 reveals the data that organizations need to collect for their data center network automation solutions. The most important data is unsurprisingly configuration information. Note that this can be configuration files or structured data extracted from configuration files.

Inventory data, device metrics, flow data, and security policies are secondary priorities. Executives were more likely to emphasize security policies. Best-in-class enterprises were the most likely to need device metrics. Enterprises selected security policies more often than communication service providers

and cloud providers. Organizations with the smallest number of data centers also did so.

Application information and DNS records are lesser priorities. Subject matter experts were far more likely than executives and middle managers to want application information.

IP address space and topology data were the lowest priorities, but communications service providers were more likely to need topology data. Europeans had a stronger need for IP address space.

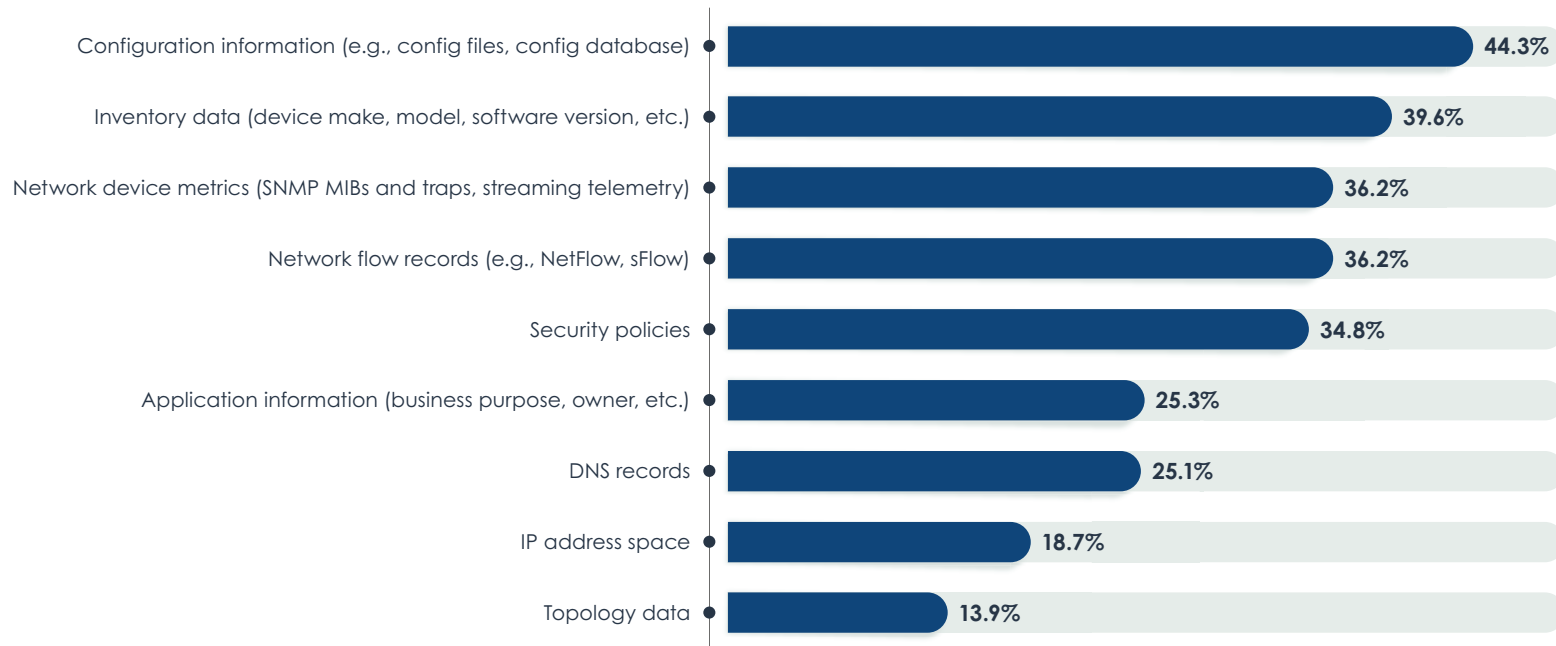


Figure 26. Data that is most important to an organization’s data center network automation toolset

Sample Size = 359, Valid Cases = 359, Total Mentions = 984



CloudOps and DevOps

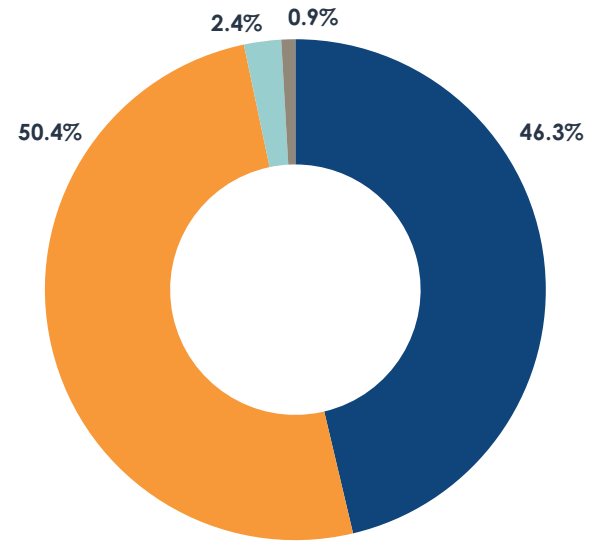
This section examines how organizations integrate their data center network automation solutions and integrate with cloud operations and DevOps tools and processes.

Integrating with the DevOps Toolset

More than 60% of the organizations represented in this research have a DevOps organization. Another 33% expect to establish one soon. Enterprises were the most likely to have a DevOps group today. In many cases, data center network automation facilitates DevOps. DevOps teams orchestrate infrastructure as applications move from development to test environments and finally to production infrastructure. DevOps teams need to be able to orchestrate networks as part of this process. Integration between DevOps orchestration, automation tools, and network automation tools can be essential.

Figure 27 reveals that nearly 97% of organizations with DevOps teams integrate their data center network automation solutions with DevOps tools. More than 46% have tight integration, where DevOps teams can automate nearly all aspects of the data center network through their own tools. Best-in-class organizations were more likely to have this tight integration. Cloud providers were more likely than enterprises and communications service providers to have this tight integration. Americans were more likely than Europeans to do this.

More than half have loose integration in which DevOps can drive some automated changes, but many operational processes are still conducted directly within the network automation tool, meaning that network managers must respond to tickets the DevOps team opened.



- Tightly integrated - DevOps can program most or all of our network through its tools
- Loosely integrated - DevOps can drive some automation of our network through its tools
- No integration - Network automation and DevOps automation are siloed
- Don't know

Figure 27. Extent of integration between data center network automation tools with DevOps tools and processes

Automation Must Extend to Public Cloud and Edge Cloud

Data centers are no longer the center of an organization’s digital universe. Instead, they are part of a constellation that includes cloud service providers, colocation data center operators, and SaaS application providers. Thus, a data center network automation tool cannot exist in a vacuum. Technology teams need to orchestrate services across private data centers and the public cloud to enable hybrid, multi-cloud architecture.

Figure 28 shows how this need for hybrid infrastructure is impacting data center network automation. Nearly 78% of organizations said their data center network automation tool must be extensible for the public cloud for the purpose of orchestrating networking across both environments. This requirement is more common in best-in-class organizations.

“The push toward the cloud is one thing that is driving [our data center] network automation,” said a network automation engineer with a \$3 billion North American retailer. “With day-to-day operations, we want to be able to provide our new cloud applications with access to resources that are sitting in a data center.”

“We have an orchestrator that talks to our [data center network automation] and our [public cloud infrastructure automation] at the same time,” said a network automation engineer with a \$3 billion North American retailer. “So, we can automate both sides of the house through the orchestrator, which we developed in-house.”

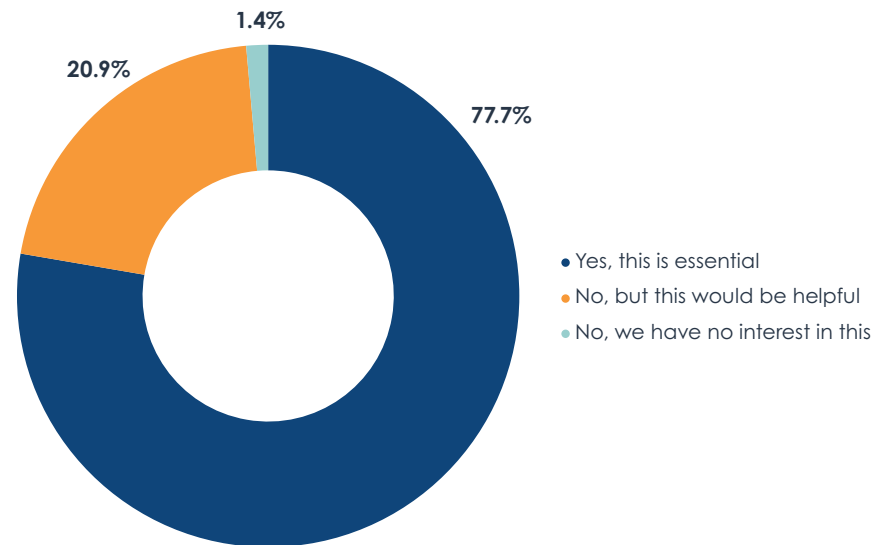


Figure 28. Do you require your data center network automation solutions to be extensible to the public cloud for the orchestration of network automation across the data center and cloud?



Conclusion

This research found that enterprises, communications service providers, and cloud providers are all taking multi-tool approaches to data center network automation. They usually have at least two tools, if not three or more. Most organizations are simultaneously developing network automation software internally and implementing commercial automation.

Most organizations are being aggressive with automating their data center networks. They are increasing their spending, integrating their tools with DevOps toolsets, and extending their tools to the public cloud and cloud edge. It is quite clear that this automation is essential to establishing hybrid, multi-cloud architectures. Extensibility is one thing, but this report dove deep. Networks are complex, and so are data center network automation tools. This research examined the technical requirements that organizations are setting for their tools. We've also identified the pitfalls that many organizations have stumbled over during their automation journeys.

This research summary should serve as a guide for organizations that are setting their data center network automation strategy, or revisiting it with starts and stops. With that said, EMA ends this report with some tips for success.

Best-in-Class Organizations

EMA identified dozens of potential best practices throughout this research by singling out the preferences of organizations that are experiencing the most success with data center network automation. Here are all of those best practices consolidated for easy reference.

- **Targeted automaton benefits:** Improved compliance
- **Executive leadership priorities**
 - Set policies for adoption, make sure network managers actually use the tools
 - Encourage network teams to work with new vendors if necessary

- **Be prepared to spend:** Grow your automation budget and don't be afraid to spend on a premium vendor
- **Consider cloud infrastructure automation tools:** Often left out of the network automation conversation, best-in-class organizations were more likely to use tools that are focused on cloud infrastructure automation
- **Homegrown automation tools**
 - Most organizations develop automation software internally, but best-in-class were the most likely to cite security and compliance requirements as a major driver of this development
 - Optimize internal development by using open-source components
 - YANG Data Modelling Language was especially popular with best-in-class organizations
- **Consolidate tools:** Try to reduce the number of network automation tools if you can
- **Test tools for stability and resiliency:** When evaluating platform capabilities, stability and resiliency should be the first thing to consider before looking at things like scalability, customizability, etc.
- **End-to-end networking:** Make sure data center network automation is extensible or integrated with automation tools for the LAN and WAN
- **Change analysis/modeling:** Automation toolsets should include the ability to understand how a change will impact the network before it is committed
- **Consider intent-based networking:** It may be an overused buzzword, but successful organizations are more likely to use intent-based networking
- **Digital network twin**
 - Digital twins are still emerging in the field of networking, but best-in-class organizations are already sold on their value
 - Consider using digital twins for threat modeling, cross-team visibility into the network, and change validation

- **Network assurance**

- Look for automation tools with integrated monitoring and troubleshooting capabilities
- Device metrics collected via SNMP, APIs, or streaming telemetry can be especially valuable
- Also, look for automated troubleshooting and remediation features

- **AIOps**

- It's another overhyped buzzword, but best-in-class organizations are engaged with it
- Look for opportunities to improve data management and quality and overall ease of use with AIOps

- **Configuration information:** Efficient and effective network automation requires configuration information to be stored as structured data. Raw configuration files are okay, but this cannot be your sole approach to storing configuration information
- **Network state and network intent:** Look for automation tools that can maintain a view into both of these simultaneously
- **DevOps tools:** Tightly integrate data center network automation with the DevOps toolchain
- **Cloud extensibility:** Ensure that your automation tools are extensible to the public cloud and the cloud edge



Colocation Data Center Operator
Leverages Nokia's Data Center Switching
Fabric to Automate Service Provisioning

An Open Switching Fabric Without White Box Headaches

When a colocation data center operator was preparing to build a new data center, it considered using disaggregated white box switching for its networking fabric. However, the company realized that its engineering teams weren't aligned with the idea, according to the chief technology officer (CTO). The company had plenty of highly skilled engineers, but white box switching would require a team of network-savvy software developers, something only hyper-scale data center operators have.

Instead, the colocation provider selected the Nokia Data Center Switching Fabric, a highly automated data center switching solution that runs the open and extensible network operating system Nokia Service Router Linux (SR Linux). The colocation provider leveraged the open APIs that Nokia offers on SR Linux to transform network operations.

“We liked SR Linux because it's basically a Linux server, which is what you get with disaggregated switching, but it's backed by a company that understands networking hardware and has significant networking intelligence,” said the CTO.

Nokia's fabric ships with a Fabric Services System, a cloud-native network automation tool that covers everything from fabric emulation, design, and validation to telemetry analytics. Thanks to this system, getting the fabric up and running was relatively trivial, the CTO said. “We take a switch out of the box, we determine whether it's a leaf or spine device, we build the config, plug in the device, and the fabric is done,” he said. “Plugging a new switch into the fabric is super easy because it's pretty much all open-source.”

The colocation provider currently has 60 switches within the Nokia fabric today, and more are added every week.

Customer Provisioning Processes Now Measured in Milliseconds

The Fabric Services System also offers open REST APIs that allow it to plug in to third party automation. These APIs proved especially valuable to the colocation provider.

“We do a lot of bare-metal servers for colo customers,” the CTO said. “I create an instance for them in the network fabric that can isolate them from other customers. We create a Layer 2 or Layer 3 instance that's assigned to a specific port for a customer. Our old approach [before Nokia] was to log into a device via an SSH client and push the config, or we would use an SNMP-based tool. That is heavy lifting that sucks down so much time for us because we are using 1.5 million IP addresses.”

Once the colocation provider had the Nokia fabric up and running, the network engineering team used the openness of SR Linux and the Fabric Services System to set up a GRPC-based connection between the networking fabric and the colocation provider's backend customer portal system. This connection essentially allows the backend system to subscribe to each switch in the fabric to collect data on network state and to push new configurations as needed. This integration had made the provisioning of new bare-metal servers for customers trivial.

Without this automation, “I would have to log into a bunch of stuff, do show commands, log into the actual box and copy-paste my configuration and hit save. All of that would take 40 minutes to provision a new port,” the CTO said. “To deploy a new config in Nokia, it's 260 milliseconds to determine the block of IP addresses that are free, then triple check that block which adds another 290 milliseconds, and then 19 milliseconds to deploy. Overall, it's now three seconds to make a change.”

Future Automation Enhancements

The CTO said he is in an ongoing dialogue with Nokia to perfect the automation he has in his data center fabric. Today the provider has a subscription model established for collecting network state from switches. He'd like to set up a central source of truth for his network that pushes intent to the switches rather than pulls state from them.

“This will give us more control over the truth of our network,” the CTO said.

The colocation provider is also prototyping a TIG (Telegraf InfluxDB Grafana) as an open-source network operations platform. The CTO said the streaming telemetry capabilities of the Nokia fabric are ideally suited for feeding data into this TIG stack. He expects to have a global picture of the entire fabric with the ability to automate “day 2” operations like troubleshooting and problem remediation.





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Founded in 1996, Enterprise Management Associates (EMA) is a leading industry analyst firm that provides deep insight across the full spectrum of IT and data management technologies. EMA analysts leverage a unique combination of practical experience, insight into industry best practices, and in-depth knowledge of current and planned vendor solutions to help EMA's clients achieve their goals. Learn more about EMA research, analysis, and consulting services for enterprise line of business users, IT professionals, and IT vendors at www.enterprisemanagement.com. You can also follow EMA on [Twitter](#) or [LinkedIn](#).

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