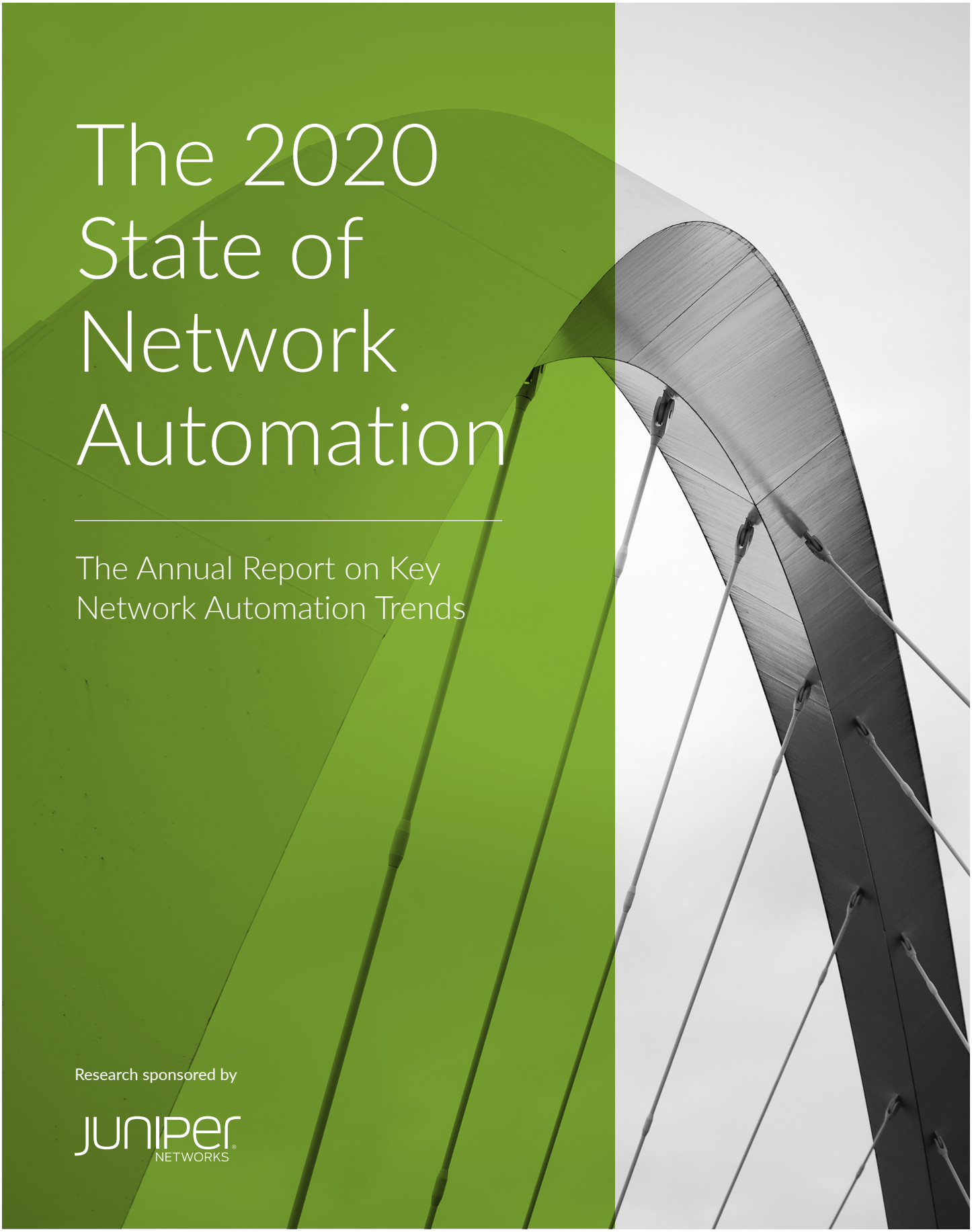
The 2020 State of Network Automation

The Annual Report on Key Network Automation Trends



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Contents

Key Findings

1 The network automation revolution is well-underway.

About 75% of Communications Service Providers (CSPs), 71% of Enterprises, and 78% of Cloud Providers report they use some type of network automation.

2 Network automation is quickly changing how networks are deployed, changed, and managed for everyone.

While 47% of organizations started to automate less than 3 years ago, 50% already automate in production networks.

3 Reducing repetitive work (toil) and scaling efficiency are the top technology drivers.

Out of the 11 technology drivers, reducing hard and repetitive work is #1 with CSPs, Enterprises, and Cloud Providers alike. Nearly 20% report that the need to reduce toil is why they automate the network.

4 The more automated the network, the lower the risk that production network changes result in degraded service.

Nearly 60% of mature automators say that network changes very rarely result in service issues, including 14% who say that network changes never lead to service degradations.

5 Job satisfaction rises with the level of network automation.

Among the top group of network automators, 78% say they're satisfied with the job compared to 60% of non-automating respondents.

6 Businesses that implement network automation outperform those who don't.

About 67% of leading network innovators exceed organizational performance goals compared to 57% of non-automating respondents.

Executive Summary

Welcome to the State of Network Automation Report (SoNAR). For the second year, SoNAR aims to provide insights about the overall journey to automation, understanding how and when companies are embracing this path, and what are the results of this decision.

For SoNAR 2020, the survey was expanded to include Enterprise, Cloud and Communications Service Provider network operators around the world. By tapping into markets beyond the United States, we are able to better understand Enterprises, Communications Service Providers, as well as Cloud Providers.

In addition, the survey also included organizations that have not yet started their network automation journey. After all, to truly understand the 2020 State of Network Automation, it's important to hear from organizations that are yet to start their automation journey, those at the beginning, those who are testing, as well as those organizations that have embraced it.

The big picture of network automation includes:

- automation maturity for telecommunications and cable service providers (referred to as "Communications Service Providers (CSPs)" throughout this report), Cloud Providers and Enterprises,
- automation tenure,
- business and technology drivers, and
- network automation challenges.

There's one chapter for each of the three types of network equipment users – Communications Service Providers, Cloud Providers, and Enterprises – that explains:

- where they automate,
- tools, vendors, and processes for network automation before and during production,
- business outcomes, and
- network architect commentary.

Finally, the last section presents the roadmap to achieving greater network automation. It has:

- individual and team skills that move you and your organization to the next level of network automation,
- departmental outcomes, and
- wrap up from a network architect and NOG (Network Operator Group) organizer to help you along your path toward greater network automation.

1 The Sample Acquired from Cloud Provider is below the expected, but still enough to present a trend and interesting Insights.

Meet the Expert

Donal O Duibhir

Donal wears many hats and believes we are all network engineers in one form or another. He's been automating networks, systems, and processes for the last 20 years across a wide variety of use cases. He currently consults at He consults at Defensible, builds engineering and security tools at PanSift, and grows community with iNOG. Donal hails from a mix of engineering, security, and product roles across telco/mobile, enterprise, vendors, and startups. He's previously held multiple industry certifications (including an early CISSP back when it was cool!) and comes from a computer science background. These days he gets the most satisfaction when growing communities of practice, writing, and automating things.

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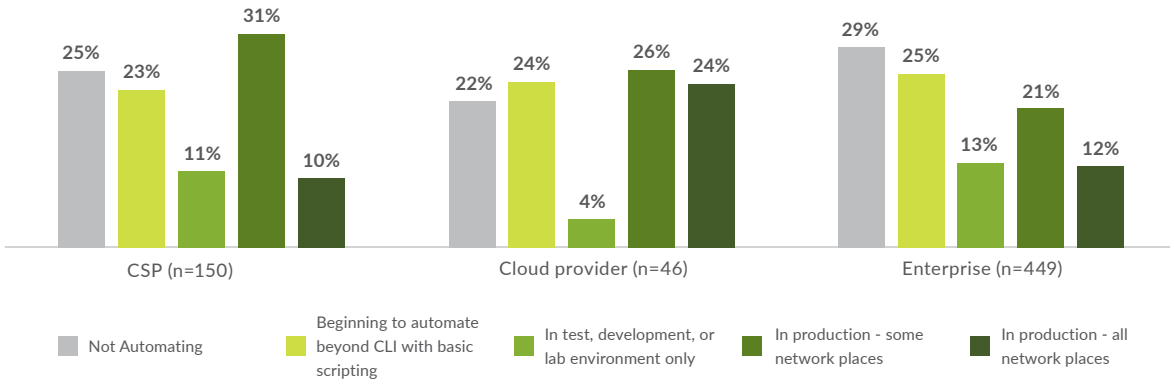
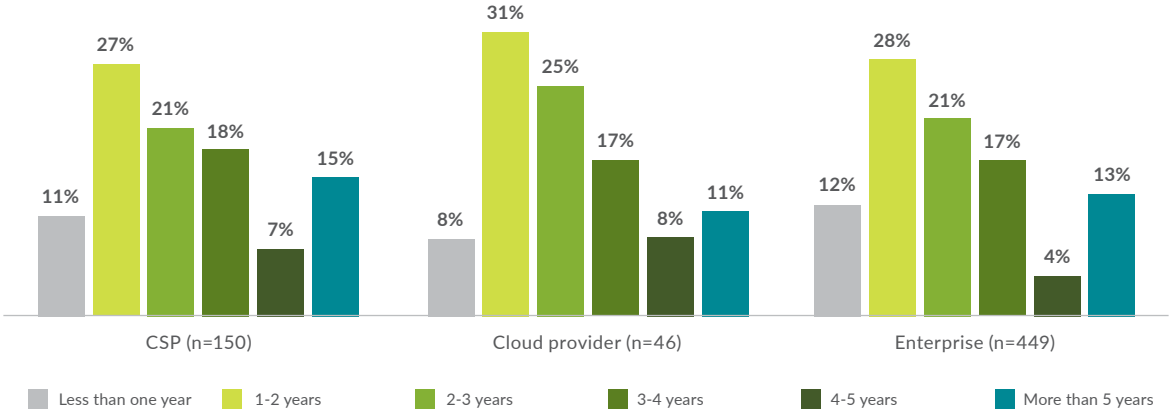
The 2020 State of Network Automation Varies by Segment

Results show that the three segments CSPs, Cloud Providers, and Enterprises – are all at different stages of automation maturity. While about a quarter of each segment is beginning to automate beyond the CLI with basic scripting – which itself, shows that network automation is a lasting trend. A full 24% of Cloud Providers say they use automation in production in all network places, even though nearly 40% are fairly new to automation and have been using it for less than 3 years.

This contrasts sharply with both CSPs and Enterprises. Only 10% of CSPs use automation in production in all network places. Given the obvious limitations that come with scale and complexity of large CSP networks, this is to be expected. Meanwhile, Enterprises lag both types of service providers in automation maturity, but resemble CSPs in how long they've been using network automation.





In 2019, the most common technology driver was improved security, but this year all segments say the top driver to automate is to reduce hard and repetitive work (toil). From there, segments rank technology drivers very differently. Both types of service providers say that scaling network operational efficiency is the second most important technology driver and improving metrics like *time to change* and incident response and *mean-time-to-repair (MTTR)* rank third and fourth. However, Enterprises are different. Equally important to reducing toil, Enterprises automate to improve incident response and their MTTR including to improve security outcomes.

Technology Drivers	**Telco and Cable/MSO**		**Cloud Provider**		**Enterprise**	
Weighted Rankings	%	Rank	%	Rank	%	Rank
Reducing hard and repetitive work	20%	1	18%	1	17%	1
Scaling efficiency of network footprint relative to headcount	13%	2	13%	2	11%	4
Improving time to change	12%	3	12%	3	10%	5
Improving incident response and MTTR	10%	4	12%	4	17%	1
Security	9%	5	8%	6	14%	3
Service experience levels	8%	6	6%	7	5%	11
Service uptime levels	8%	7	11%	5	9%	6
Keeping current on network tech	7%	8	8%	8	6%	7
Compliance	6%	9	9%	9	6%	7
Improving MTBF	5%	10	0%	10	6%	7
Sustaining innovation	4%	11	4%	11	6%	7

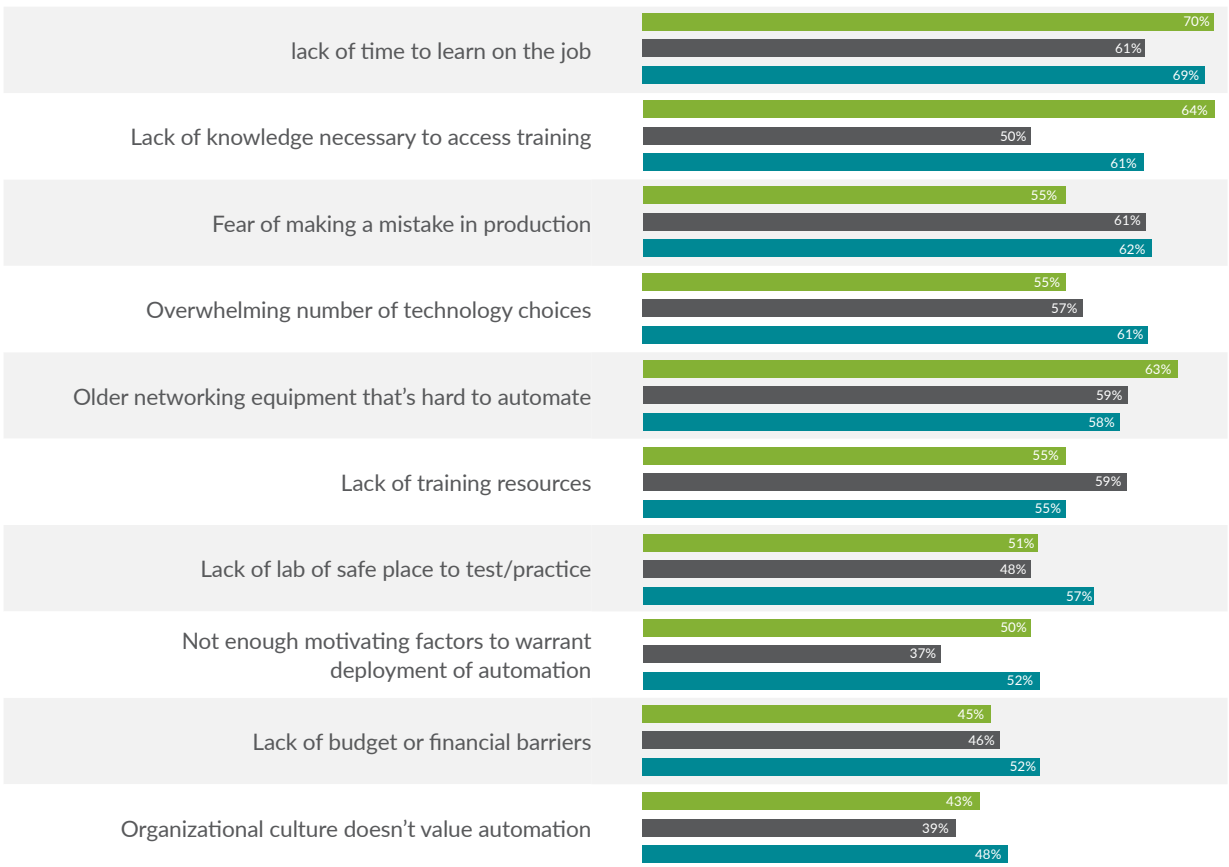
When it comes to business drivers for network automation, this time, Cloud Providers look more like Enterprises. The cloud crowd pairs up with the enterprise segment where 26% and 27% respectively report IT service reliability as the top driver. This contrasts with CSPs who at 32% strongly report cost savings as the top business driver. Compared to 2019, when business agility gained the top spot, network professionals overall have come to appreciate how network automation can improve IT service reliability and service delivery efficiency.

Business Drivers	Telco and Cable/MSO		Cloud Provider		Enterprise	
Weighted Rankings	%	Rank	%	Rank	%	Rank
IT service reliability	24%	2	27%	1	26%	1
IT service delivert efficiency	24%	2	22%	2	23%	2
Cost savings	32%	1	17%	3	19%	3
Business agility	21%	4	15%	4	14%	4

As for challenges relating to automation, just like 2019, **the biggest challenge for all segments is the lack of time to learn on the job. But from there, each segment ranks challenges differently**. At 61%, Cloud Providers report that fear of making a mistake in production is equally challenging, which happens to rank second for enterprise network professionals. Meanwhile, CSPs grapple with different challenges with automation. 64% don't have the knowledge necessary to access training and almost as many – at 64%, say older networking equipment makes it hard to automate.

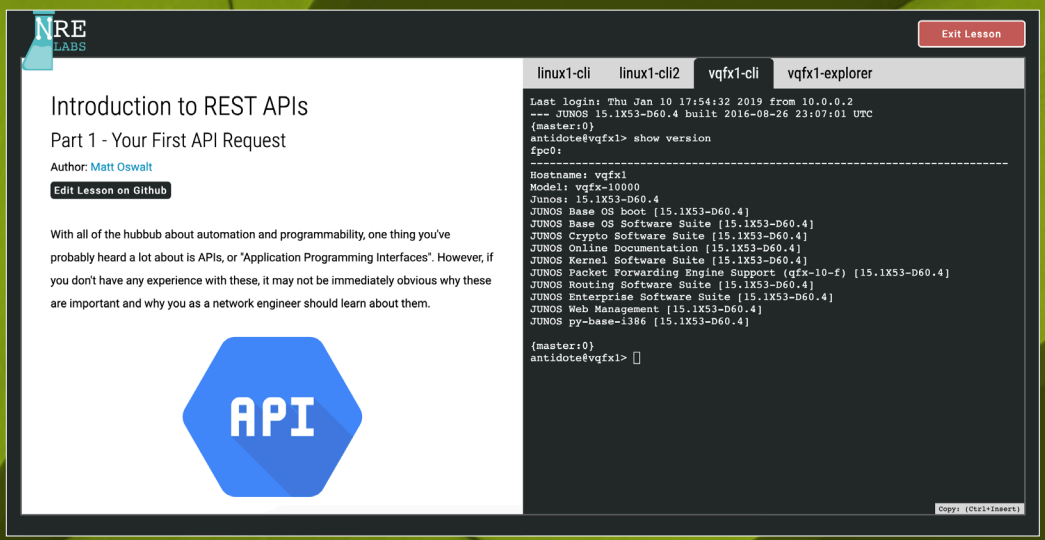
After you look at why these three types of network users automate network operations and their challenges with it, the conclusion is inescapable. They are very different. This is why we analyze and present network operations related results separately for Enterprises, Communications Service Providers, and for Cloud Providers.

Challenges Related to Automation



An automation dojo in your browser. Learning to automate is now free, open, easy, and fun.

Learn more



Chapter 1: The 2020 State of Enterprise Network Automation

In our research, nearly one-third of our 449 Enterprises don't automate at all. Another 12% consider themselves to be full automators and just over 20% are partial automators. All told, about another third are testers and beginners. In this section, results cover industry and automation maturity within each industry, where Enterprises automate in their networks, their tools, processes, and of course, business outcomes according to network automation maturity.

Specifically, after you understand respondents, you'll learn by network automation maturity:

- where they automate,
- tools,
- vendors,
- processes for network automation before and during production, and
- how well Enterprises meet 4 key business goals.

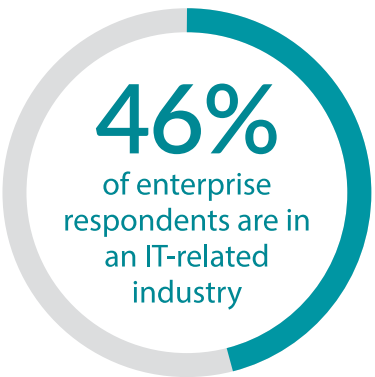
The automation maturity scale has 5 levels, ranging from not automating at all to being in production across all places in the network. The below key has the short names used throughout the report and how they are defined.

Key: Short names for groups along the maturity scale

Full automators = in production in all network places
Partial automators = in production in some network places
Testers = in a test, development or lab environment only
Beginners = beginning to automate beyond CLI with basic scripting
Non-automators = Not automating

Enterprise respondents are dominated by those in IT-related industries.

The remaining respondents are spread among all the economy's industries and some have quite small numbers. Nonetheless, the following chart helps explain the role of industry in network automation maturity. There are more full automators in IT, financial services, education and manufacturing, and more non-automators in energy, healthcare and government. Trends are consistent with the usual "innovation by industry" trends.



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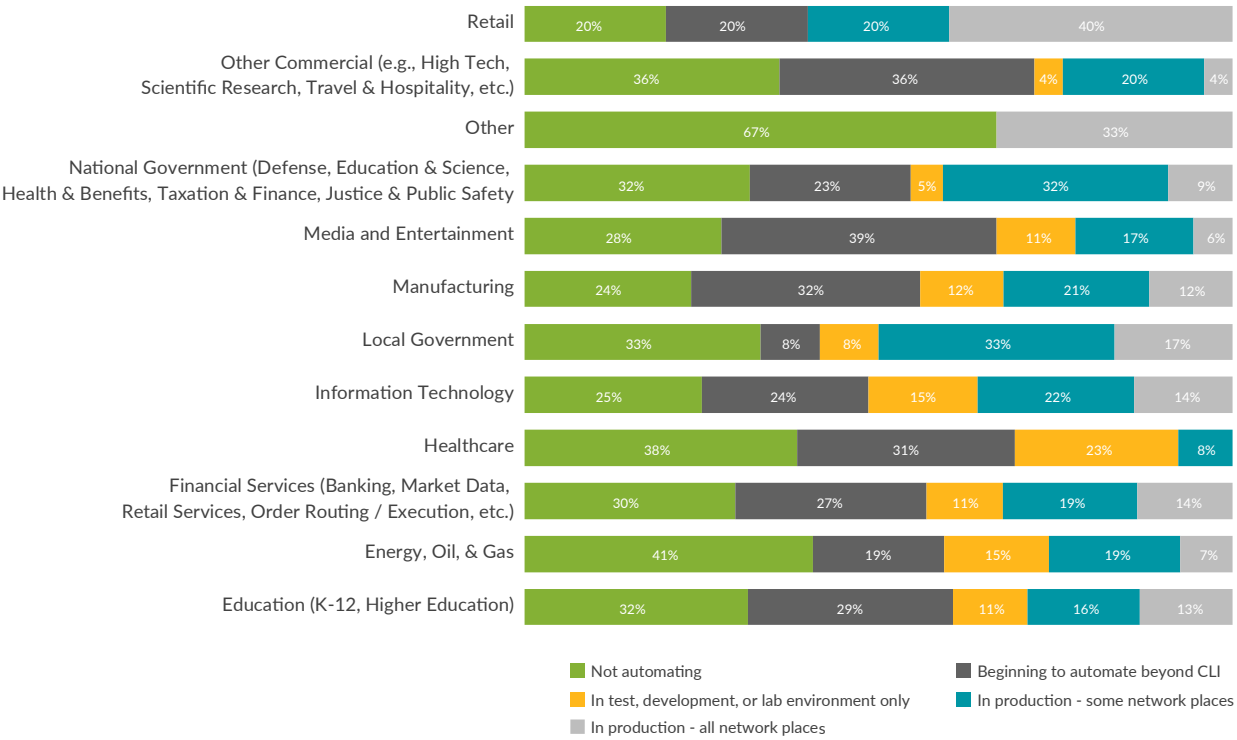
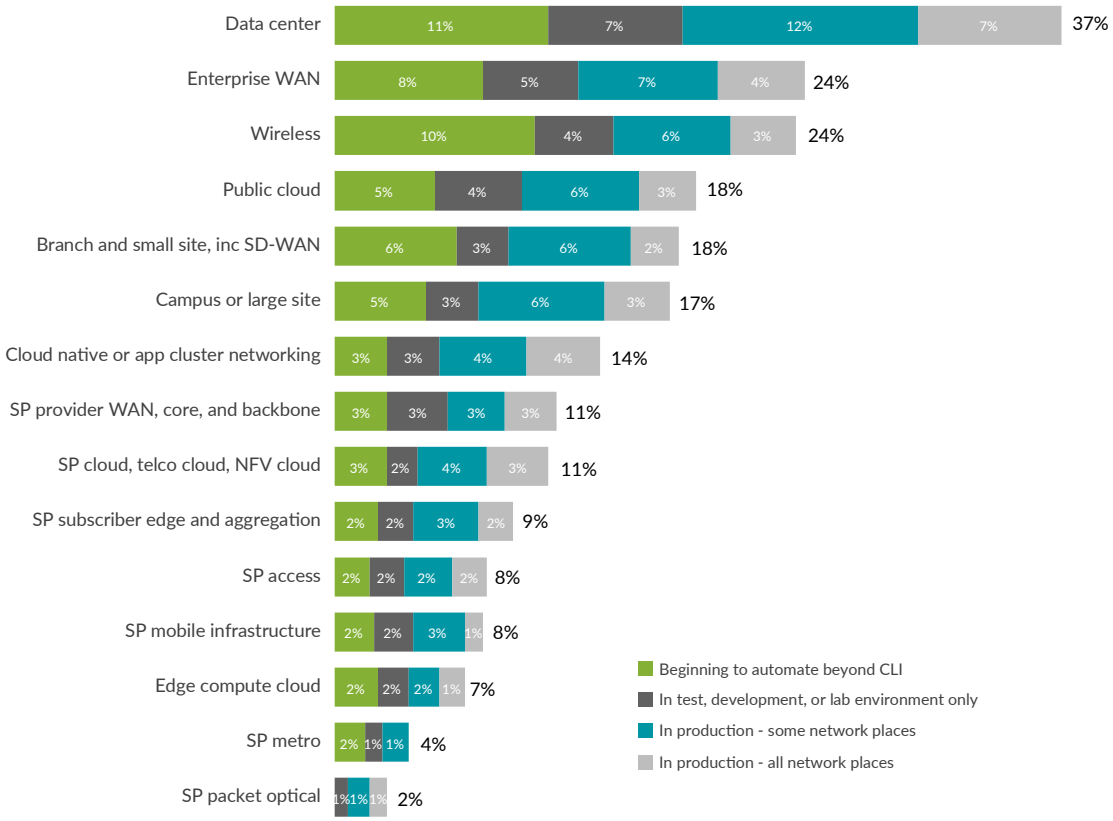


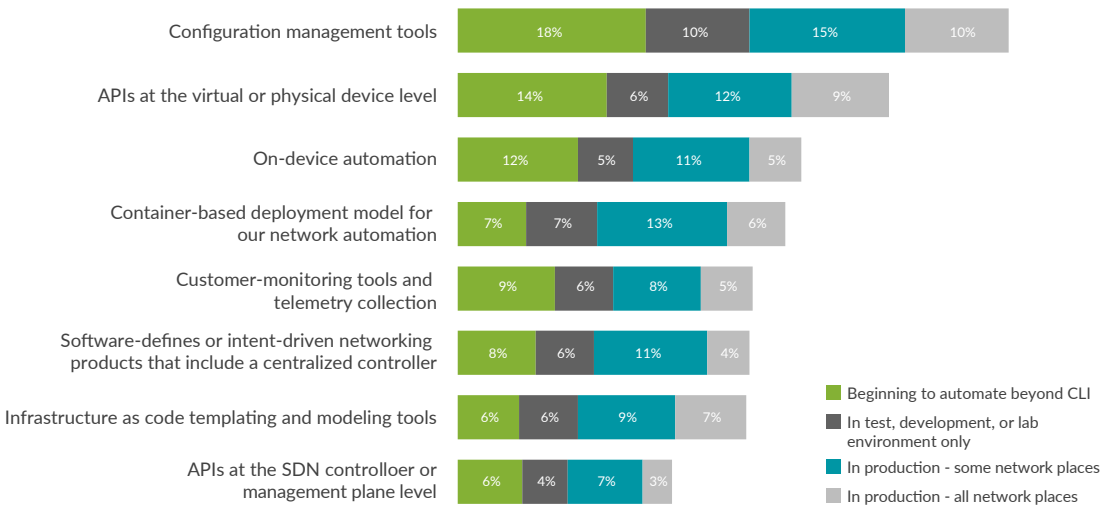
Enterprises automate the data center most often and the enterprise WAN second most.

Beginners also tackle their wireless network automation more often than others. Partial automators are slightly more likely to focus on the data center. Full automators, much like you'd expect – spread automation efforts everywhere

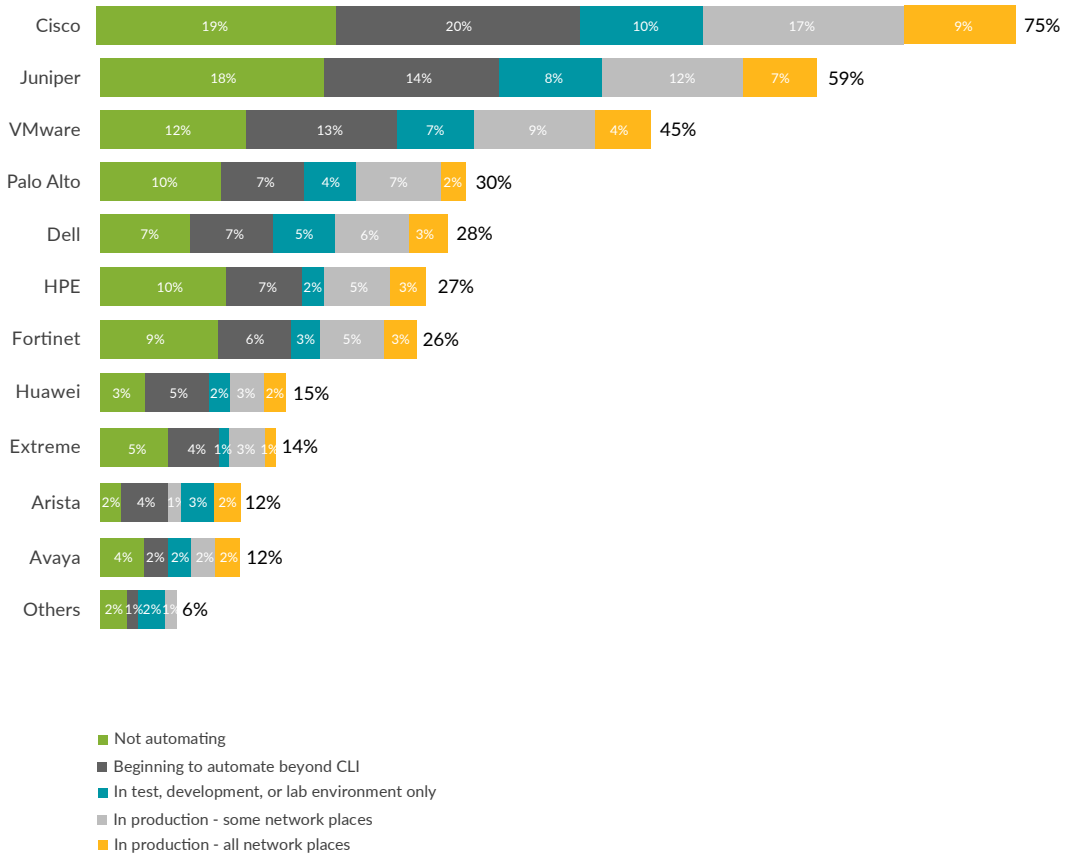


Enterprises rely most on configuration management tools to automate network deployments, changes, and management.

Enterprises resemble their communications provider colleagues in the tools they use. Slightly more than half – 53% - use configuration management tools compared to the second most common at 42%, APIs at the virtual or physical device level. Full automators – who have been automating longer – mostly use config tools and APIs with devices. But partial automators and testers also use container-based deployment for network automation more than full automators. Partial automators also use on-device automation more often, as well. It may well be cheaper, easier, and lower risk for partial automators to use ephemeral or pre-built containers to perform infrequent tasks against vendor APIs. This could be seen as a lightweight and frictionless path to more long-lived automation practices.

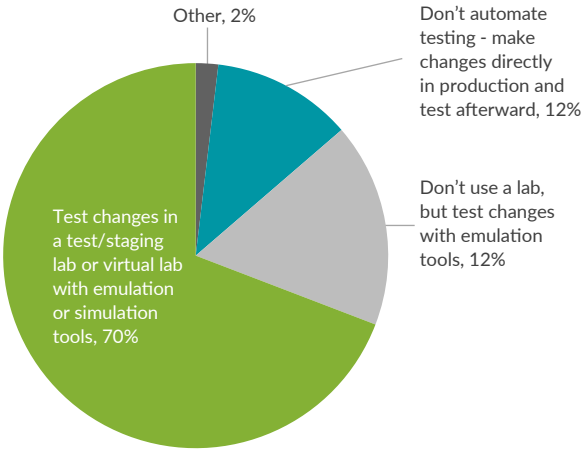


Enterprises that use network automation primarily use 4 leading vendors.

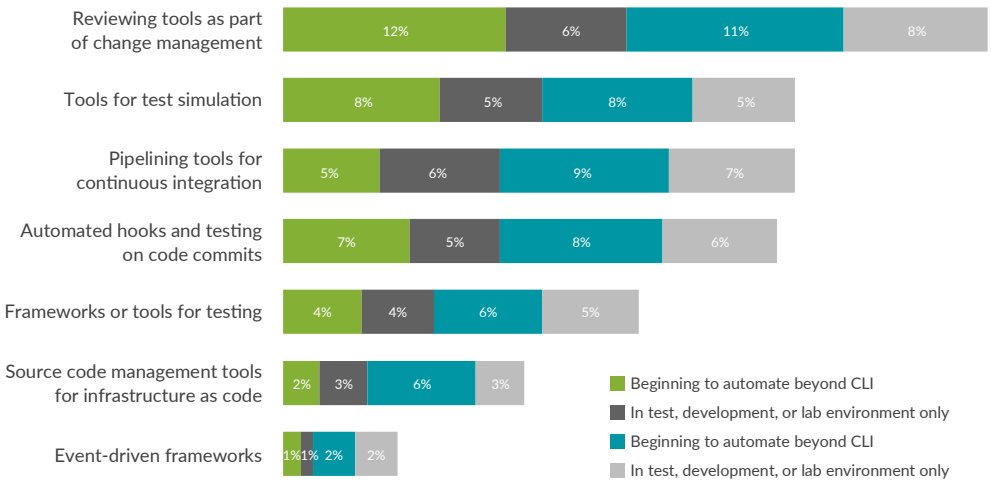


How Enterprises manage automation before and during production varies by automation maturity stage.

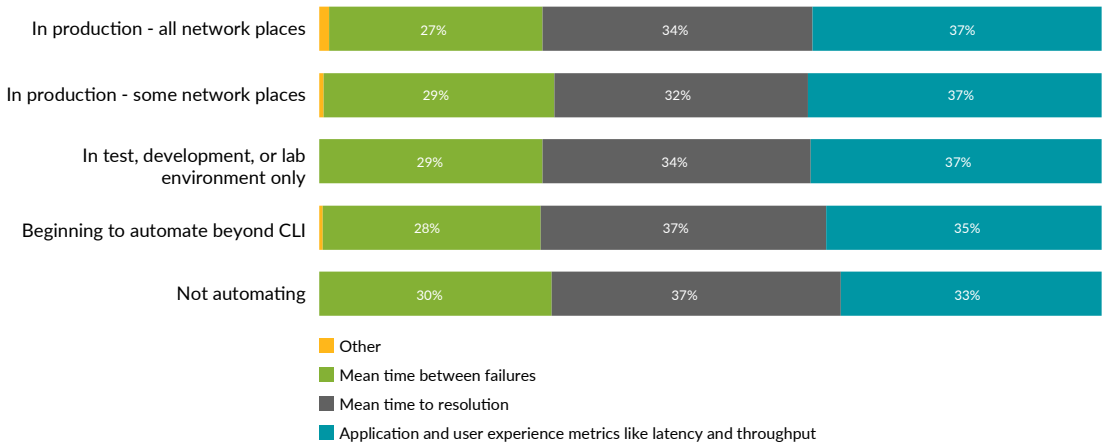
Most Enterprises test changes in a test or staging lab using emulation or simulation tools. However, unlike both communications and cloud service providers, Enterprises are more likely to skip the lab. After all, 17% test changes with emulation tools and another 12% simply make changes directly in production and then test it.



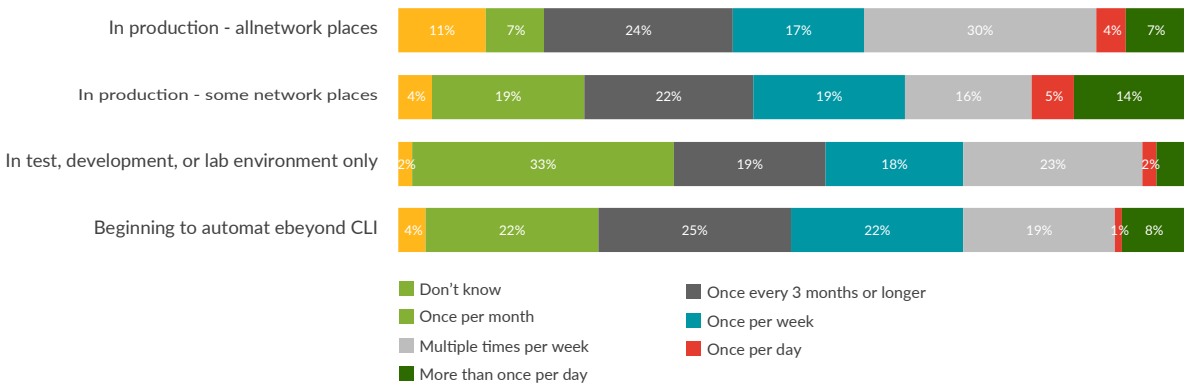
As to how they automate testing, nearly 40% use reviewing tools that are part of change management. Full and partial automators obviously use reviewing tools, but automated pipeline tools are second most common. Partial automators seem to use a broader range of tools than full automators including automated hooks and testing on code commits, source code management tools and frameworks.



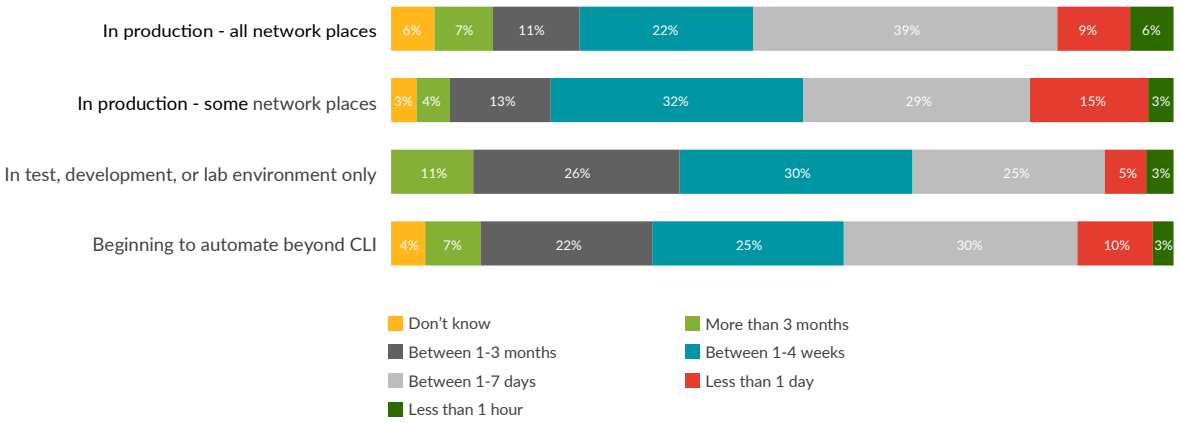
For full, partial and testers among enterprise network automators, the most important service reliability metrics *are application and user experience metrics like latency and throughput*. Next comes MTTR (*Mean Time To Resolution*) and MTBF (*Mean Time Between Failures*) is least important. This contrasts with beginners and non-automators who still say MTTR is the most important service reliability metric.



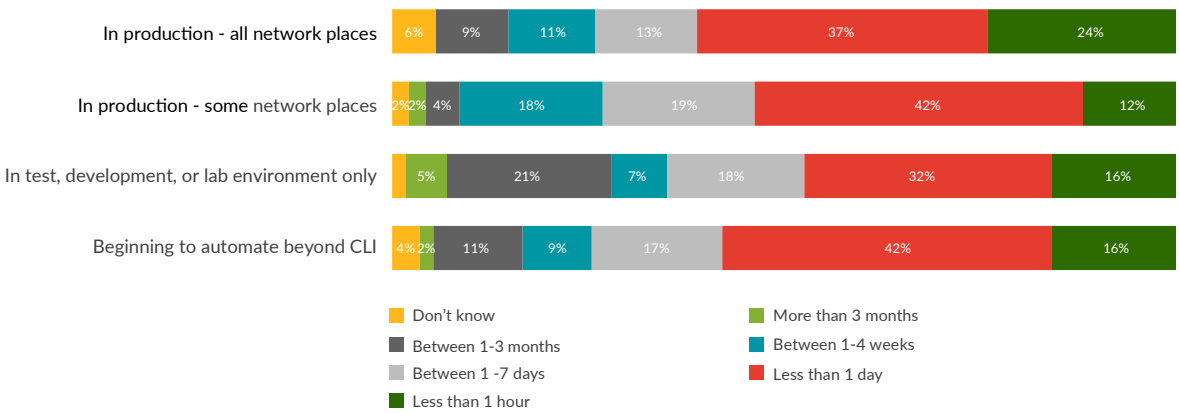
Consistent with service provider networks, the more a network is automated, the more often changes are made to the primary network service. 27% of full automators make changes at least multiple times a week with 7% making changes more than once a day. As for partial automators, 35% make changes at least multiple times per week and half of those are more than once a day.



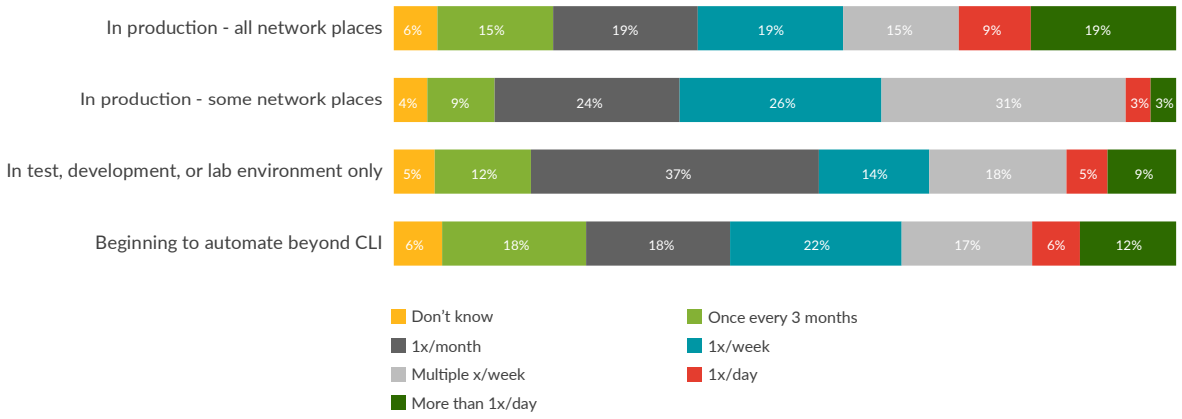
The more an enterprise network is automated, the less lead time for changes is required. 15% of full automators and 18% of partial automators say it takes a day or less from the time a change request is serviced until it takes full effect in production. While not as strong of a trend as in the service provider segments, both beginner and testers skew toward longer time intervals for changes taking effect in production.



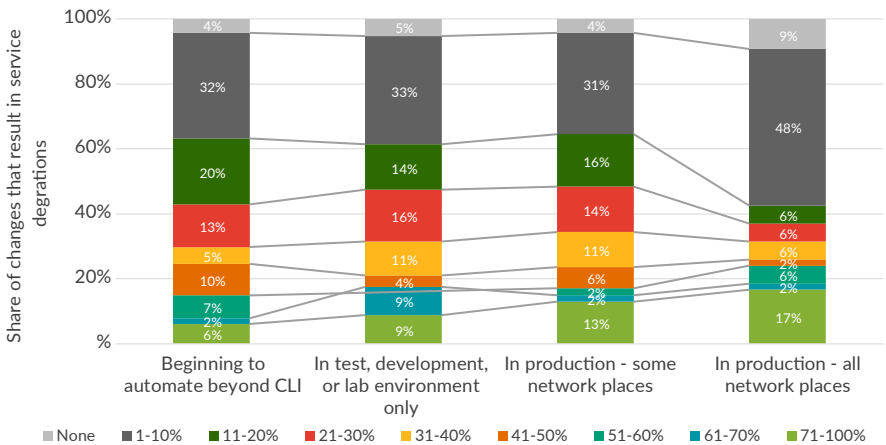
The speed of restoring service after service incidents or defects does not vary as much by network automation maturity for Enterprises. While research shows a huge impact that higher automation levels bring to service restoration on communications and cloud provider networks, it's not as impactful for Enterprises. This is likely due to vastly differing enterprise requirements as well as smaller network scale. Nonetheless, full automators still restore service in less than an hour far more often than beginners and other less mature enterprise network automators.



The more automated the enterprise network, the more frequently teams detect trouble. 28% of full automators say they get trouble reports at least once per day – most of them say it's more than once of a day - compared to 14% of testers and 18% of beginners.



Lastly, an automated enterprise network is a more reliable enterprise network. The more automated it is- the more likely changes become less prone to human error. The end result is that changes to production are less likely to end up in degraded service - that then lead to remediation. More than half of full automators experience service problems for less than 10% of changes and 9% of full automators never make changes that result in service problems.

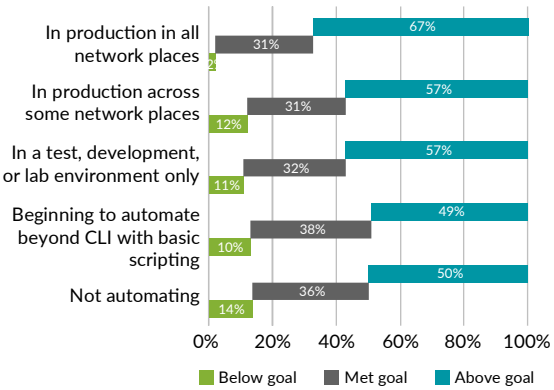


Network automation contributes to an enterprise's overall success.

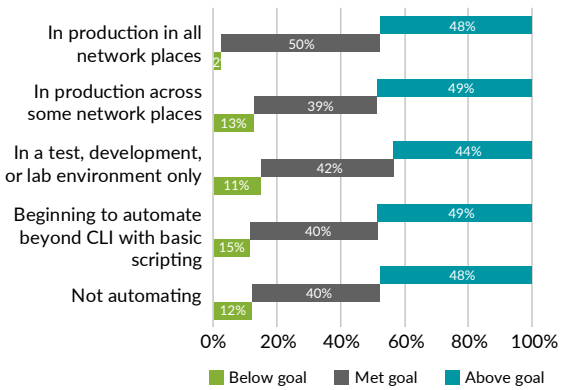
Just as with communications and cloud service providers, the more an organization uses network automation, the higher the business benefit. The gap between automators and non-automators, though, isn't as strong among Enterprises as we see among service providers. But Enterprises represent a broader of business requirements than they do. For example, unlike service providers, some Enterprises offer goods and services where technology is not central to the offering. Still, when asked about whether they were above, met, or below goal for 4 key business goals for the last year, full automators are consistently at or above goal. All told, 98% of them are at or above goal for for more customers and relative market share. Meanwhile, 94% say they're at or above goal for time to market for new products and organizational performance.

Over the past year, the status of goal for...

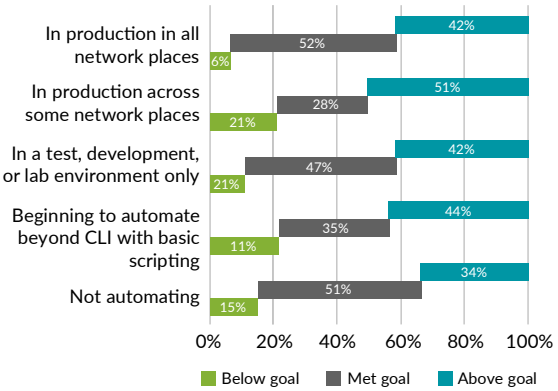
More Customers



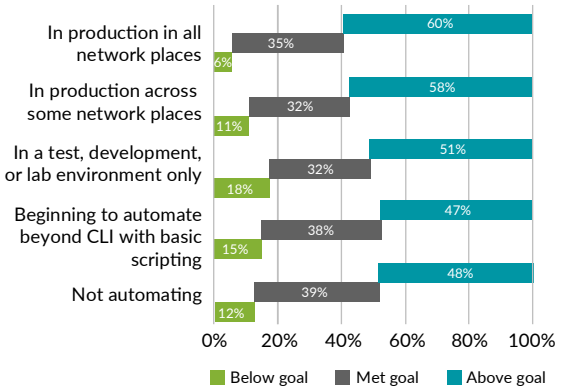
Relative Market Share for Primary Products



Time to Market for New Products



Organizational Performance



Summing up: Enterprises may lag service providers in network automation, but they see the same network operations, reliability and business benefits.

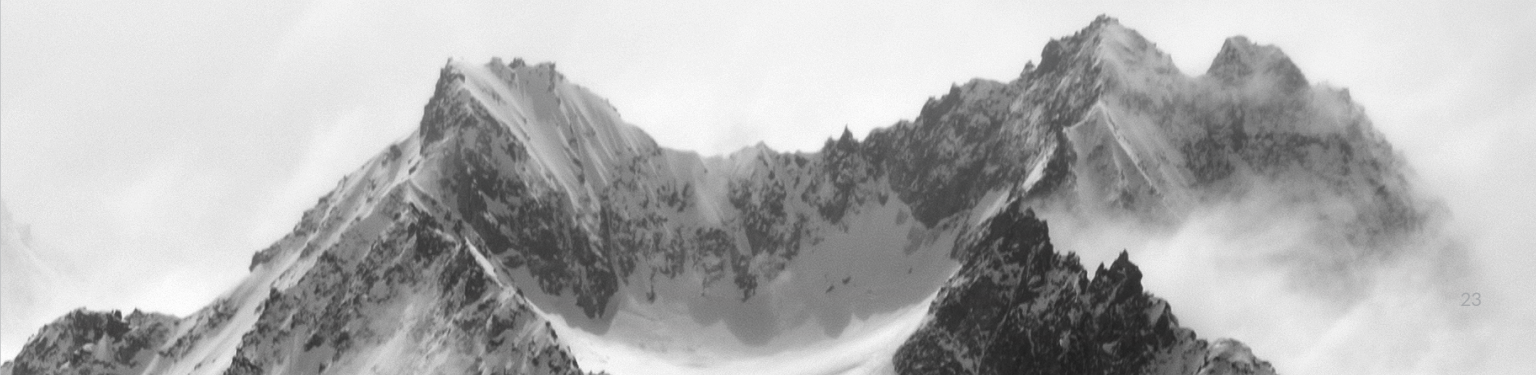
Enterprises automate in 3 or 4 key areas, and penetration of network automation into the general enterprise market has a long way to go. But that said, Enterprises who do automate see the same benefits as service providers. Although they tend to use less expensive tools to automate like pre-built containers and may not have complex testing labs, the trend is the same. The more automated the network is, the better the operations and reliability help the business.

Donal's Takeaways for Enterprises

Enterprises come in all shapes and sizes. They often provide or integrate a mix of functions previously seen in our other service provider segments but use a wider range of vendors. The access edge provides an on-ramp to local or remote services sourced from private or shared data centers (but increasingly from public clouds). The network plays a productivity supporting role, and more often than not, does not generate or contribute directly to an organization's revenue streams. Services are consumed primarily by internal users via managed endpoints (though not always). When network scale is considered, the enterprise segment automates at a slower pace. It is unclear why and what specific or aggregate factors contribute to this lack of automation. It may be due to a slower cadence of new services, slower organic growth, or perhaps due to a primarily internal service consumption model. Another hurdle may be that of a more heterogenous footprint of services. It might be interesting in future to explore which enterprises host their own revenue generating platforms and on who's underlay or overlay network stack.

Within the enterprise segment, the largest percentage of those who automate in all network places reside in the Retail sub-sector. This may be due to chain stores' scale and homogeny. When found together, these characteristics are ripe for automation though the overarching figures point to data center automation rather than branch provisioning and management. Automation is readily applied to standardized and modular service offerings, so it's unsurprising that most enterprise automation takes place in the data center highlighting the old, "pets vs. cattle" analogy.

Following closely behind enterprise data center automation is that of the WAN(Wide Area Network) and then the wireless edge. WANs are traditionally expensive and prime candidates for cost reduction initiatives such as SD-WAN(Software Defined WAN) for more intelligent and reliable service delivery irrespective of the underlying circuit type. One of the most interesting innovations and paradigm shifts though is happening on the wireless edge. WLAN(Wireless LAN) is hugely complex and the often misunderstood 802.11 protocol has helped unchain us from our desks and enabled new forms of collaboration. WLAN's have also brought with them their own set of complex challenges as the medium and protocol is only robust up to a point. It suffers from rapid and intermittent congestion collapse which is extremely hard to predict and observe. It is this complex service edge where AI-driven automation is making in-roads, not just with configuration and change management, but with troubleshooting, service assurance, and even remediation activities. This service edge is crucial for enterprises as their shared productivity rests upon it and we're set to see AI transform more than just the edge! To see user experience metrics being the most important service metric to all levels of automators in enterprises is also heartening (and echoes that of the most mature automators who reside in the cloud provider space).



Chapter 2: The 2020 Communications Service Provider State of Network Automation

In this chapter, you'll learn about network automation from this year's sample of 150 Communications Service Providers around the world.

Specifically, you'll learn about the follow aspects of automation, segmented by network automation maturity level:

- where they automate,
- tools,
- vendors,
- processes for network automation before and during production, and
- how well CSPs meet 4 key business goals.

The automation maturity scale has 5 levels, ranging from not automating at all to automation being in production across all places in the network. The below key has the short names used throughout the report and how they are defined.

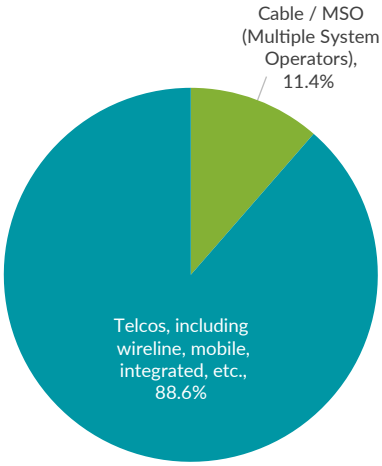
Key: Short names for groups along the maturity scale

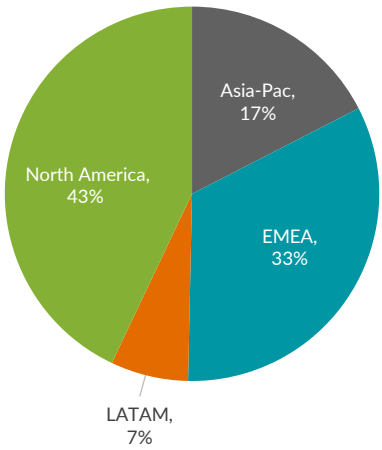
Full automators = in production in all network places
Partial automators = in production in some network places
Testers = in a test, development or lab environment only
Beginners = beginning to automate beyond CLI with basic scripting

Non-automators = Not automating

Respondents are mostly telecommunications providers and represent all continents.

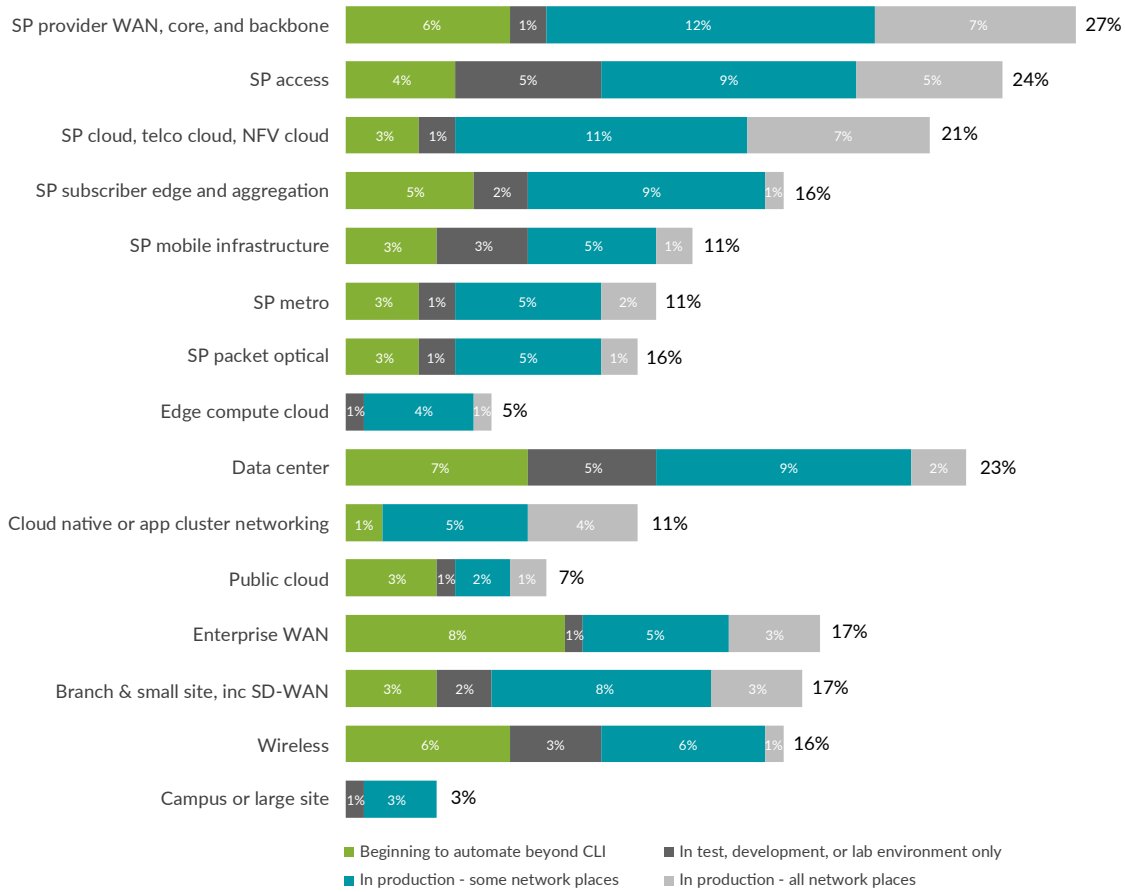
Nearly 89% of participating CSPs are telecommunications providers and the remaining are cable or multiple system operators. About 57% are outside North America.





Automation is used throughout CSP (CSP) networks.

But it's deployed most often in the communications service provider WAN, core and backbone network domains, followed by access networks and then data center.



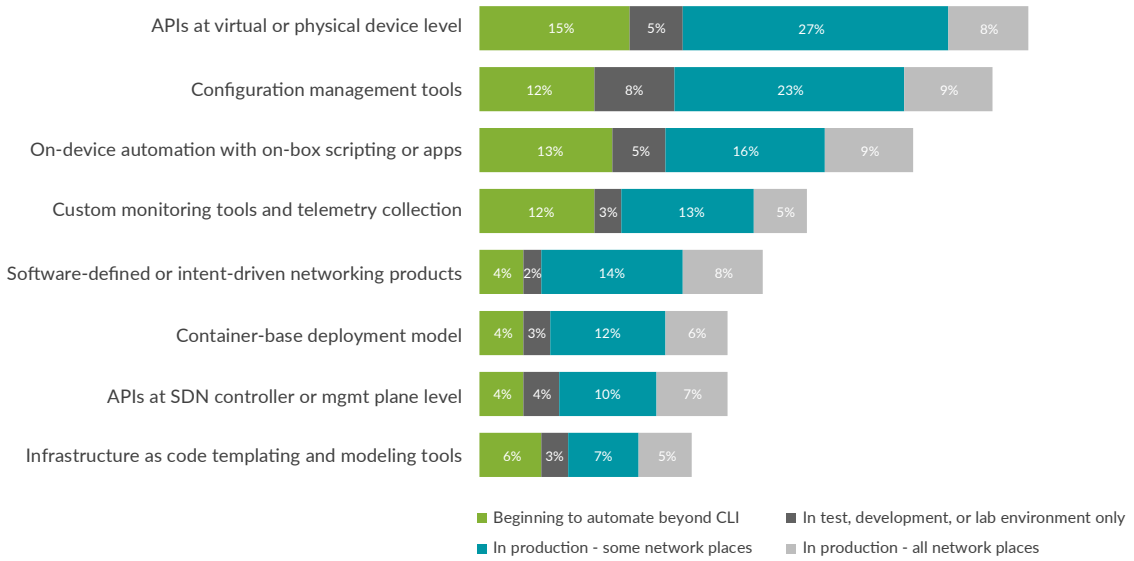
Pay attention to beginners and testers. **Beginners show where automation starts** – which is in the enterprise WAN (8%) and data center (8%).

Network automation is poised to substantially impact communications service provider network operations. Partial automators are fast gaining experience in many locations in the network. Most notably, at 9%, they're innovating at the SP subscriber edge and aggregation.

Not surprising, most CSPs use multiple tools for network automation.

Overall, CSPs use about 3 different ways together to automate network deployments, changes, and management. More than half of CSPs automate using APIs at the virtual or physical device level and configuration management tools. Ranking third, just over 40% of CSPs use on-device automation with on-box scripting or apps.

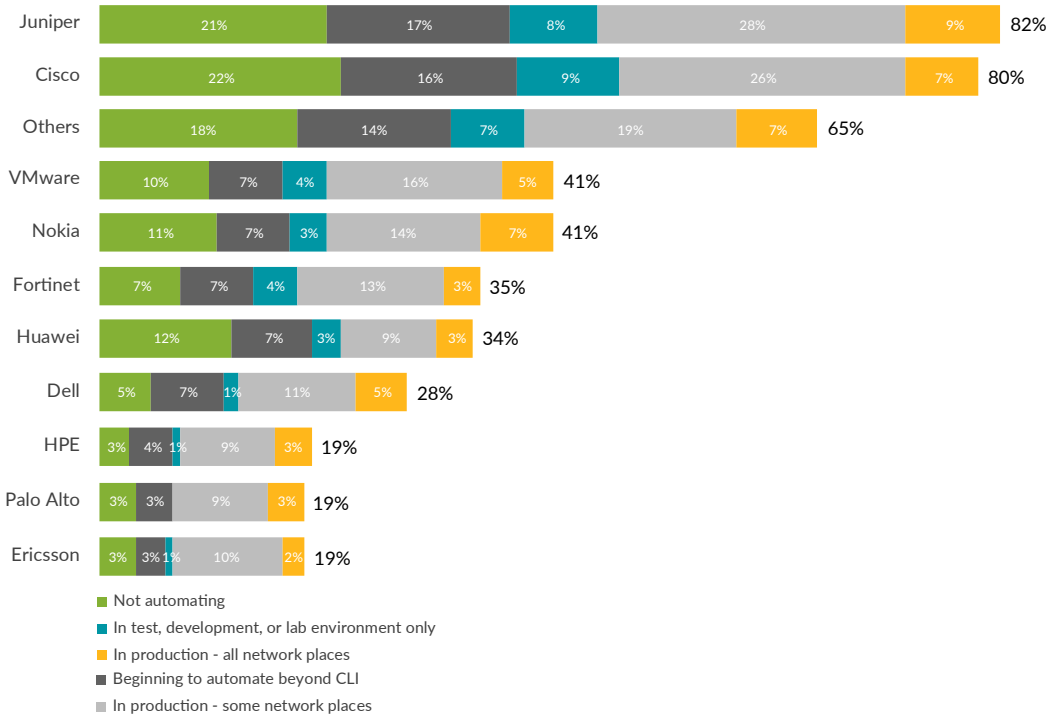
There are some differences though, according to automation maturity. Admittedly, full automators use the range of tools. But the top 2 tools used that edge out other options – at 9% each- are configuration management tools and and on-device automation with on-box scripting or apps. This compares to partial automators who are consistent with the overall trend. But it's interesting to note that partial automators who – at 27% - are strongly most inclined to use APIs at the virtual or physical device level. The second most common tool for partial automators, at 23%, comes configuration management tools.



3

The average number of tools communications service providers use to automate network deployments, changes, and management.

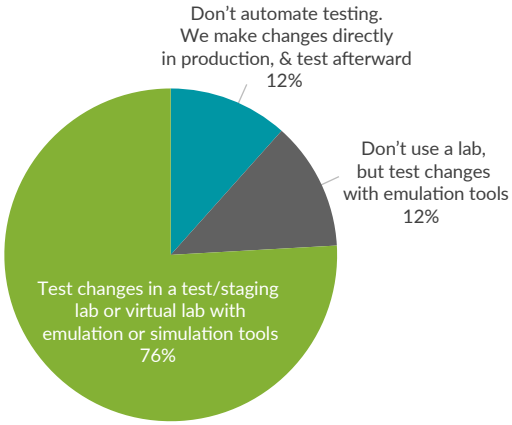
CSPs also use multiple network vendors.

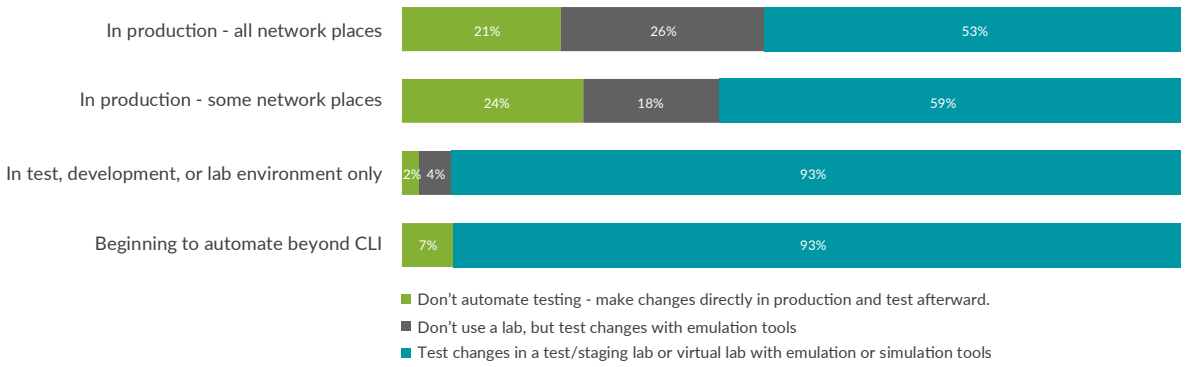


Juniper is the **most common vendor** for partial and full automators.

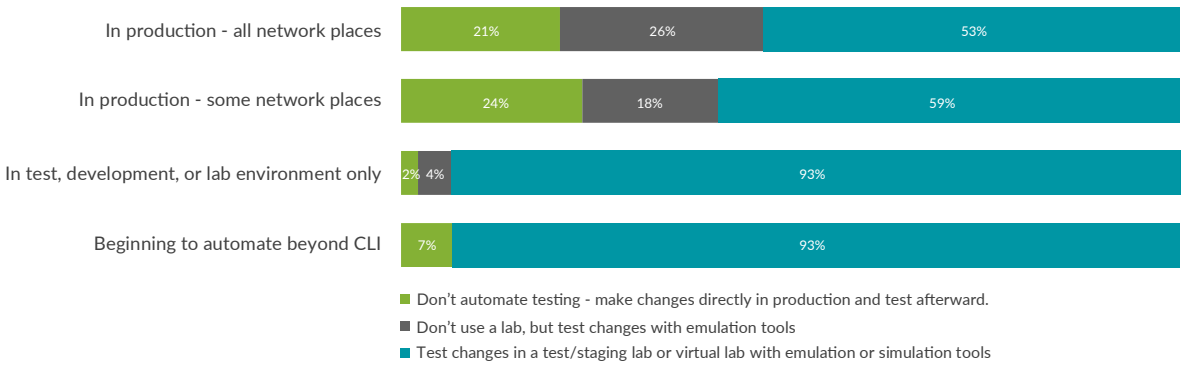
How CSPs manage automation before and during production also varies by level of maturity.

As for pre-production set-up, the vast majority of Communications Service Providers test changes in a test, staging, or virtual lab using simulation or emulation tools. Of the remaining 25% who don't automate testing, the chart below shows that they are mostly partial or full automators.





1.4 The average number of tools CSPs use to automate network testing.



To automate network testing, more than a quarter of communications service providers use reviewing tools as part of change management

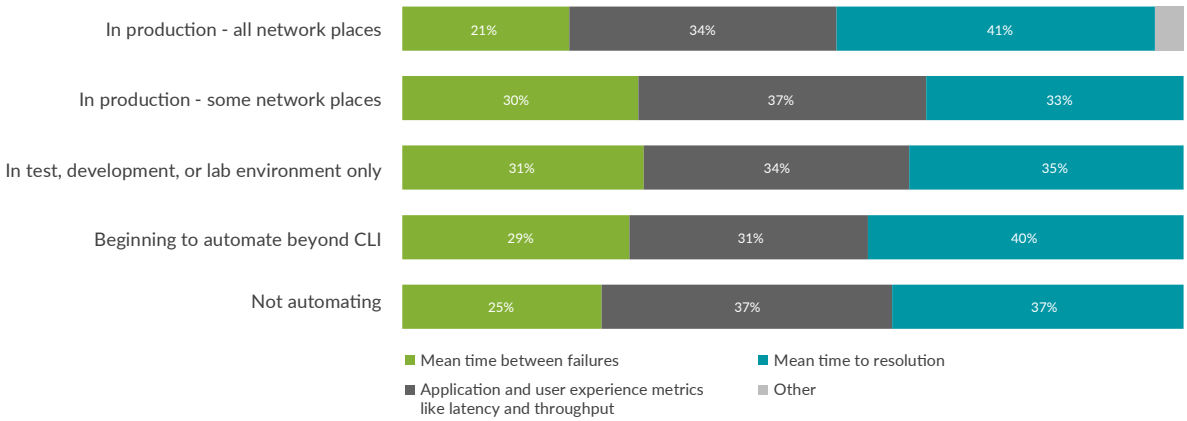
However, full automators most commonly use tools for test simulation and source code management tools.

Partial automators, in addition to reviews, also rely on:

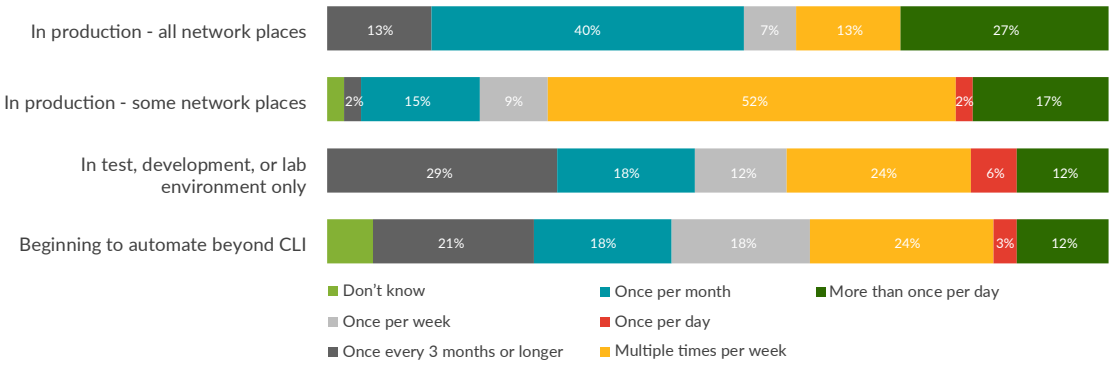
- Pipelining tools for continuous integration,
- Frameworks or tools,
- Automated hooks and testing on code commits.

Partial automators likely point to how network testing will be commonly done as network automation becomes a more and more established practice.

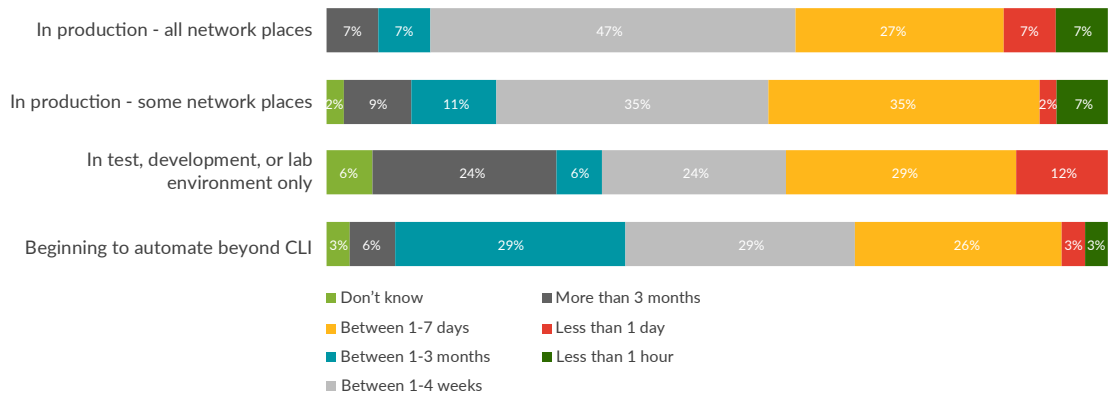
The most important service reliability metric varies some by according to the automation maturity level. Full automators find MTTR (*Mean Time To Resolution*) most important. Partial automators – who again will likely set the new standards – say application and user experience metrics are most important. For all, MTBF (*Mean Time Between Failures*) is the least important.



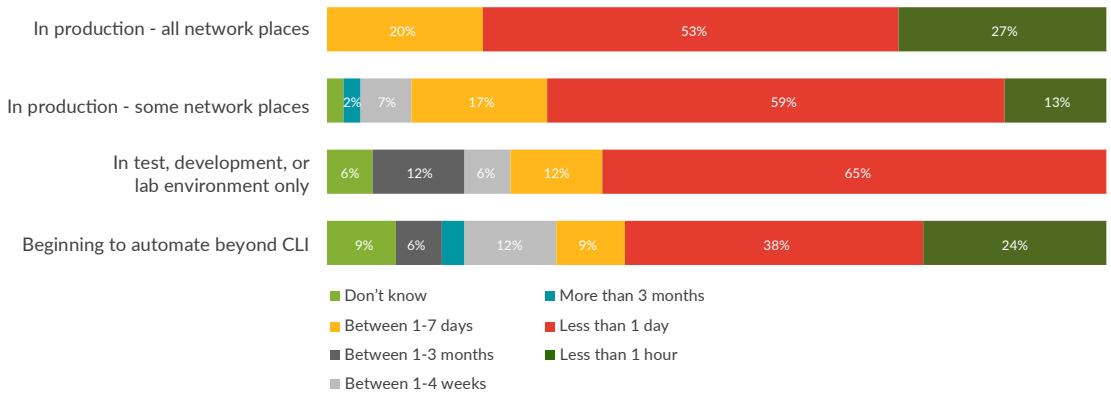
As the chart below shows, the more a CSP network is automated, the more often changes are made to the primary network service. 27% of full automators and 17% of partial automators make changes more than once a day, while another 20% of full automators and 52% make changes at least multiple times per week. This compares to 12% of beginners and testers who make changes more than once a day about another 30% who make them multiple times per week.



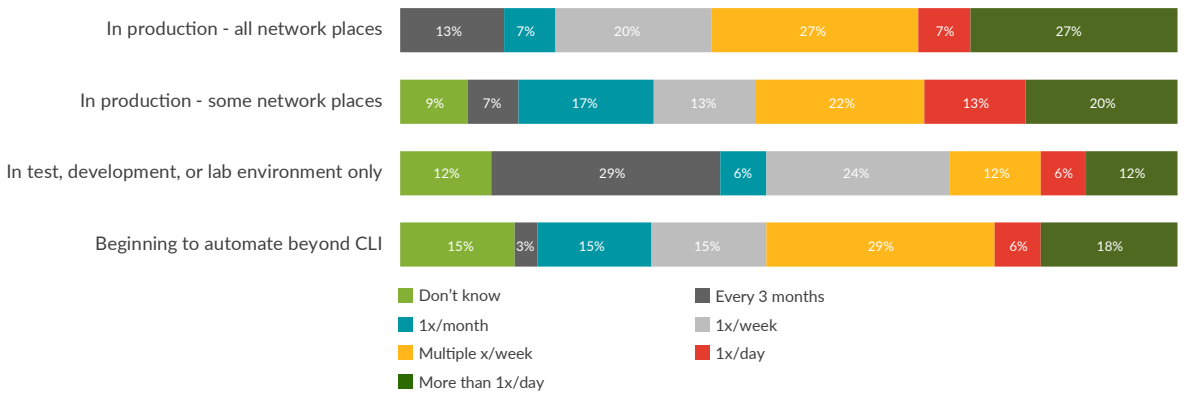
And the more a network is automated, the less lead time for changes is required. 14% of full automators say it takes a day or less from servicing a change request to having it take effect in production. Compare this to beginners who require much more time lead time for changes.



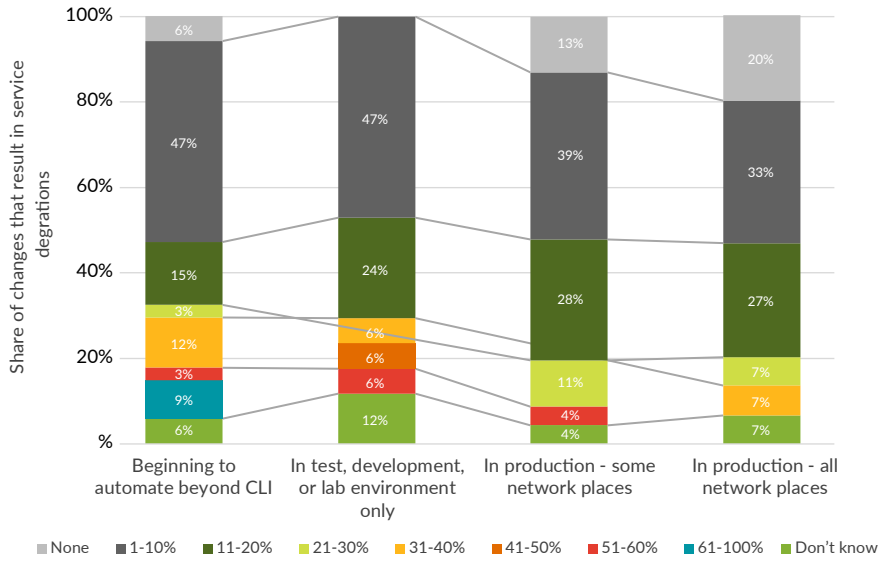
It's the same trend for the time to restore service after there's a service incident or defect that impacts users. **The more automated a network is, the faster service is restored.** 80% of full automators and 73% of partial automators restore service in less than a day – and this includes 27% of full automators and 13% of partial automators restore service in less than an hour. Compare this to 65% of testers and 62% of beginners who say it takes less than a day.



The same also holds true with the frequency of detecting or receiving reports of service degradations or issues. **The more automated a network is, the more frequently teams detect trouble.** 34% of full and 33% of partial automators say they get trouble reports at least once per day compared to 18% of testers and 24% of beginners.



Lastly, an automated network is a more dynamic and more reliable communications service provider network. **The more automated a CSP network is, the fewer changes to production end up in degraded service – that then lead to remediation.** About 20% of full automators and 13% of partial automators never have service problems as a result of changes. Avoiding hot fixes, rollbacks, forward fixes and patching saves time for the whole team.

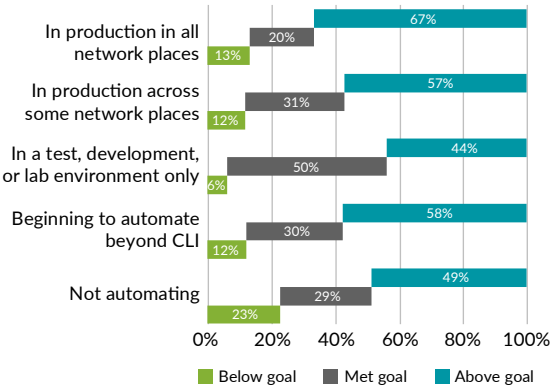


The more a Communications Service Provider uses network automation, the higher the business benefit.

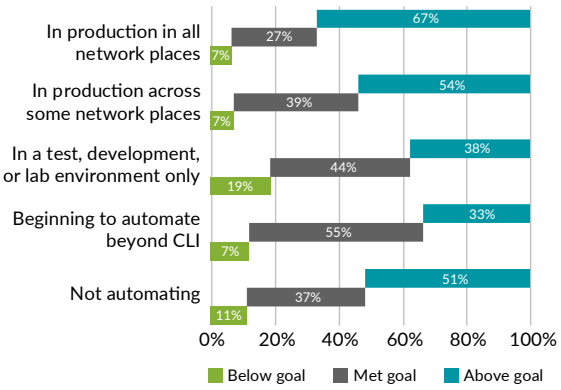
When asked about whether they were above, at, or below goal for 4 key business goals for the last year, CSPs that automate in production in all places in the network are consistently above goal. 67% are above goal for new customers and relative market share. 47% of them who say they're above goal for time to market for new products and 73% above goal for organizational performance.

Over the past year, status of the goal for...

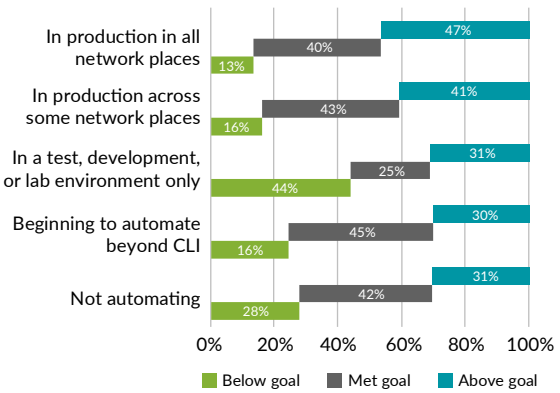
More Customers



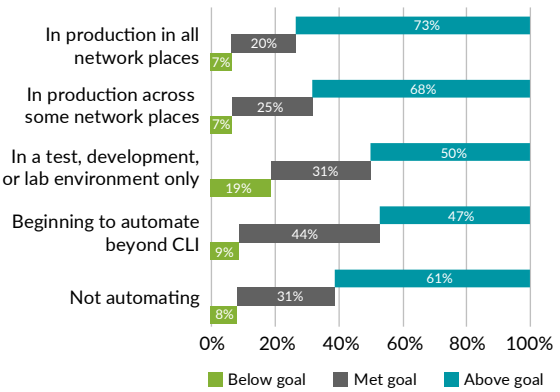
Relative Market Share for Primary Products



Time to Market for New Products



Organizational Performance



Summing up: Communications Service Providers that use network automation have improved network operations, reliability for better business outcomes.

CSPs are increasingly embracing network automation. However, there are three main conclusions. First, as underlying technologies themselves mature, processes and practices that automators use are shifting. While automators at all stages might use the same network vendors, they don't use the same exact same tools before and during production – suggesting what partial automators do today will be the new standard. Second, the more automated the network, the more network operations and reliability improve. Third, those improvements in NetOps (Network Operations) and reliability translate to business advantage.

Donal's Takeaways on Communications Service Providers

Automation is about increasing speed and reliability while facilitating action at scale. It is a force multiplier where traditional drivers such as cost reduction and improved quality can coexist happily. When we consider the underlying promises of technology, the drive for efficiency and efficacy stand out. However, there is an innate fear of losing control and cognitive dissonance tied with the rise of network automation as we observe "software eating the world". This feeling stems in part from a ubiquitous sense of future shock and is underpinned by a personal fear of obsolescence. It also carries with it the recognition of a skills gap, one that must be overcome before attempting the next challenge. But what is preventing many of us from getting started? Well, understandably, some of the primary human challenges related to the adoption of automation involve finding the time to learn and train, and a deep apprehension related to making mistakes in production. Ironically these are challenges that a mature automation practice solves, so it should be no surprise that those who embrace automation report higher job satisfaction and exceed their performance goals.

In the last five years of running Network Operator Group events and presentations, I've observed a shift towards ubiquitous automation, irrespective of vertical or horizontal. The focus is not just on the traditional places in network that require automation by necessity of scale or volume, but also with many of their adjacent and dependent workflows. This includes automating multiple aspects of service delivery and assurance, general business process optimization, and sometimes even automating vendor TAC(Technical Assistance Centre) engagement.

As the volume, scope, and scale of digital assets increase, each asset and platform comes with its own inescapable overheads and externalities. Measuring, monitoring, and managing these are table stakes, yet as scale and complexity grow, so too does the need for better overall observability and controllability. The more digital state and associated dependencies we deploy, the greater the need for better telemetry and intelligence to allow us to make evidence-based decisions, and take (or automate) decisive actions.

CSPs primarily sell network services with some additional OTT(Over-The-Top) services. Delivery of these network services are predicated on the deployment or delivery of physical entities such as a SIM (Subscriber Identity Module) or CPE (Customer Premises Equipment). These physical constraints mean that unless a subscriber is already within their managed footprint (and has satisfied the correct endpoint requirements), they are subject to some naturally asynchronous steps or processes to complete service activation. When compared to the service model for cloud providers, with service boundaries focused on API(Application Programming Interface) first, we begin to think differently about how a service surface or consumption model affects the need for automation. Automation may begin 'lumpy' in many CSP scenarios but closed-loop end-to-end service automation is often driven by the expectations of consumers. Are CSP service consumers humans or machine agents, and what speed, type, or interface is used for service fulfillment?

Internally, albeit Telcos and cable MSO's may make extensive use of API's and automated configuration management for their own footprints, their external service consumers (with some exceptions in the B2B (Business To Business) and communications provider cloud space) do not programmatically consume services. Many customers may utilize self-serve web portals or make voice calls to human agents who then initiate upstream interactions with internally automated services. The service request trigger is manual and often comes with asynchronous delivery expectations. This would seem to lead to CSP's network automation efforts being driven by their scale, as an operational necessity, rather than the customer consumption model and lead time expectations of individual or business customers.

Yet one of the lowest risk, most effective, and highest return paths for a more mature automation practice revolves around automating quality assurance and testing activities, especially when working at scale. This is to be expected as it also creates fertile ground and cumulatively beneficial conditions for further automation. Automation types involving read-only workflows for activities like assurance and monitoring increase overall observability, while helping to build confidence as they result in "safe" measurable outcomes (ones that support continuous improvement). The greater the potential for a destructive operation (and the less capable and confident an operator is at completing a timely roll-back), the more likely they will continue with manual, time-consuming, and low-value tasks. There's a gradual and natural evolution of stair-stepping up through automation confidence levels as personal skills and risk tolerance evolve. The exception to this stair-stepping is when your whole service stack is expected to be consumed programmatically, synchronously, and predominantly by machine agents from the beginning.

Chapter 3: The 2020 Cloud Provider State of Network Automation

This chapter showcases the state of network automation for Cloud Providers. Specifically, after you understand respondents, you'll learn by network automation maturity:

- where they automate,
- tools,
- vendors,
- processes for network automation before and during production, and
- how well Cloud Providers' meet 4 key business goals.

The automation maturity scale has 5 levels, ranging from not automating at all to being in production across all places in the network. The key below has the short names used throughout the report and how they are defined.

Key: Short names for groups along the maturity scale

Full automators = in production in all network places
Partial automators = in production in some network places
Testers = in a test, development or lab environment only
Beginners = beginning to automate beyond CLI with basic scripting

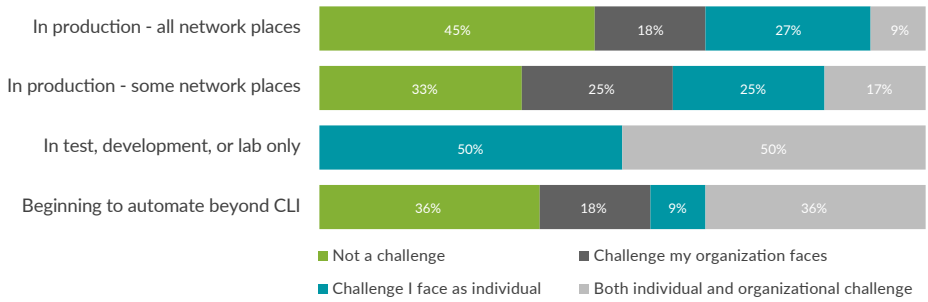
Non-automators = Not automating

Cloud Providers lead the way with network automation.

Our sample includes 46 Cloud Providers and 65% are from North America. It's important to know that it's fairly small sample of a varied group. A cloud provider in our research could be a low-code platform, a hosted cloud infrastructure or a public cloud provider. But what they all have in common is the imperative to operate efficiently, so they adopt automation more than their networking colleagues.

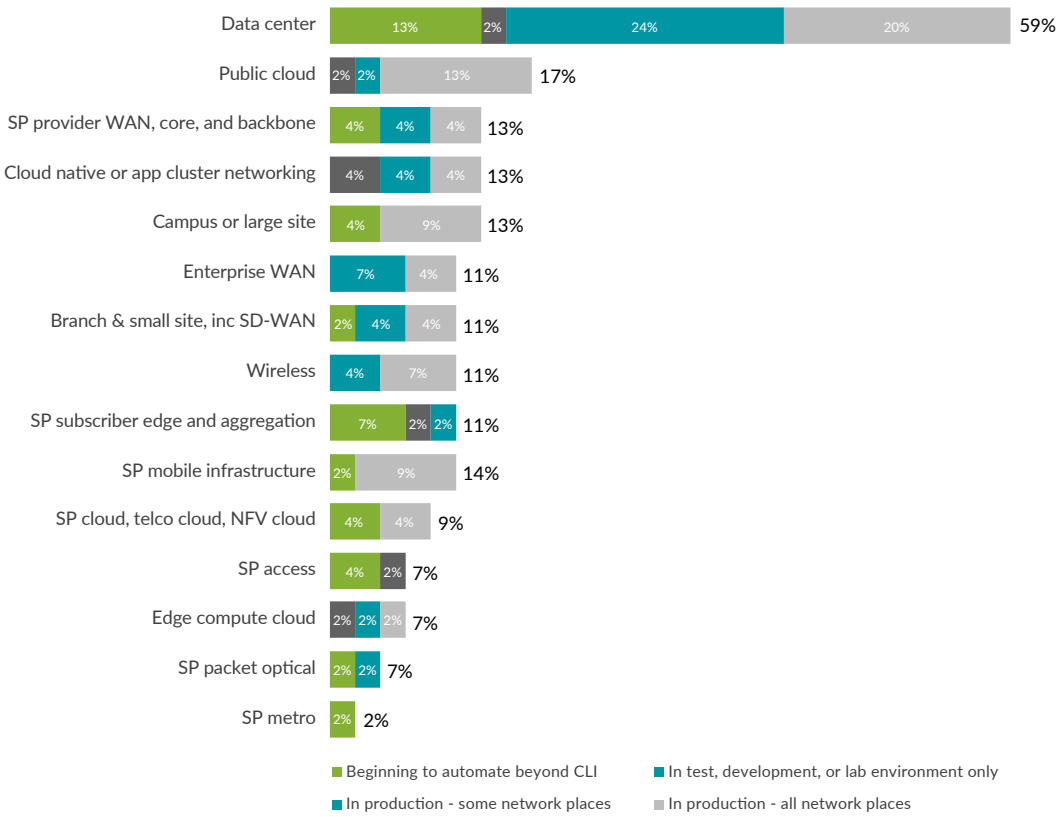
Since Cloud Providers have more mature automators than Communications Service Providers or Enterprises, it means that remaining respondents are spread among testers, beginners, and non-automators. It's limiting because the sample of testers ended up being particularly small. While we include this group in results, we don't make any conclusions about Cloud Providers who are testers.

Since Cloud Providers lead in network automation adoption, they show that experience helps conquer fear of making a mistake in production. Full automators are less afraid than less mature automators.



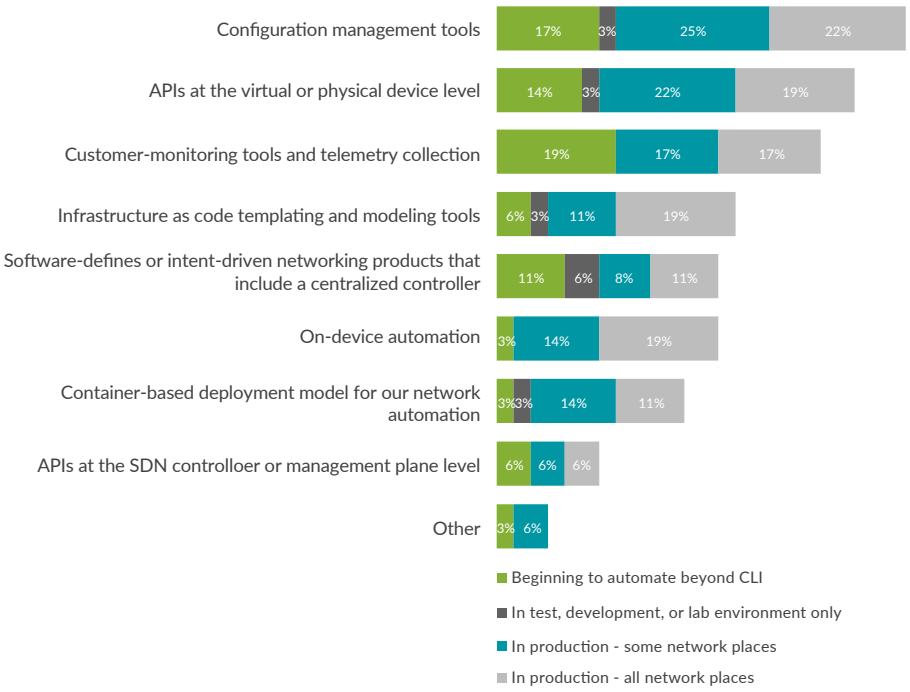
Cloud Providers mostly automate data centers.

Overwhelmingly, Cloud Providers first tackle date center automation. It is top among all groups along the network automation maturity continuum, so keep this in mind as you review all results. Next, at a distant second at 9%, is automation of the public cloud. From there, Cloud Providers are automating a little bit of everywhere. There is one place they stand out – when compared to their communications service provider colleagues – with their level of automation of the edge compute cloud.



Cloud Providers mainly use 3 different tools to automate network deployments, changes, and management.

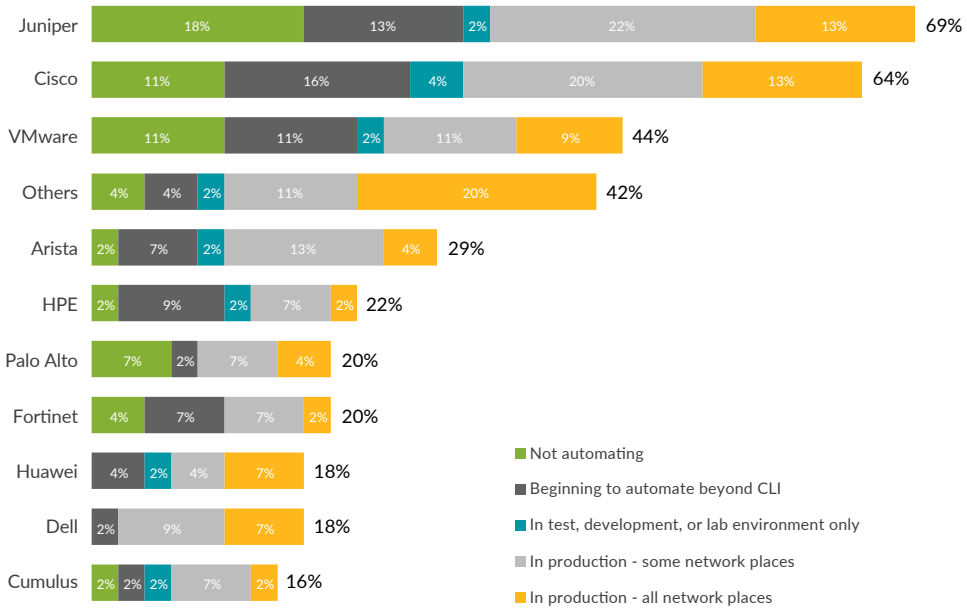
Configuration management tools tops the list at 67%, next it's APIs at the virtual or physical device level at 58% and customer-monitoring tools and telemetry collection at 53%. What stands out is that full automators use everything. They're just as likely to use Infrastructure as Code(IaC) templating, modeling tools and on-device automation. This isn't true of partial automators who primarily use the top three: configuration tools, APIs on the device level, and customer monitoring and telemetry.



4

The average number of tools a cloud provider uses to automate network testing, making them the segment that uses the most tools to get the job done.

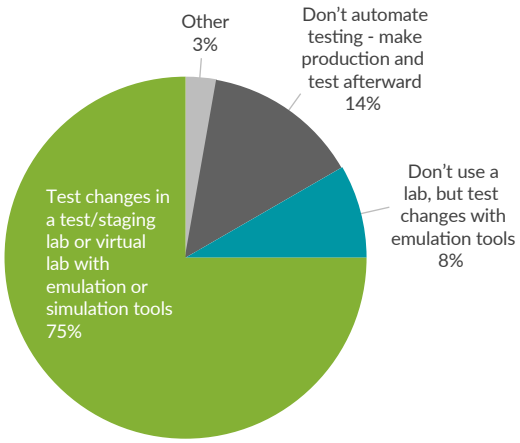
Most Cloud Providers tend to use a smaller set of network vendors.



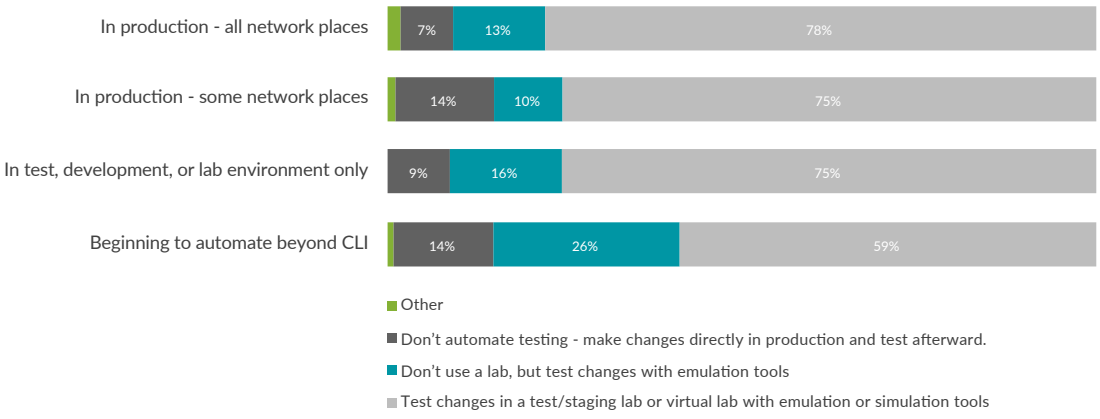
Nearly **70% of cloud providers rely on Juniper**, making it the top vendor

How Cloud Providers manage automation before and during production varies by automation maturity stage.

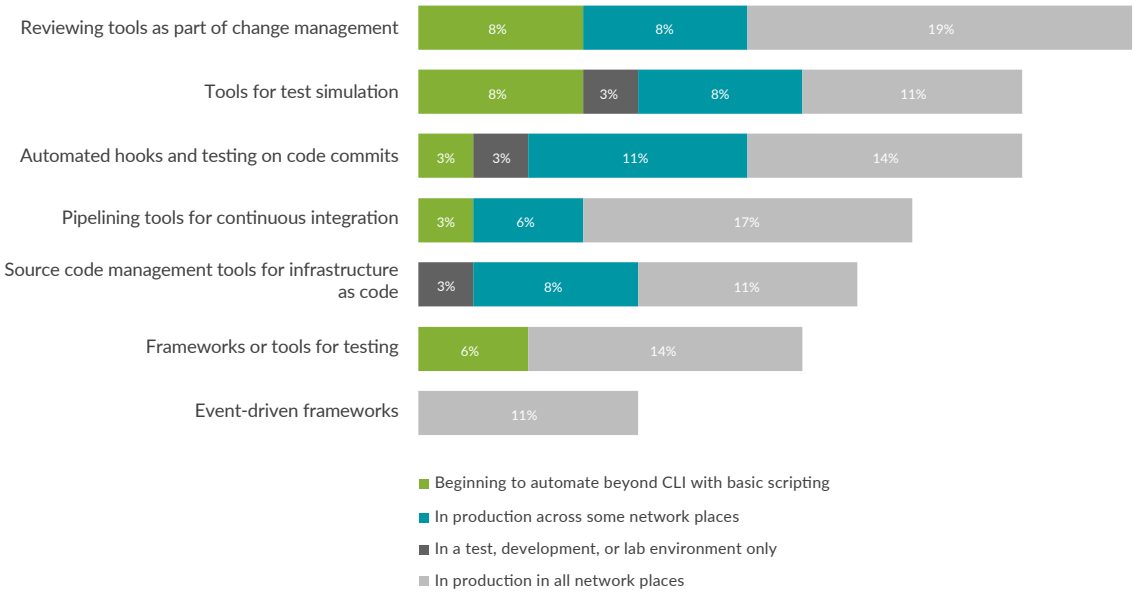
In the pre-production setup to test automation for making changes, just like communication service providers, 75% of Cloud Providers test changes in a test/staging lab or virtual lab with emulation or simulation tools.



But unlike those Communications Service Providers, they tend to not automate testing, particularly the less mature automators. Instead, they make changes directly in production and test them afterwards. This may be due to their primarily stub based network and datacenter nature. As a utility compute provider their fixed underlay networks rarely change whereas their virtual overlay networks can withstand churn and be rolled forward or backward in the case of a breaking change without losing management capabilities.

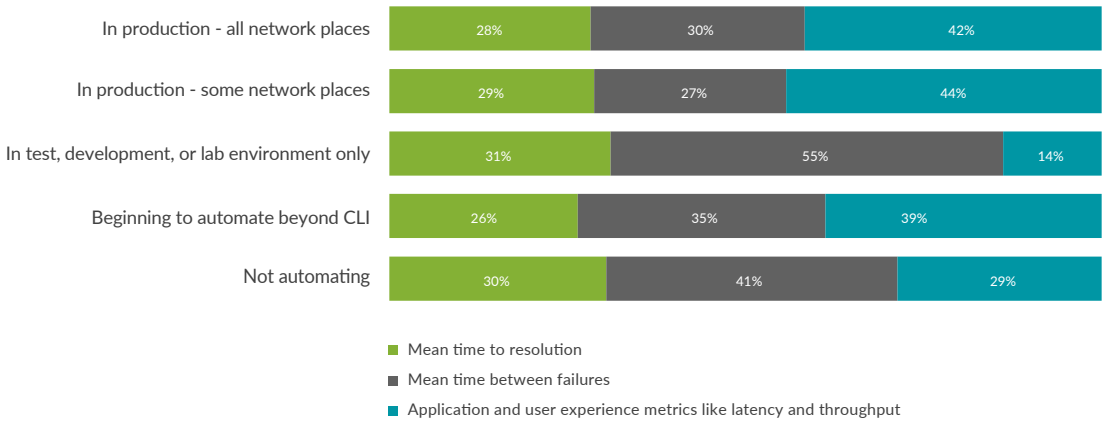


To automate testing, Cloud Providers are like both Enterprises and Communications Service Providers and use reviewing tools as part of change management most. But Cloud Providers differ from them that they're far more likely to use automated hooks and testing on code commits. In addition, more mature automators are nearly as likely to use automated pipeline tools for continuous integration.

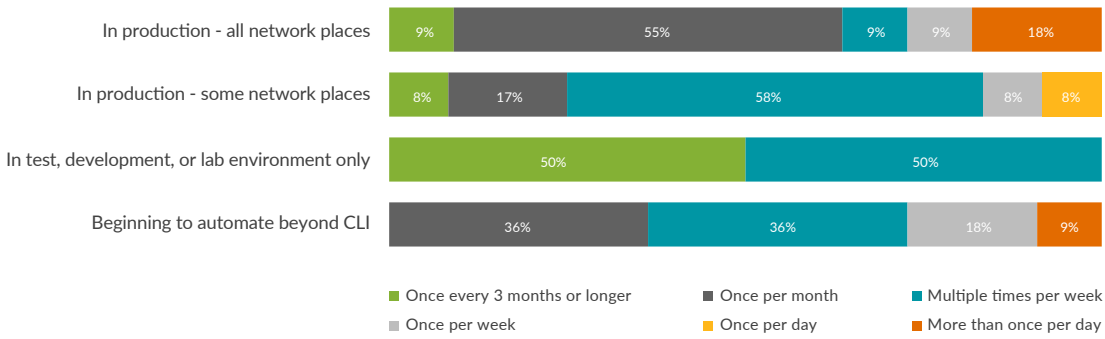


When it comes to the **service reliability metrics, the most important ones are application and user experience metrics like *latency* and *throughput***. This is true for beginners, partial, and full automators alike.

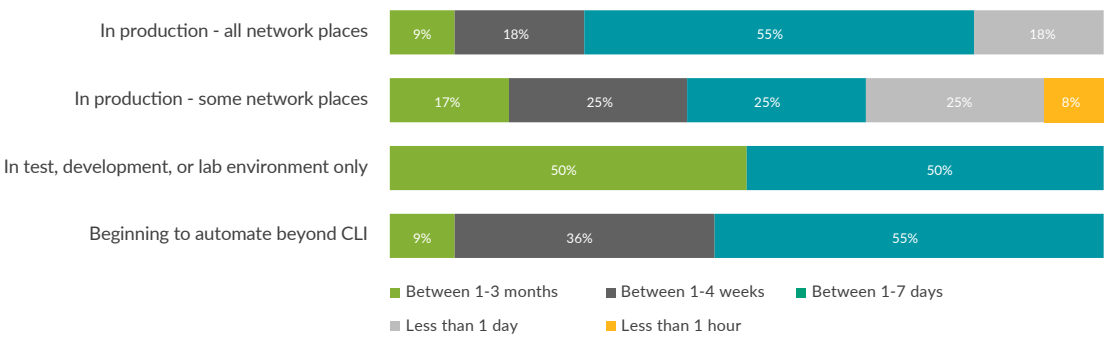
For non-automators, MTBF (*Mean Time Between Failures*) is most important and for all Cloud Providers, MTTR (*Mean Time To Resolution*) is least important.



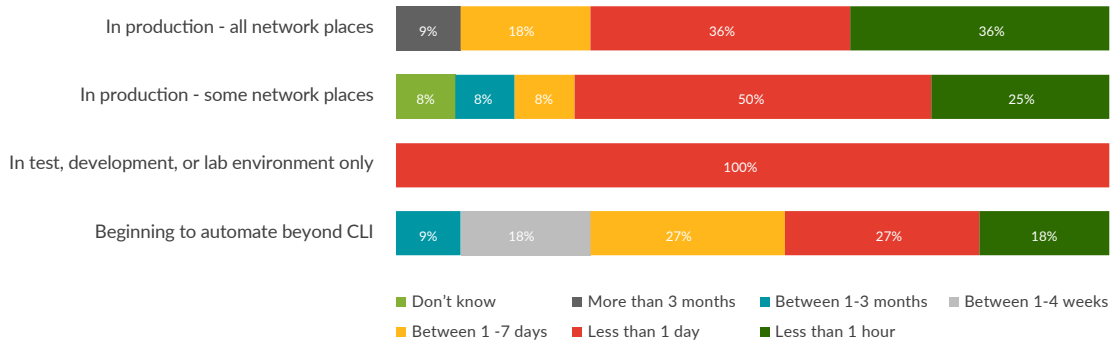
Just as we saw with Communications Service Providers, the more a network is automated, the more often changes are made to the primary network service. 18% of full automators make multiple changes per day and another 8% make them daily. Partial automators and beginners make changes less often, though. The nature of many Cloud Providers service delivery model and consumption by machine agents (via APIs) mandates tightly-coupled automation throughout their stacks. Once a certain level of automation coverage, scale, and maturity is achieved, it would suggest that feature velocity and aspects of lifecycle management accelerate.



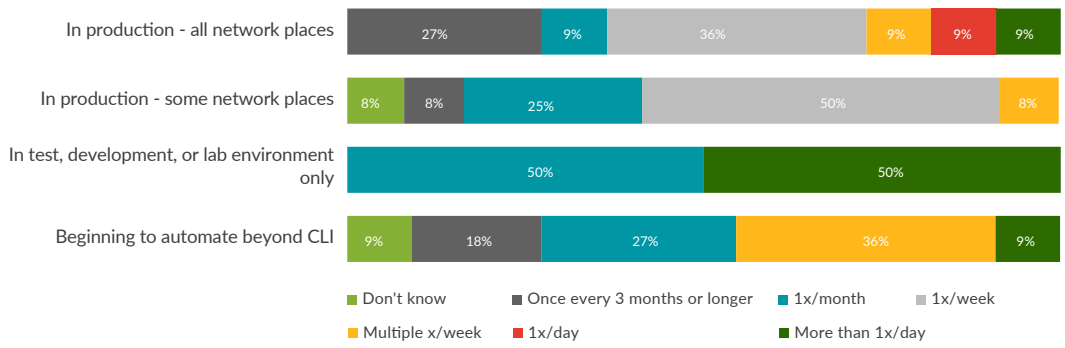
Cloud provider networks that are more automated require less lead time for changes. 18% of full automators say it takes less than a day from servicing a change request to having it take effect in production. Another 55% get it done within a week. Compare this to beginners who skew toward longer time intervals – with not one reporting the ability to service change requests on the same day.



For Cloud Providers, uptime is everything; no service equals no revenue and unhappy customers, so it's crucial to restore service as fast as possible. So how does network automation impact time to restore service after an incident or a defect that impacts users? **The more automated a cloud provider network is, the faster service is restored.** 72% of full automators and 75% of partial automators say it takes less than a day. Compare this to beginners; only 45% of them say it takes less than a day, while another 27% say it takes between 1-7 days.

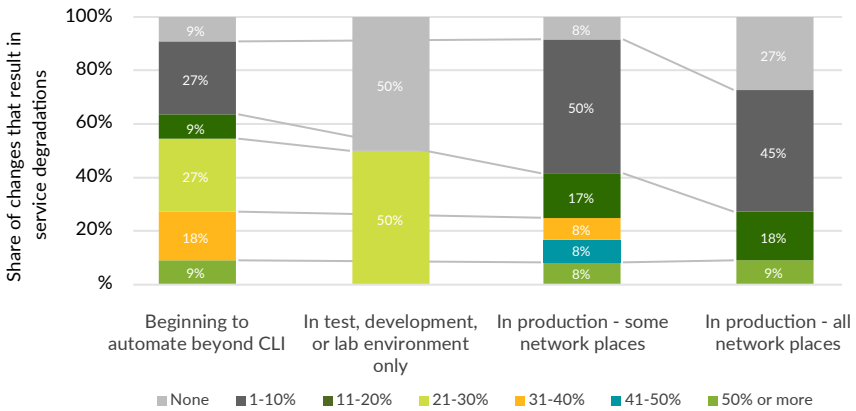


Regarding the frequency of detecting or receiving reports of service degradations or issues, 18% of full automators say they get trouble reports at least once per day compared to 9% of beginners. With greater automation coverage and monitoring, comes the potential for more frequent and observable breaches of a broader set of SLOs (Service Level Objectives). In other words, the more you automate, the more you measure, and the more likely you are to detect trouble in the first place.



Lastly, an automated network is a more dynamic and more reliable cloud provider network. The more automated it is, the fewer changes to production end up in degraded service – that then lead to remediation efforts. About 27% of full automators and 8% of partial automators never have service problems as a result of changes. This means no need for hot fixes, rollbacks, forward fixes and patching as a result of production changes to the network. Next about 45% of full automators and 50% of partial automators say less than 10% of changes create problems that need remediations.

This compares to beginners where a higher percentage of their changes in production lead to service degradation. And only 9% have no problems as a result of changes.



Cloud Providers that use network automation crush their business goals.

The more network automation is used, the higher the business benefit. When asked about whether they were above, at, or below for 4 key business goals in the last year, full automators met or exceed expectations.

For example, among full automators:

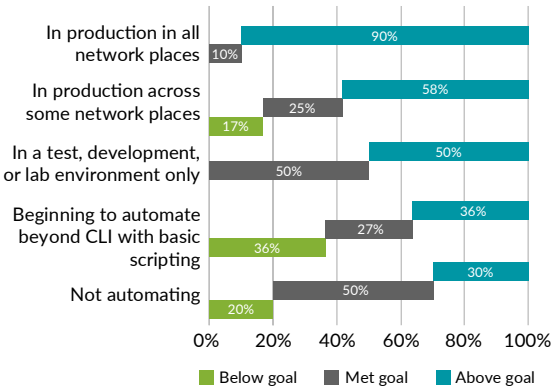
- 90% are above goal for more customers,
- 70% are above goal for relative market share for primary products,
- 60% are above goals for time to market for new products, and
- 91% are above goal for organizational performance.

Let's quickly compare to non-automating Cloud Providers. They are more likely to be at or below goal. For example:

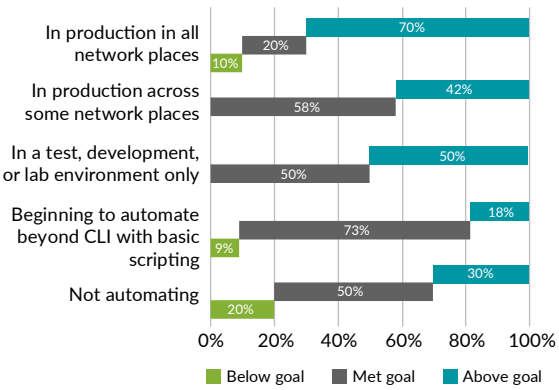
- 20% are below goal for more customers, for relative market share for primary products, and for time to market for new products, and
- 11% are below goal for organizational performance.

Over the past year, the status of the goal for...

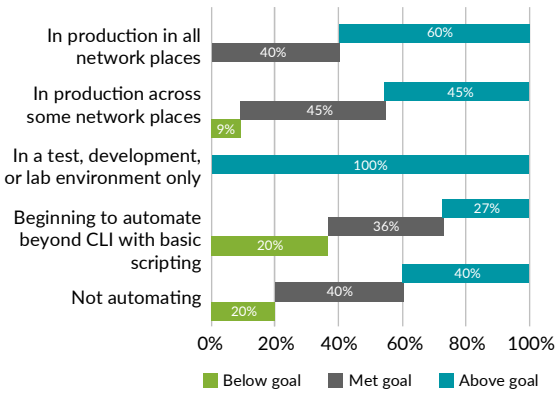
More Customers



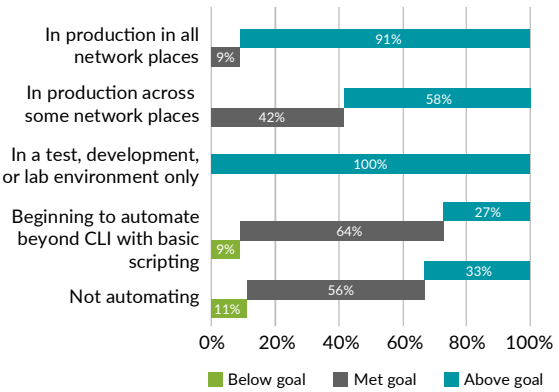
Relative Market Share for Primary Products



Time to Market for New Products



Organizational Performance



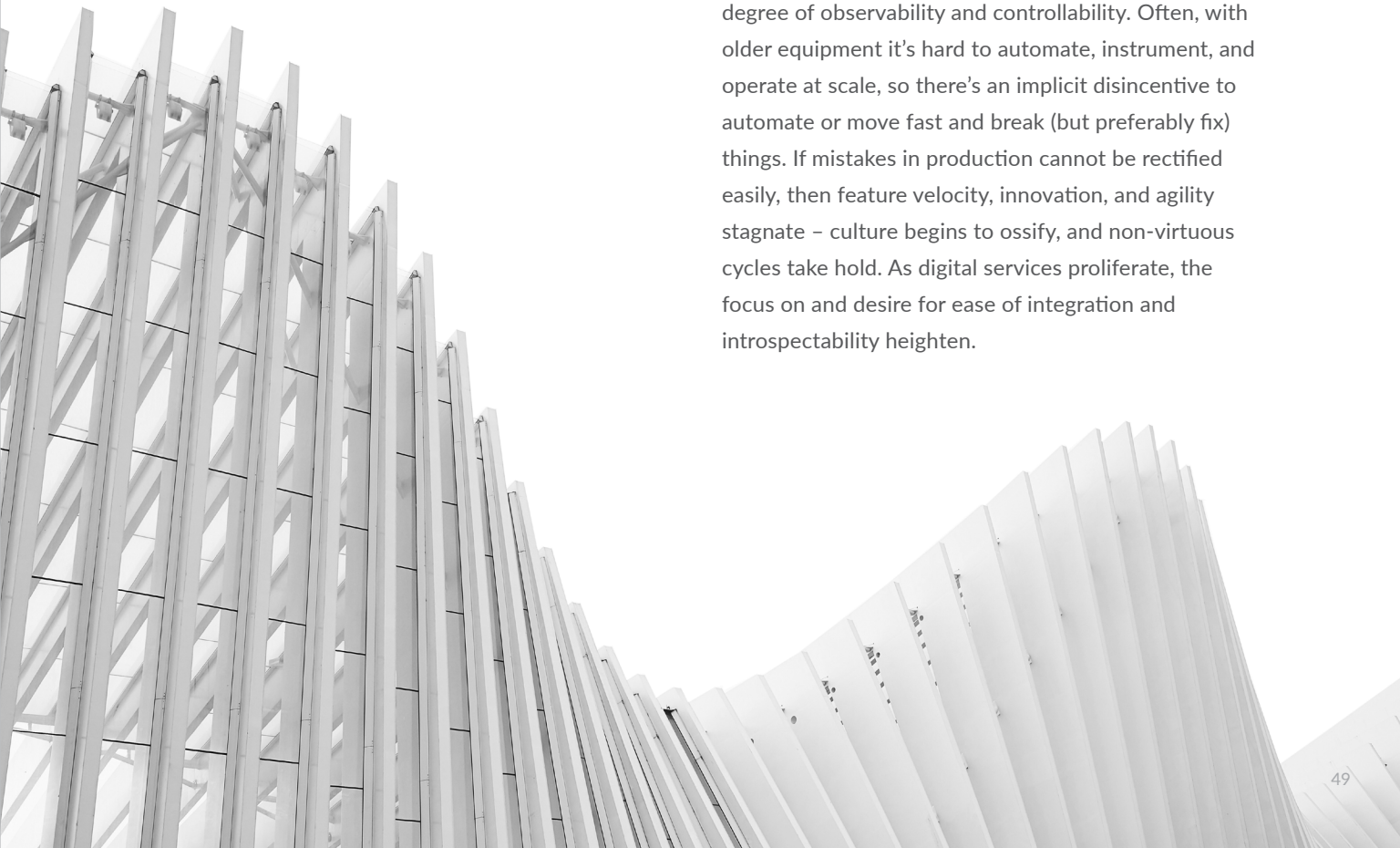
Summing up: Communications Service Providers that use network automation have improved network operations, reliability for better business outcomes.

Cloud Providers are quickly automating their networks, particularly in the data center and public cloud, more than Communications Service Providers and Enterprises. There are a few noteworthy conclusions. First, they use a broader set of tools to automate testing, too. Second, *application and user experience metrics like latency and throughput* is by far the most important service reliability metric. Last, like Communications Service Providers, the more automated the network, the more network operations and reliability improve, which translates to great business advantage over Cloud Providers that use lesser degrees of automation.

Donal's Takeaways on Cloud Providers

Managing change is a cornerstone of building and operating technology. Rather than let the fear of change ossify an organization or its culture, optimizing for reliable, resilient, and rapid changes result in increased efficiency and agility. Mature automation practices lend themselves to not just better and faster outcomes but also decreased risk.

When network operators highlight the fear of making a mistake in production as one of the predominant challenges related to automation adoption – concepts of risk, impact, and culture come to the fore. For learning and development to occur, there needs to be psychological safety in teams [Ref: Project Aristotle]. And to fail well, one must quickly identify problems and errors, limit their potential blast radius, and then remediate or rapidly roll-back. This entails a high degree of observability and controllability. Often, with older equipment it's hard to automate, instrument, and operate at scale, so there's an implicit disincentive to automate or move fast and break (but preferably fix) things. If mistakes in production cannot be rectified easily, then feature velocity, innovation, and agility stagnate – culture begins to ossify, and non-virtuous cycles take hold. As digital services proliferate, the focus on and desire for ease of integration and introspectability heighten.



Cloud providers rank reliability as their top business driver for automation (with efficiency a close second). As per the previous CSP segment, cloud provider networks are tightly coupled to revenue generation. Cloud provider's downstream customers also build their own revenue-generating products and services on top of these clouds. These customers also consume cloud services programmatically, which inevitably leads to them independently instrumenting the cloud provider's service performance. When your customers are SaaS (Software as a Service) businesses who are laser-focused on their own user experience metrics and can easily instrument them, a symbiotic and amplified form of monitoring occurs. Tighter and faster feedback loops develop around service expectations, measurements, and resultant optimizations.

Additionally, and dependent upon a cloud customer's scale and architecture, provisioning and switching costs are lower than that for the aforementioned communications service providers who require the deployment of physical devices. When all friction has been removed from service provisioning through to service consumption using APIs, there's an understanding that automation is required to fulfill service requests end-to-end (be they synchronous calls or asynchronous background jobs).

Once a device or service provides a robust API with good coverage, it becomes a somewhat frictionless way to explore automation and to test integration possibilities with existing platforms or stacks. The use of containers for rapid commissioning, prototyping, and safer experimentation means that early adopters lean towards API first products and services. They are seen to enable faster and more controllable automation outcomes. Skills and concepts relating to containers and APIs (especially RESTful ones) are themselves transferable to other platforms and scenarios. This creates immediate and cumulative value with well-defined learning paths. One of the paradigm shifts that's less obvious when approaching automation, is not to apply network engineering learnings to software principles, but to apply software engineering principles to network engineering. This shift means embracing automation not as a toolchain but as a pattern language and process ontology that focuses on how actors and agents achieve goals by moving through different states. There are indeed some quick wins, safe paths, and low hanging fruit, but a more abstract and holistic view leads to the most profound gains.

Note: Humans are still required to design, implement, and evolve these automation workflows, but there is help at hand with new breeds of AI (Artificial Intelligence) assistants that can augment or trigger automation workflows using the patterns they spot in the compounding complexity.

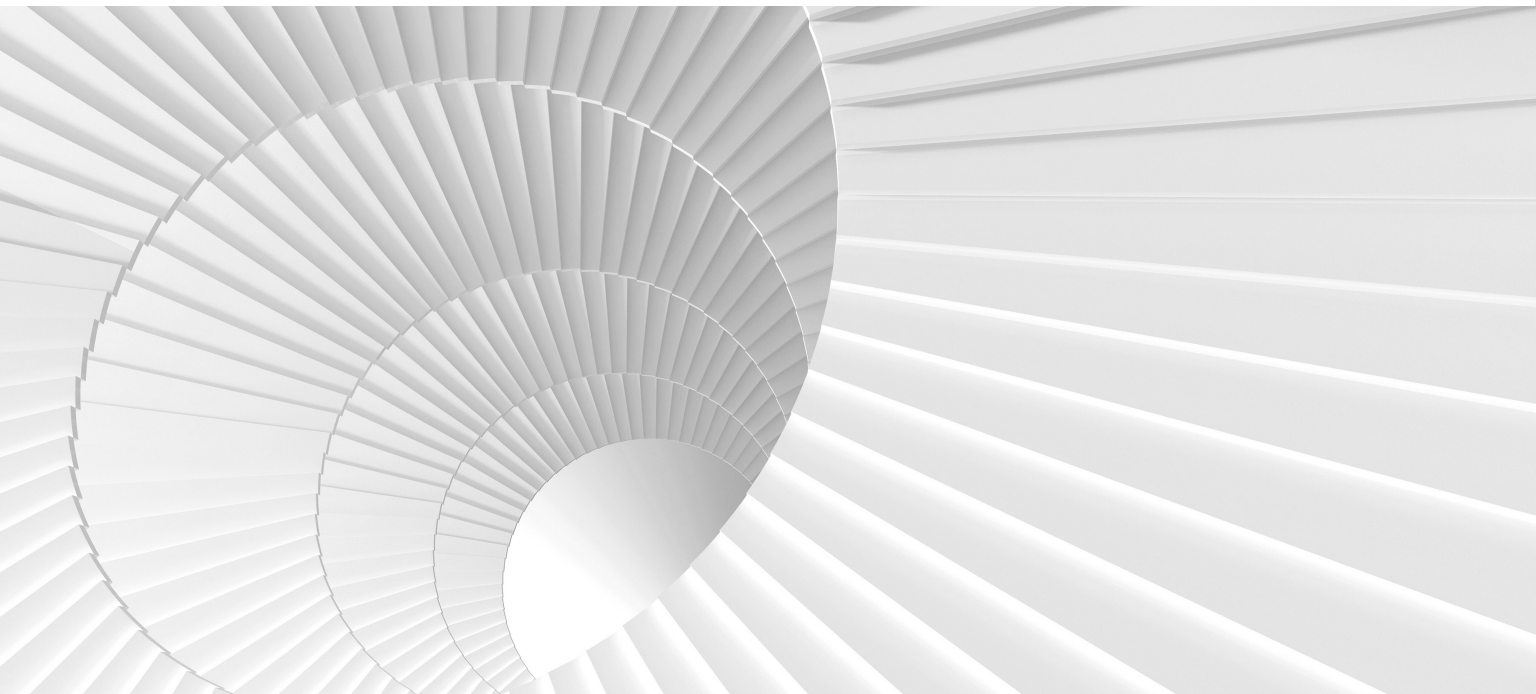
Chapter 4: The Road to Greater Network Automation Maturity

Regardless if you're an Enterprise, Cloud Provider, or a Communications Service Provider, the path to achieving full network automation is a function of building the right individual and team skills, fostering a culture of automation, and growing a high-performing team.

In this final section, we explore each one by automation maturity.

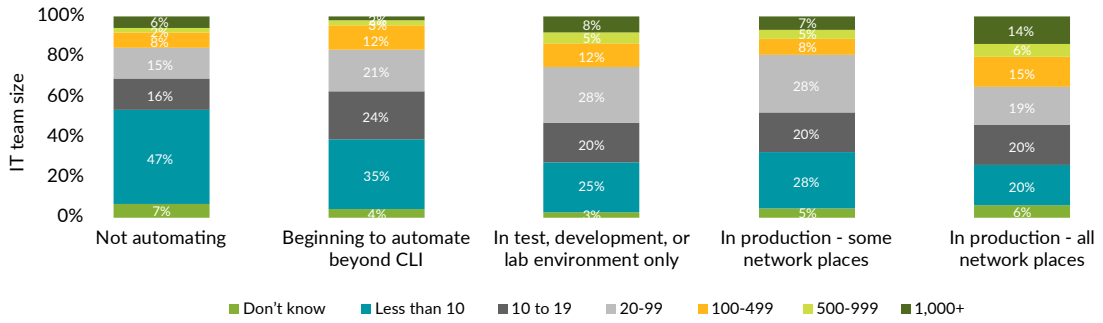
More mature network automators build new skills for new responsibilities.

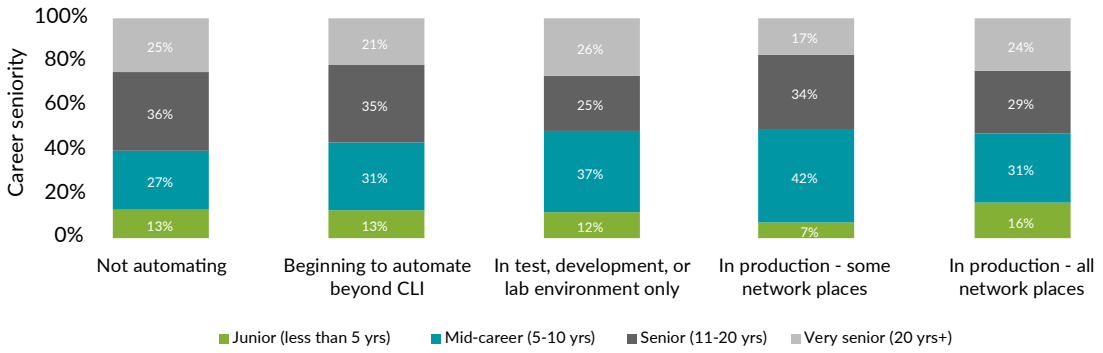
All network teams have the same network architecture and security-related responsibilities. More mature automators are also more likely to have network automation architectures, frameworks and tools integration, as well as network automation software engineering. And this means since they have reduced needs, they don't do network monitoring, provisioning and on-call incident response at the same rates.



Most important responsibilities	Not automating	Beginning to automate beyond CLI with basic scripting	In test, development, or lab environment only	In production - some network places	In production - all network places	Overall
Network architecture	16.0%	17.3%	19.3%	18.1%	16.4%	17.3%
Network monitoring	15.3%	13.4%	11.1%	9.1%	9.7%	12.2%
Information or network security	11.8%	12.9%	12.7%	9.1%	9.5%	11.2%
Network automation architecture, frameworks, and tool integration	7.1%	8.9%	8.9%	14.5%	15.3%	10.5%
Network provisioning	12.7%	10.5%	8.9%	9.8%	7.8%	10.4%
Documentation	8.0%	9.8%	9.1%	6.7%	9.6%	8.5%
Network automation software engineering	3.2%	7.0%	8.6%	11.3%	13.2%	7.9%
On-call/incident response	9.5%	6.0%	5.8%	5.9%	4.7%	6.7%
Project or product management	6.9%	3.5%	3.0%	4.9%	4.5%	4.8%
People management	4.2%	4.1%	3.9%	4.7%	4.9%	4.4%
Requirements analysis	3.1%	4.4%	4.7%	2.9%	1.9%	3.4%
Testing	1.0%	1.6%	3.4%	2.8%	2.2%	2.0%
Other	1.2%	0.7%	0.4%	0.2%	0.5%	0.7%

More mature automators tend to have larger IT teams, span the range of career seniority levels, and know the importance of developer skills.





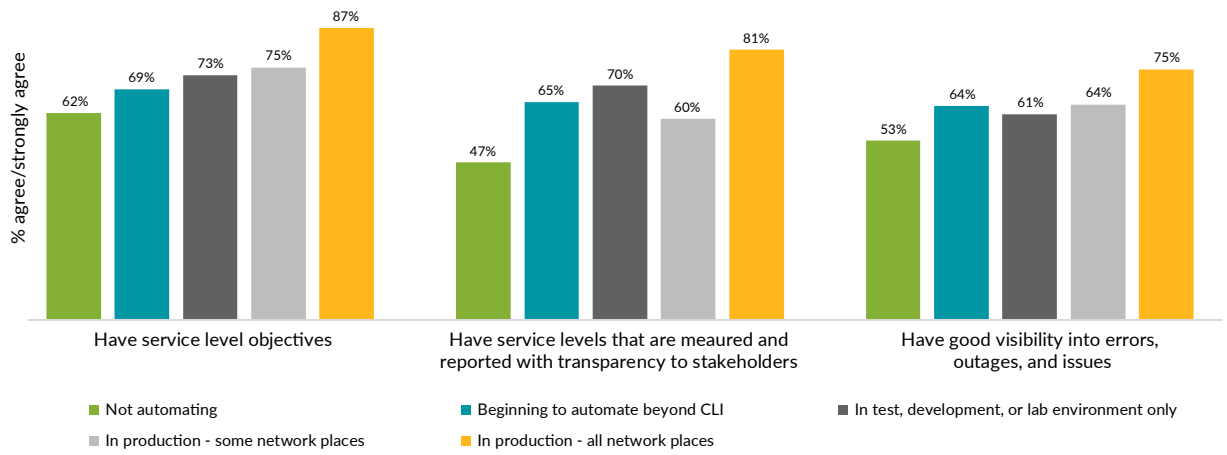
Larger IT teams automate more, likely due to needs for higher service reliability, lower human-error tolerance, and time to learn on the job.

…but **career seniority is not highly related to automation maturity**.

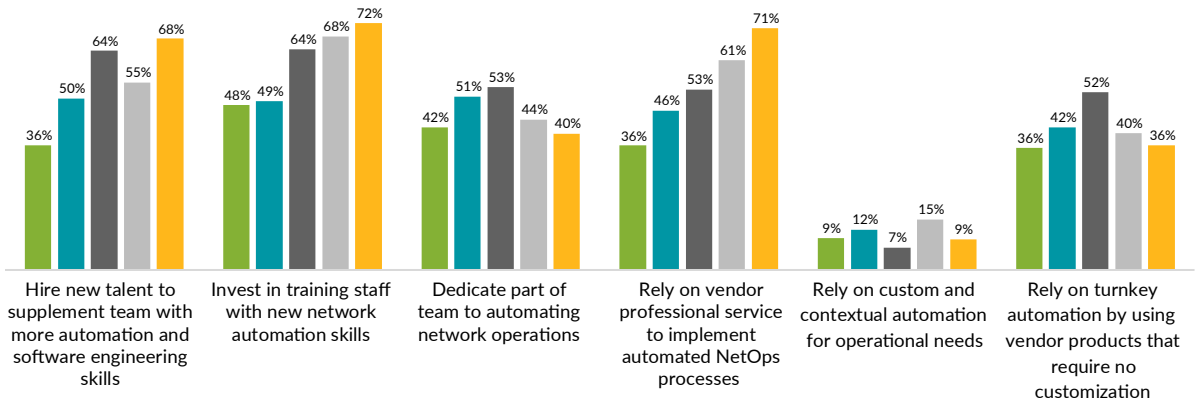
Top 3 trends that inspire you to improve	Not automating	Beginning to automate beyond CLI with basic scripting	In test, development, or lab environment only	In production - some network places	In production - all network places
Network Reliability Engineering (NRE/SRE)	29%	27%	21%	28%	27%
DevOps	21%	22%	27%	25%	22%
DevNetOps	21%	20%	22%	20%	20%
NetOps 2.0	16%	20%	16%	13%	16%
Developer	9%	9%	12%	14%	14%
Other	4%	2%	1%	1%	1%

In 2019, respondents drew inspiration to improve from DevOps, but this year Network Reliability Engineering (NRE/SRE) takes the top spot. **And mature automators now get their inspiration from developers**.

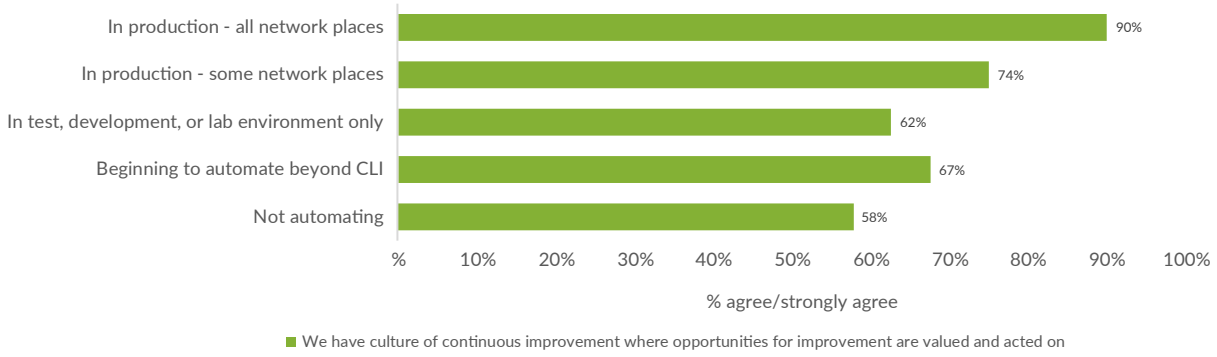
More mature automators tend to have larger IT teams, span the range of career seniority levels, and know the importance of developer skills.



More mature automators invest in automated network operational skills, processes and technology – and less on turnkey automation.

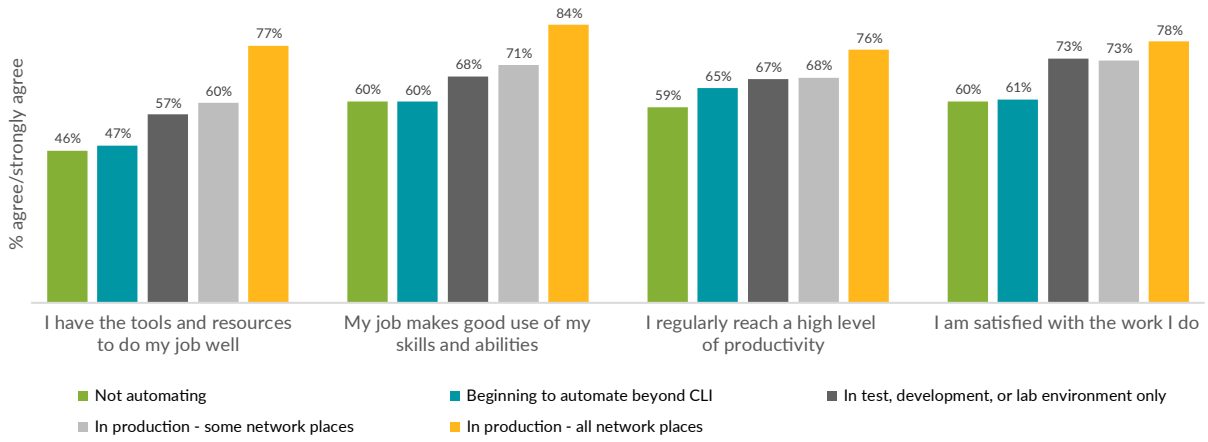


More mature automators invest in a culture of continuous improvement.



Full automators – as opposed to the both non-automators and less mature ones – **consistently report that they have defined service level goals**, a way to measure and report them as well as good visibility into network problems.

More mature network automators build more job satisfaction and a more enriching workplace.

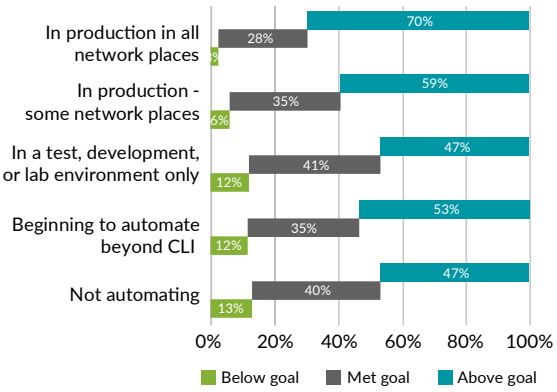


Full automators agree or strongly agree much **more than non-automators** that they have what they need to do the job well and get to use their skills for higher productivity and job satisfaction.

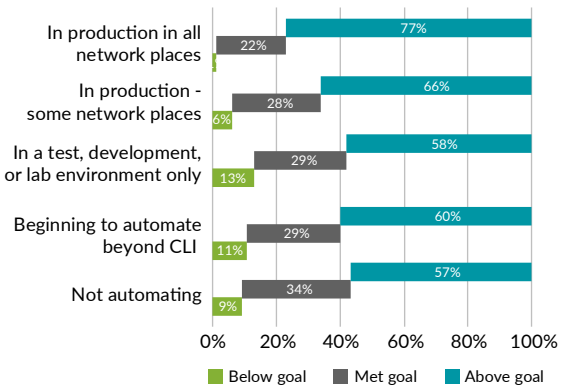
Most importantly, more mature network automators build teams that exceed goals for security and network quality, operational efficiency, and customer satisfaction.

For all 4 of last year's team goals, full automators were much more likely than non-automators to perform at or above goals for operational efficiency, as well as security and network product or service quality. Such higher performance enabled network teams reach the ultimate goal of the IT team: meet or exceed expectations for customer or stakeholders – their users. Thus, more mature automators provide a higher level of application and user experience, so IT is true partner with the business to contribute to its overall success.

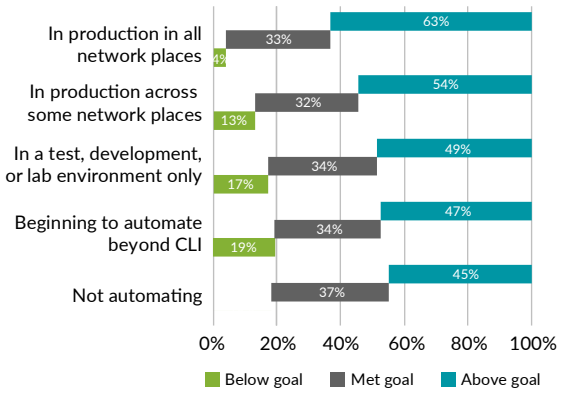
Security Product or Service Quality



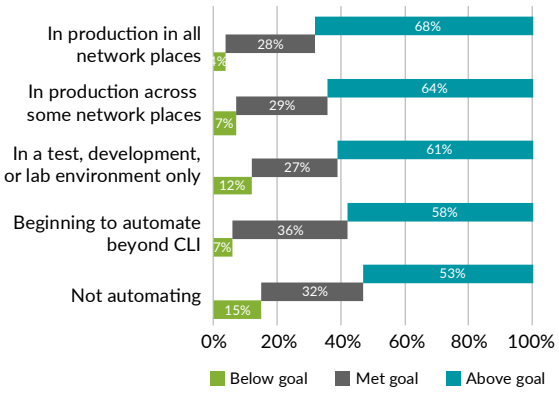
Network Product or Service Quality



Operational Efficiency



Customer or Stakeholder Satisfaction



Donal on Reaching for Greater Network Automation

Automation has a long historical arc and its trajectory will continue to stretch far into the future. The most interesting aspect in this report for me is the challenge of how to move from the innate human fear of making mistakes, to a culture of psychological safety that supports continuous improvement. The real business benefits of automation are undeniable but unlocking an individual or team so they can accelerate their learning and have a greater impact through automation is key.

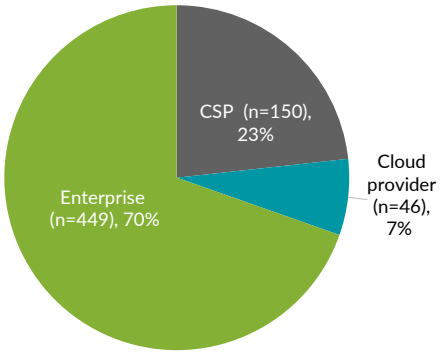
Overall, the more a network is automated, the more changes that are made to the primary network service. This speaks to a newfound velocity and agility that correlates with an organization's automation maturity level. Once a tipping point is reached, there's an intrinsic organizational confidence and capability to move faster (and more reliably). Services evolve more quickly due to increased feature velocity and any resultant bugs, incidents, or problems are squashed evermore rapidly along the way.

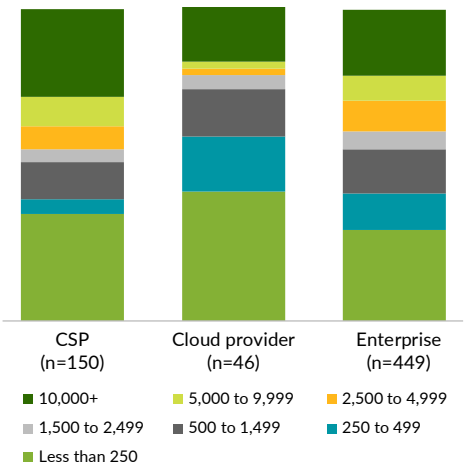
Removing the blockers and challenges to automation is non-trivial, but some are easier than others. Culture itself is an amorphous entity, a distributed network operating system with shared states and feedback loops fed by everyone. By providing the time and targeted training for individuals and teams to up-skill on automation, especially in low-risk and frictionless environments, organizations can reap the rewards.

An initial goal of greater observability, both pre and post network changes, can increase your situational awareness and provide a safe stepping stone on the next hop of your automation journey. In this marathon, there are very few shortcuts.

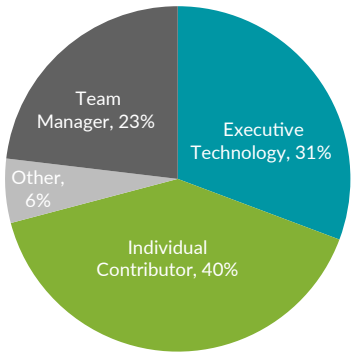
Appendix: Demographics and Methodology

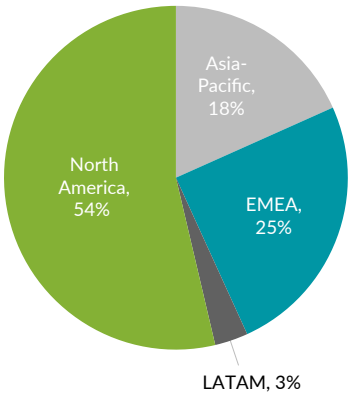
A mix of segments and organizations

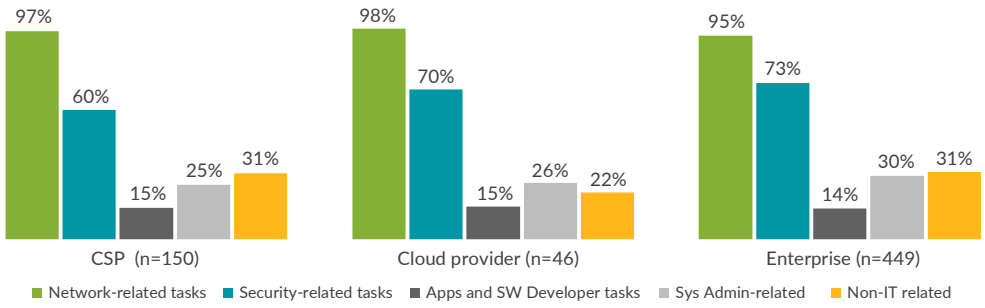




A mix of levels, skills used on the job, and regions







Methodology: The sample of 645 respondents was collected via a web survey from February 24 to March 24. 2020. Respondents were recruited using internal Juniper customers and prospects using its social media, email and community channels.

THE AUTOMATION JOURNEY

The challenge lies not only in knowing where to go, but how to get there.

Automation has become imperative to modern network operations. You need it within the products you use to build your network to make it more autonomous. It's also critical to enabling reliability in your network operations processes. But not everyone knows how to get started with automation, how to set long- and short-term goals for achieving it, and how to measure success.

Getting there certainly raises technical challenges that organizations must address. Equally important, however, are changes in processes, skill sets, and culture. All three areas—people, process and technology—must evolve in parallel to accomplish the ultimate automation goal, a more reliable network infrastructure, and such secondary goals as speed, efficiency, and agility.

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