Perspective

End-to-end automation: opportunities, challenges and the state of deployment

April 2023

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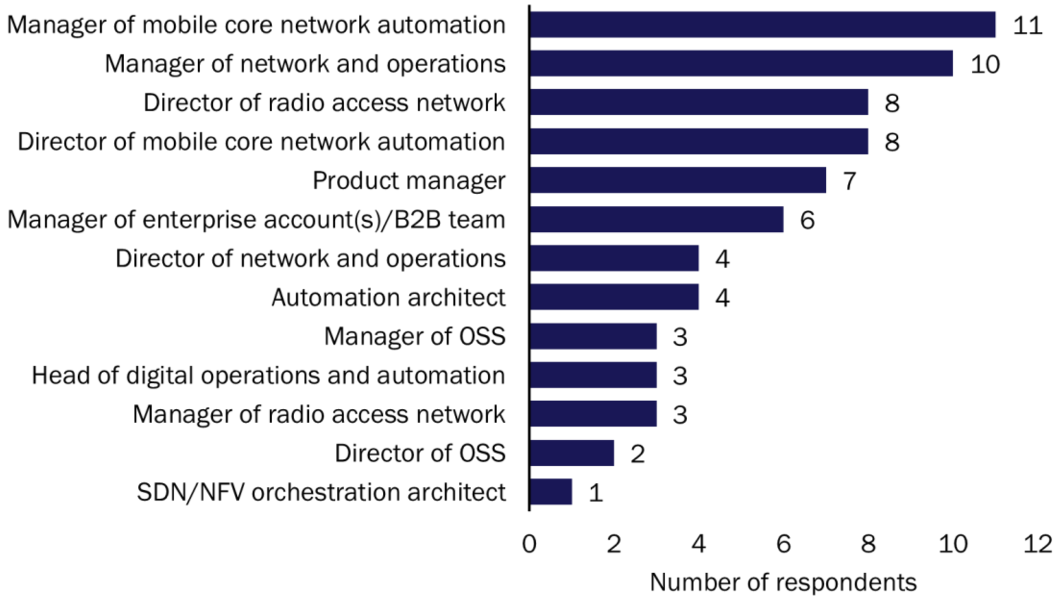
1. Executive summary

Automation has been a strategic focus for communications service providers (CSPs) for many years in order to improve operational efficiency, offer higher-quality services and reduce the time to market for new services. 5G deployments have acted as a catalyst for the acceleration of automation due to their requirements for cloud-native and microservices-based development, software-defined and highly-virtualised network architecture and new services that support the Industry 4.0 era and other advanced use cases. Extreme network automation is also required when adopting open and disaggregated RAN architecture to reduce the cost of integration across multi-vendor environments using standardised, open and interoperable interfaces. All of these factors mean that CSPs must increase their levels of automation to be able to realise new revenue opportunities such as network slicing, software-defined networking (SDN) and cost savings using network function virtualisation (NFV).

Analysys Mason conducted a study in October 2022 to assess the current state of CSPs' automation journeys. This paper provides in-depth analysis of the results of the study, which comprised a survey of 70 Tier-1 and Tier-2 CSPs worldwide (Figure 1.1 and Figure 1.2),[1] interviews with a subset of 10 CSPs and Analysys Mason's existing network automation and orchestration research. The study focused on areas relating to CSPs' automation initiatives such as the challenges, benefits, financial impacts, use case priorities, deployment timelines and key performance indicators (KPIs) for multiple end-to-end processes including the process from network planning to building virtual infrastructure, that from designing a service to building it and the processes from ordering to activating, from problem to resolution and from termination to confirmation.

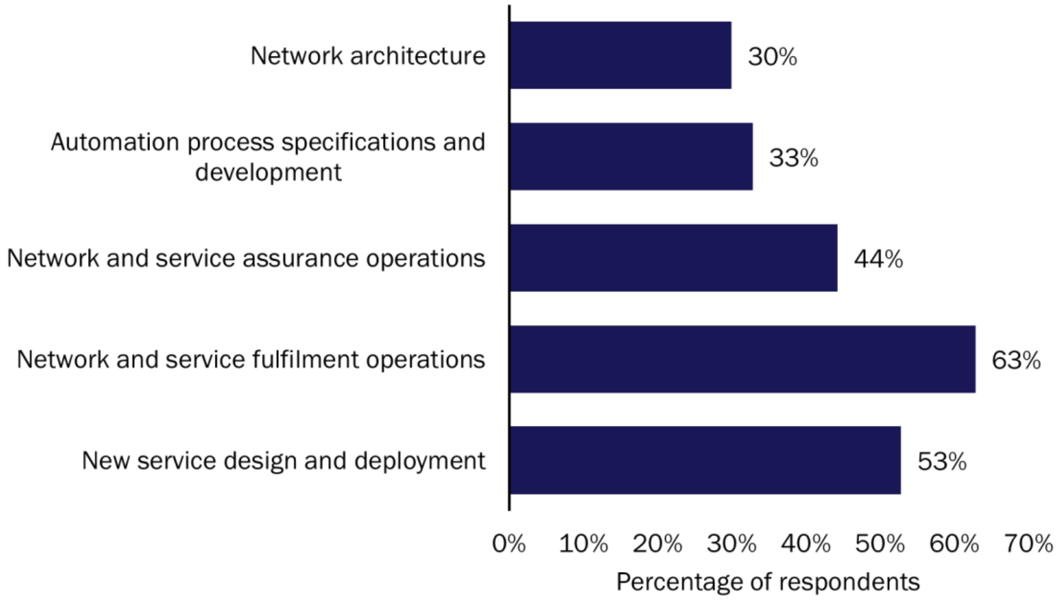
1 Respondents' specialities are the core network (57%), fixed access (56%), the transport network (34%), the RAN (21%) and edge networks (16%). Their products and services are tailored to the B2B (36%), B2C (9%) and both the B2B and the B2C (56%) markets.

Figure 1.1: Job titles of the survey respondents, worldwide, 2022[2]



Source: Analysys Mason

Figure 1.2: Responsibilities held by the survey respondents, worldwide, 2022[3]



Source: Analysys Mason

The key findings from our survey are as follows.

- The four main drivers of automation are cost avoidance (53%), shorter time to launch new services (43%), new revenue creation (41%) and improving operational accuracy (41%). This shows that CSPs are currently

2 Question: "What is your job title?"; *n* = 70.

3 Question: "Do you have any responsibility for the following areas?"; *n* = 70.

placing a stronger emphasis on using automation to address financial and operational challenges than to enhance the customer experience, because improving the Net Promoter Score (NPS) is ranked as the fifth most important driver (39%).

- The biggest challenges that CSPs are using automation to tackle are overcoming the complexities of a microservices-based 5G core to deploy 5G standalone (34%), simplifying workloads to accelerate 5G roll-out (24%) and eliminating the high costs associated with deploying Open RAN (16%). 5G standalone has complex network requirements (in terms of connection density, rate, latency and reliability), which requires a high level of workload automation. Vendors must re-engineer their portfolios around microservices-based infrastructure, containerised workloads and orchestration solutions to support new 5G use cases. CSPs and vendors must work closely together to deploy pilot vRAN and ORAN sites, and should develop advanced orchestration and automation solutions for the virtualisation of the RAN.

- A lack of technology maturity (46%), change management (46%) and a lack of the right skillsets (39%) were cited as the top three challenges faced by CSPs on their automation journeys. CSPs must invest in the research and development of new automation technologies (SDN/NFV, network slicing and edge compute) and should consider organisational changes to enable them to embrace new industry standards and architecture frameworks. They should also reskill their workforces to ensure that they have the requisite software engineering skills to advance in their automation journeys.

- 70% of respondents agreed that it is beneficial if assurance and orchestration processes are integrated by the same vendor, while 11% of CSPs disagreed. 19% are still unsure. We predict that most CSPs will continue to scale up their single-vendor virtualised network function (VNF) orchestrators, and vendors must ensure that they continue to advance their automation and orchestration solutions for NFV-based services.

- 61% of the surveyed CSPs expect that a vendor-agnostic, zero-touch automation solution with service modelling will help to resolve most of their automation-related challenges. CSPs are looking to adopt new operating models that are built on a multi-vendor strategy and that enable greater agility and flexibility through the use of best-of-breed products and applications. An automation solution that enables vendor-agnostic service lifecycle management and can orchestrate all the exposed network applications and resources to provision, manage and control services on demand will help to accelerate CSPs' automation goals.

- The process for which deploying automation has the greatest financial impact (ranked in the top two) is service design to build (53%), followed by network plan to build virtual infrastructure (48%), problem to resolution (47%), order to activate (33%) and termination to confirmation (19%). Vendors must ensure that they continue to improve their automation credentials by offering a service and network automation and orchestration solution that covers all aspects of service lifecycle management (testing, onboarding, monitoring and operation) and network planning and design.

- 70% of CSPs have already started to automate their assurance and orchestration functions. 20% have plans to begin their automation journeys in the next 12 months and the remainder have no plans for automation. CSPs that have already begun their automation journeys have a long way to go until they achieve fully autonomous networks with closed-loop operations. There are likely to be many partially automated processes across the entire service lifecycle whereby manual processes are supported but not entirely replaced.

2. Automation is critical to ensuring success in the 5G era

Next-generation 5G networks are causing existing operations models to become unsustainable because management tools are not able to support new technologies, new service types, the higher cadence of network and service changes and the demands for rapid self-service delivery. Established systems will therefore require manual intervention from technicians unless automations are implemented. The ability to automate both the network and services will enable CSPs to rapidly launch and support next-generation service offerings at scale, thereby providing the foundation for the digital transformation of enterprises across various industries. As such, CSPs are working towards enabling a high degree of automation and zero-touch management throughout all phases of the network and service lifecycle.

- **Network plan to build virtual infrastructure.** The network plan and build stage covers operational processes such as project management, surveying, designing, planning, estimation, partner and supplier management and implementation.

- **Service design to build.** This process deals with all the activities related to the launch of a new product/service and the retirement of an old product/service. An idea for a new product or service must be transformed into a ready-to-sell entity with process flows, integrations, tariffs and assurance.

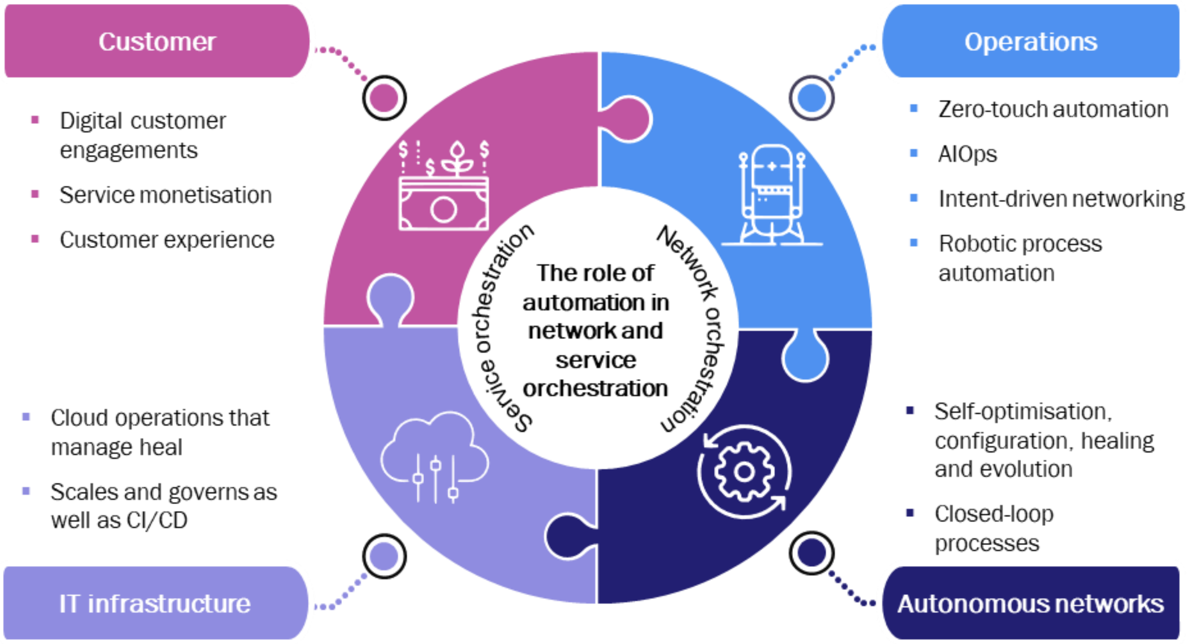
- **Order to activate.** This process takes a customer order and implements it in the network and other infrastructure. It also supports service testing prior to going live and informs customers of any change in the status of their order.

- **Problem to resolution.** This process deals with activities that allow a problem raised by a customer or technical support team to be solved. It also addresses problems that are proactively identified internally, even before the customer or service is affected.

- **Termination to confirmation.** This process deals with all the activities related to the execution of a customer’s termination request. It also involves activities that can prevent customers from terminating.

Network automation eliminates the manual tasks that are associated with the configuration, management, operations and lifecycle of network services and enables autonomous operations. Service automation involves the use of continuous integration/continuous delivery (CI/CD) tools to automate and monitor the lifecycle of apps, from the integration and testing phases to delivery and deployment. Figure 2.1 describes how the role of automation in network and service orchestration supports CSPs in deploying end-to-end automation to deliver differentiated 5G services in an agile and scalable manner, reduce the time to revenue and improve operational efficiency.

Figure 2.1: The role of automation in network and service orchestration

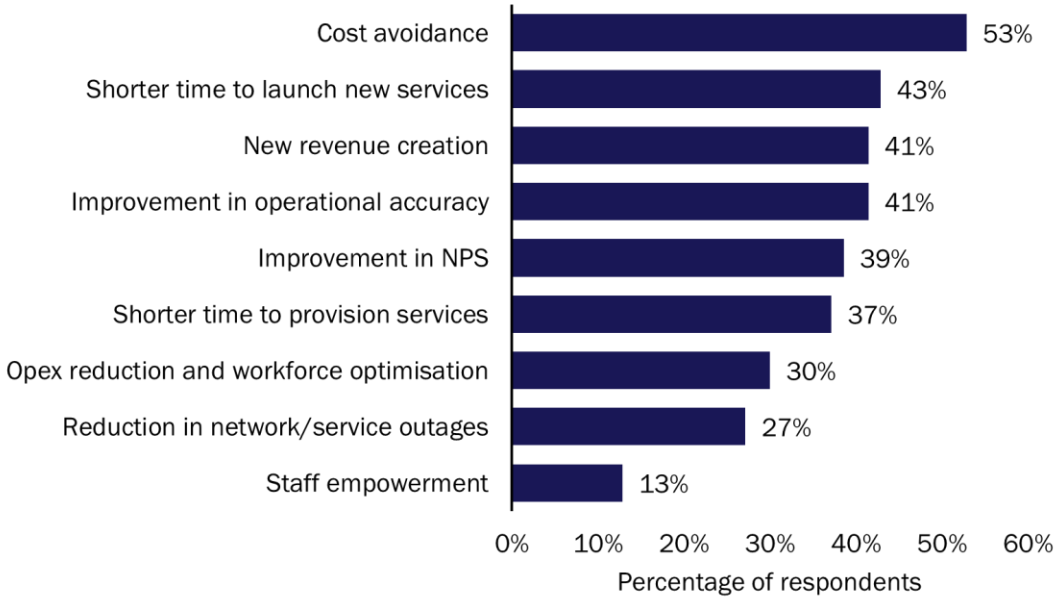


Source: Analysys Mason

2.1 Key drivers of automation

CSPs' success in the 5G era will be defined by their ability to launch and operationalise new digital services in an agile and cost-effective manner. The existing telecoms operational model is not fit for purpose for the 5G era because business processes such as network design and planning, network roll-out and provisioning, assurance, operations and maintenance are highly disjointed and often require manual interventions and manual inter-departmental handovers. This results in high opex and limited service agility. As such, the key drivers of automation are cost avoidance, new revenue creation and an improvement in operational accuracy (Figure 2.2).

Figure 2.2: Factors driving CSPs' automation initiatives, worldwide, 2022[4]



Source: Analysys Mason

Cost avoidance

CSPs are under pressure to significantly reduce their operational costs because traditional methods of operating the network and service lifecycle are costly and inefficient. The shift to 5G standalone (SA) networks, which involves a more-radical change of architecture than is needed for 5G non-standalone (NSA) networks, carries a huge potential cost for CSPs, many of which are not yet clear about how to monetise these networks. The desire to avoid additional costs is reflected in our survey results; more than 56% of respondents identified cost avoidance as the biggest commercial driver of automation. Cost avoidance is also the most important driver for CSPs in North America.

New revenue creation

The emergence of advanced 5G network capabilities (network slicing, low latency and ultra-reliable connectivity) creates the potential for new revenue opportunities in the enterprise segment. However, a high degree of automation is required to scale up the monetisation and delivery of these new digital experiences and advanced B2B services to digital-native customers. Indeed, 42% of respondents cited new revenue creation as a key driver of automation. New revenue creation is also the most important driver for CSPs in developed Asia–Pacific (DVAP).

Improvement in operational accuracy

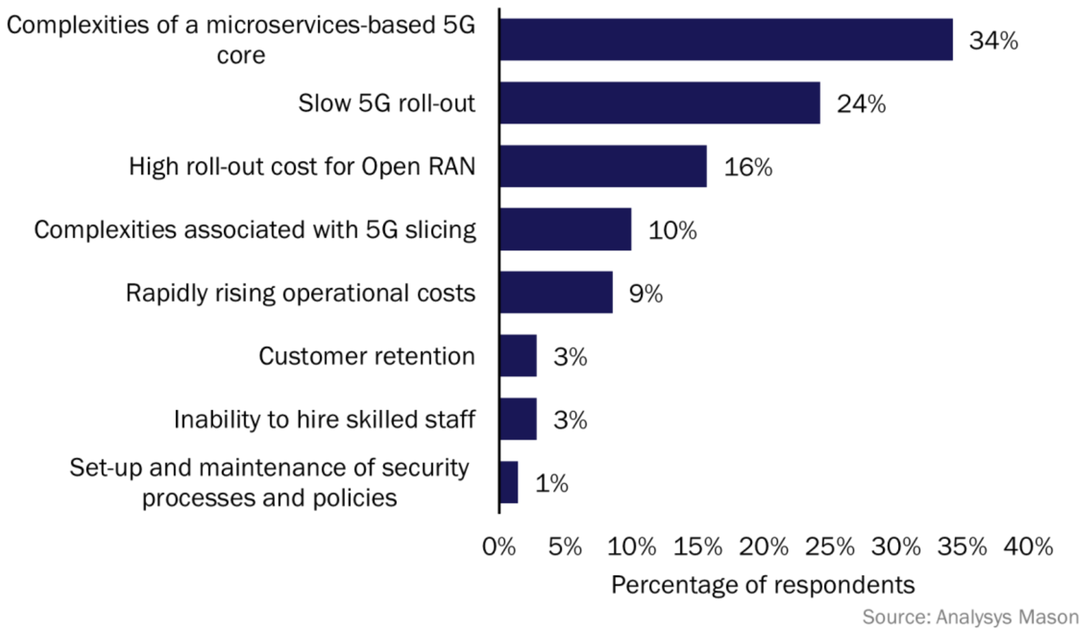
CSPs are deploying closed-loop automation to reduce the number of errors introduced during service fulfilment processes. This is particularly important for service modifications, which typically require network operations staff to manually delete the service and provision a new version with a modified configuration. The remote and automated monitoring, troubleshooting, configuration and optimisation of network resources and service lifecycles will enable greater efficiency in network operations and ensure a high quality of service (QoS). 41% of respondents in our survey cited improving operational accuracy as a key driver of automation.

4 Question: "What is driving your automation initiatives?"; *n* = 70.

2.2 Automation will help CSPs to tackle the complexities of 5G

5G network deployments require a new generation of orchestration technologies and CSPs will need new automation capabilities to overcome the complexities of deploying, operating and configuring 5G networks to support new use cases. The top three challenges that CSPs are using automation to address are overcoming the complexities of a microservices-based 5G core to deploy 5G SA, simplifying the exponential growth in workloads associated with 5G roll-outs and eliminating the high costs associated with deploying Open RAN (Figure 2.3). CSPs are evaluating new approaches to network and service automation to ensure that they remain competitive. They are also using automation to reduce the need for manual interventions so that they can both respond more quickly to new service orders, modifications and network issues and provide real-time experiences.

Figure 2.3 Top challenges that CSPs are using automation to overcome, worldwide, 2022[5]



5G SA

The number of 5G mobile network deployments grew considerably in 2022, and many more launches are scheduled for 2023. Some of these are expected to use 5G SA architecture. CSPs are increasingly keen to showcase their credentials in terms of both the coverage and the architecture of the network that they are deploying. They are accelerating their shift to SA networks (which support the full range of 5G capabilities) as the need to deliver a fully 5G experience to end users becomes more compelling. However, rearchitecting the 5G core to be fully cloud-native and independent of 4G will increase the complexity of the 5G architecture, so zero-touch end-to-end network automation needs to be employed in order to scale 5G SA deployments.

Open RAN

CSPs that wish to deploy the Open RAN can benefit from new control and management architecture to enable the fine-grained programmatic control of RAN resources based on evolving network conditions and to deliver a range of use cases with various requirements for QoS, network performance, service-level agreements (SLAs)

5 Question: "Which are the top 3 challenges you are trying to tackle using automation?"; *n* =70.

and latency. The RAN intelligent controller (RIC) gives CSPs the ability to control and manage RAN resources at a more granular level and enables RAN automation that is more intelligent and use-case-driven .

Network slicing

5G enables new technologies such as network slicing. Network slicing in turn enables networks to be partitioned into multiple isolated, virtual network slices with unique characteristics (in terms of quality of service, latency and bandwidth) that are specific to the requirements of the service supported. 5G network slicing is a key enabler for CSPs to efficiently manage network resources and offer differentiated SLA-based services to improve service agility. 5G network slicing requires advanced orchestration solutions that can work across domains and vendors, as well as automation solutions that can create, deploy and manage slices at scale.

> *"The motivation here is to look from the virtualisation and cloudification perspective. The relationship is very complex once you know CNFs' and VNFs' looks and perceptions. So, how we can manage this complex architecture of CNFs and VNFs? The solution is automatic orchestration. We have an opportunity to progress considerably and automate the operations of CNFs and VNFs.*
>
> ***Senior Product Manager/Lead – Design & Architecture, Tier-1 CSP, UK***

3. What is the state of CSPs' closed-loop automation deployments today?

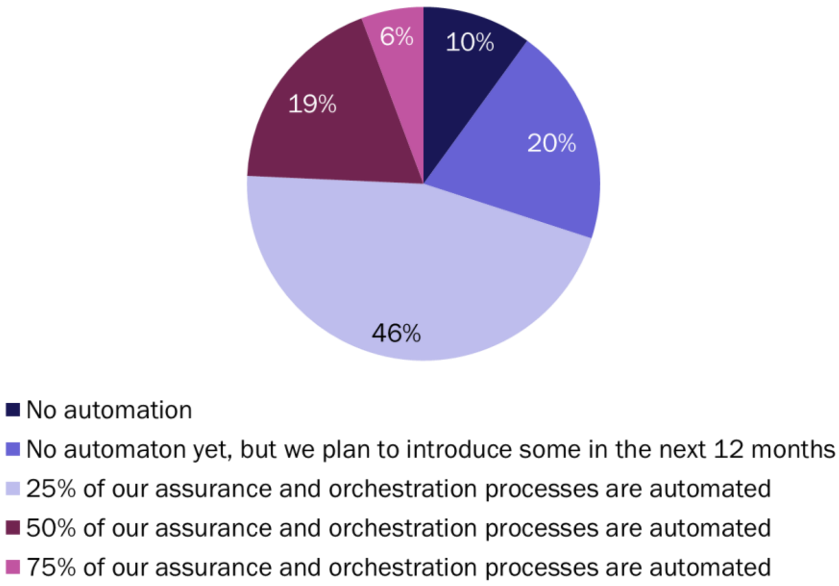
3.1 Who is in charge?

The majority of CSPs' automation projects are currently led by CIO teams (36%), followed by CTO (33%) and CMO (30%) teams. Respondents to our survey reported that automation is more of an IT issue than a networking operations issue. Indeed, 77% of respondents reported that their IT department is the most involved in their automation initiatives.

3.2 Level of automation

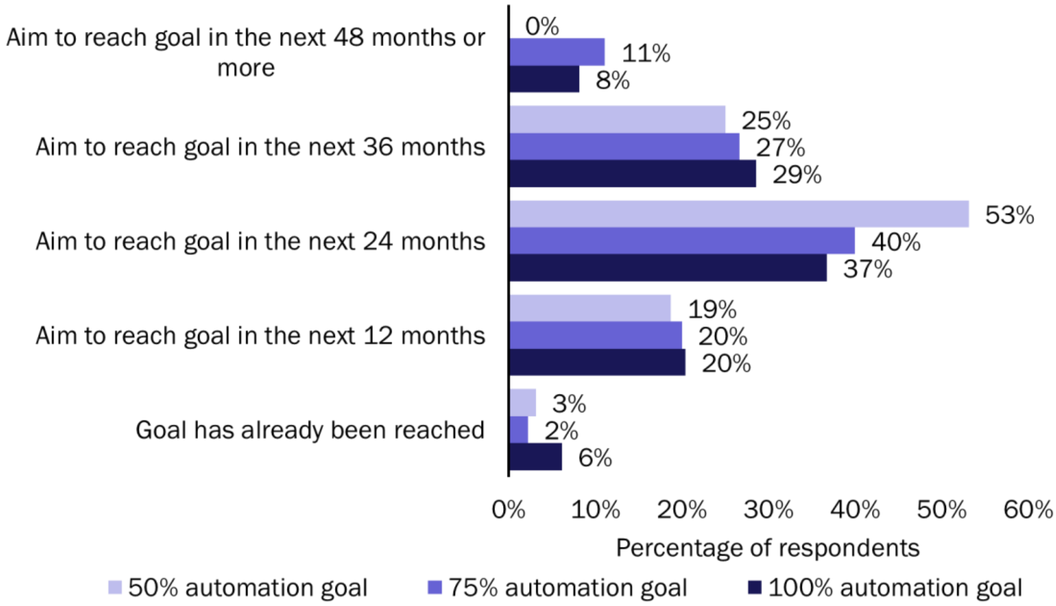
46% of respondents have automated 25% of their assurance and orchestration functions (Figure 3.1), but almost all plan to increase their level of automation (Figure 3.2).

Figure 3.1: CSPs' current automation levels for their assurance and orchestration processes, worldwide, 2022[6]



Source: Analysys Mason

Figure 3.2: CSPs' future plans for automation, worldwide, 2022[7]



Source: Analysys Mason

6 Question: "How far have you automated your assurance and orchestration functions (closed-loop orchestration)?"; *n* = 70.

7 Question: "Do you plan to increase further the degree of automation for your assurance and orchestration functions (closed-loop orchestration)?"; *n* = 70.

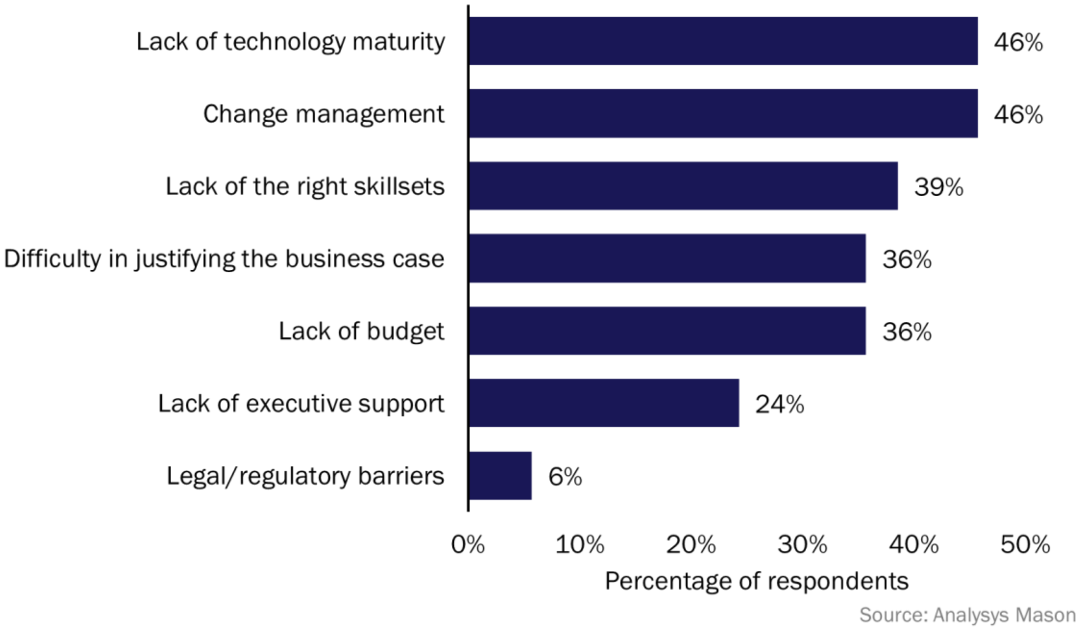
"It is going to be on the top at the group CTO level to update the strategic plan [for CSPs' automation journeys], and then each entity will have to take that into consideration; we are still on trying to catch up, for example, on the tools in the CI/CD chain and what we're going to use to propose or suggest and offer commonalities."

Director of IT/Network Strategy and Transformation for the Middle East and Africa, Tier-1 CSP, Europe

3.3 Challenges

CSPs still face challenges to deploying end-to-end network automation due to the difficulties in orchestrating network functions. Internal issues, both cultural and technological, are the key barriers to the widespread adoption of automation solutions. Respondents cited a lack of technology maturity (46%), change management (46%) and a lack of the right skillsets (39%) as the top three challenges that they face on their automation journeys (Figure 3.3).

Figure 3.3: CSPs' main challenges to achieving their automation goals, worldwide, 2022[8]



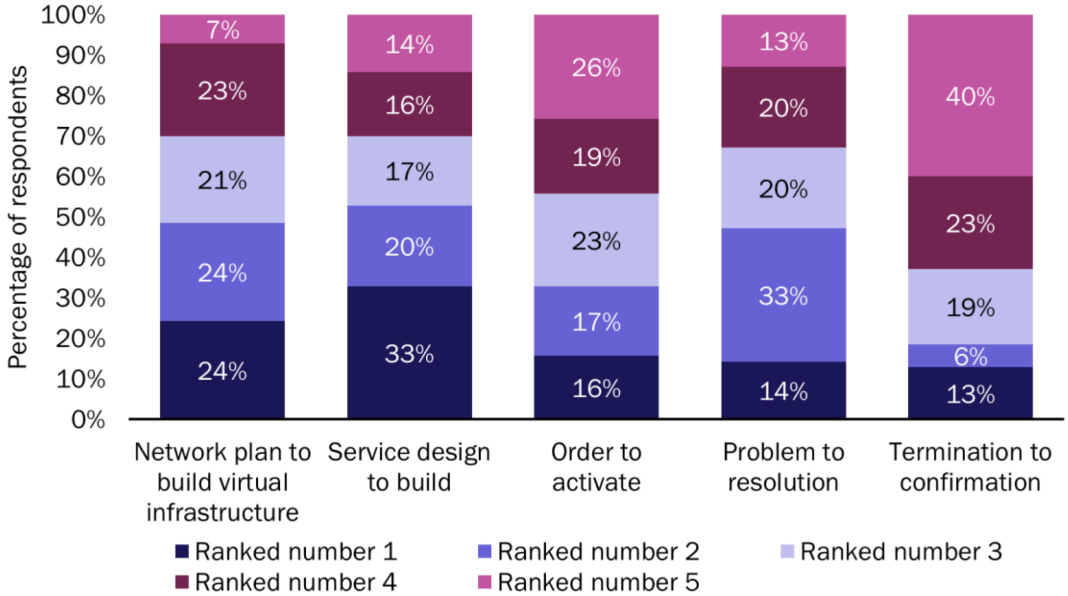
Organisational resistance to change is the most significant barrier to deploying automation. This implies that respondents feel that their organisations will resist changes despite them being beneficial. CSPs also lack the technology maturity and in-house technical expertise and skillsets required to implement automation solutions that comply with the latest software engineering paradigms such as container- and microservices-based development for cloud deployment and agile principles such as DevOps and CI/CD pipelines. Furthermore, CSPs' current IT systems and network infrastructure are highly customised and built upon silos, and processes such as network design, planning, fulfilment, assurance and operations are highly disjointed, thereby often requiring manual interventions and manual interdepartmental handovers.

8 Question: "What are the main challenges you expect to face/are facing in achieving your automation end goal?"; *n* = 70.

3.4 Financial impact

Respondents were asked to rank network and service lifecycle processes in terms of the financial impact of the deployment of automation solutions (Figure 3.4). Service design to build was ranked in the top two by 53% of respondents; this is the largest share for any process. This was followed by network plan to build virtual infrastructure (48%), problem to resolution (47%), order to activate (33%) and termination to confirmation (19%).

Figure 3.4: Ranking of network and service lifecycle processes in terms of the financial impact of the deployment of automation solutions, worldwide, 2022[9]



Source: Analysys Mason

"Making a payment depends on the mediation role. The mediation role is about USD1 million. Where the RAN5 got to a different level, we are talking about USD300 million last year, because the department of the whole cell size infrastructure, and the core network is about USD200 million plus programmes and the BSS is about USD50 million. Even some of the programs, for example, some of the OSS tools, had no network, and they were as small as, for example, USD800 000 or less than USD1 million. The automation mandate was spread across various programs, then how much they can invest all of that for the automation part will be quite lenient. In about 2 years, we should save about USD40 million."

Senior Product Manager/Lead – Design & Architecture, Tier-1 CSP, UK

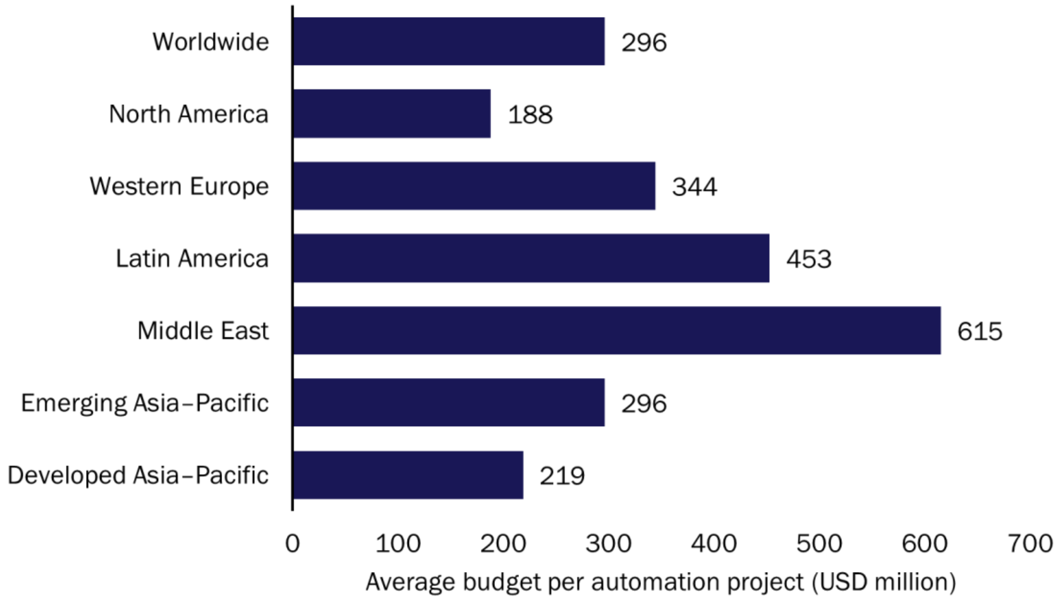
3.5 Budget allocation

Most of the CSPs surveyed reported that automation projects account for 21–30% of their operations budget, and that they had carried out 31–40 automation projects in the past 3 years. CSPs tend to allocate most of their budgets to in-house teams or managed services providers when implementing automation solutions. Indeed, 35% of CSPs' automation budgets are allocated to in-house teams, followed by managed service providers

9 Question: "Please rank the following processes (please refer to the process diagram) in terms of greatest financial impacts brought about by the deployment of automation solutions for your business"; *n* = 70.

(18%), prime system integrators (16%), key network equipment providers (14%), OSS vendors (12%) and others (5%). Our survey results also show that CSPs from the Middle East have the highest average budget per automation project, followed by those in Latin America and Western Europe (Figure 3.5).

Figure 3.5: Average budget per automation project, by region, worldwide, 2022[10]



Source: Analysys Mason

3.6 Technology and vendor selection

CSPs have an overwhelming preference to use components from a single vendor. Indeed, 70% of respondents agreed that it is beneficial if assurance and orchestration processes are integrated by the same vendor, 11% disagreed and 19% are still unsure. Most CSPs are currently deploying single-vendor VNF orchestrators.

Network disaggregation will enable CSPs to move away from the traditional operating model and take a multi-vendor strategy that offers the ability to select best-of-breed products and applications. 61% of CSPs believe that a vendor-agnostic, zero-touch automation solution with service modelling will resolve most of their automation-related challenges.

4. Measuring the success of automation

4.1 KPI categories

CSPs are using various KPIs to monitor their network performance and QoS as a result of deploying automation solutions. These KPIs can be split into the following categories.

10 Question: "What region is your organisation's headquarters located in?"; *n* = 70.

- **Time taken.** Using automation to reduce the time taken to complete a process will help to decrease costs due to the reduction in the number of time-consuming, manual processes. Further advantages of lowering the time taken to complete a process include a decrease in backlogs (including for orders and payments) and improvements to customer satisfaction.

- **Reliability.** This refers to the ability of a system or component to perform its required functions under stated conditions for a specific period of time. Increasing reliability will help to reduce the costs associated with maintenance and manual intervention.

- **Capacity.** This is a measure of the actual output of a process compared to its potential maximum output. Automation will enable processes to be executed at scale. For example, whole network equipment upgrades could be carried out in one go.

- **Integrity.** This involves measuring the quality of the network, throughput and latency, making improvements and ensuring that SLAs are met.

"For KPIs, we have about five categories. Accessibility, reliability and sustainability are the major ones for the service department. The other two categories are accountability for postal service deployment and functions. Service provisioning mainly involves accountability, accessibility, reliability and sustainability. For the fault automation part, you are mainly concerned about how to deploy and set up those KPIs automatically, largely for zero-touch provisioning. Integrating APIs and VNFs based on different cloud platforms is a major challenge because each vendor has its own interfaces, the APIs and their own VNF-like container design. They need to have good interoperability on different platforms, which is another challenge."

Principal RAN Engineer, Tier-1 CSP, USA

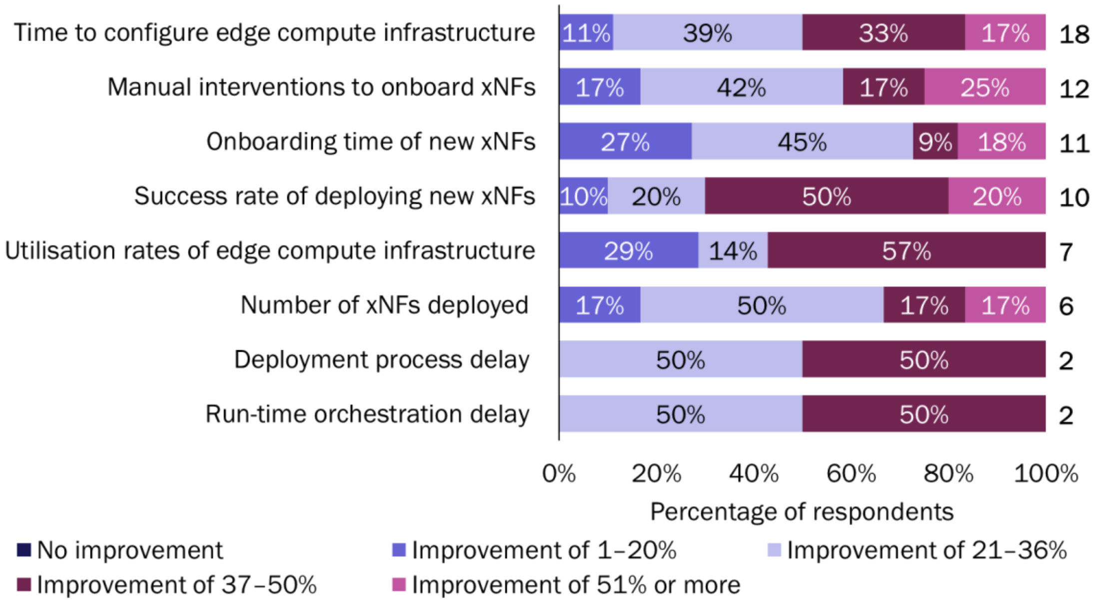
4.2 KPIs for end-to-end automation processes

Network plan to build virtual infrastructure

Network lifecycle management involves the provisioning and upgrade of network equipment and can be highly automated. Indeed, many CSPs are already in the process of automating such processes; basic use cases include network site planning, network resource optimisation, data correlation and network troubleshooting and configuration.

The time to configure edge compute infrastructure is the most commonly used KPI to measure the success of automation during the network plan to build virtual infrastructure process. 39% of the respondents that ranked this KPI as one of their two top KPIs for the network plan to build virtual infrastructure process have seen an improvement of 21–36% since 2020 (Figure 4.1), and 44% expect to see a 37–50% improvement in the next 24 months (Figure 4.2). The number of manual interventions required to onboard new VNFs and CNFs was the second-most-popular KPI to measure the success of automation in the network plan to build virtual infrastructure process. 42% of the respondents that ranked this KPI as one of their two top KPIs for the network plan to build virtual infrastructure process have seen an improvement of 21–36% since 2020, and 25% have seen improvements of 51% or more (Figure 4.1). 58% expect to see a 37–50% improvement in the next 24 months (Figure 4.2). It is noteworthy that the onboarding of xNFs still poses a major challenge more than 10 years since the advent of NFV.

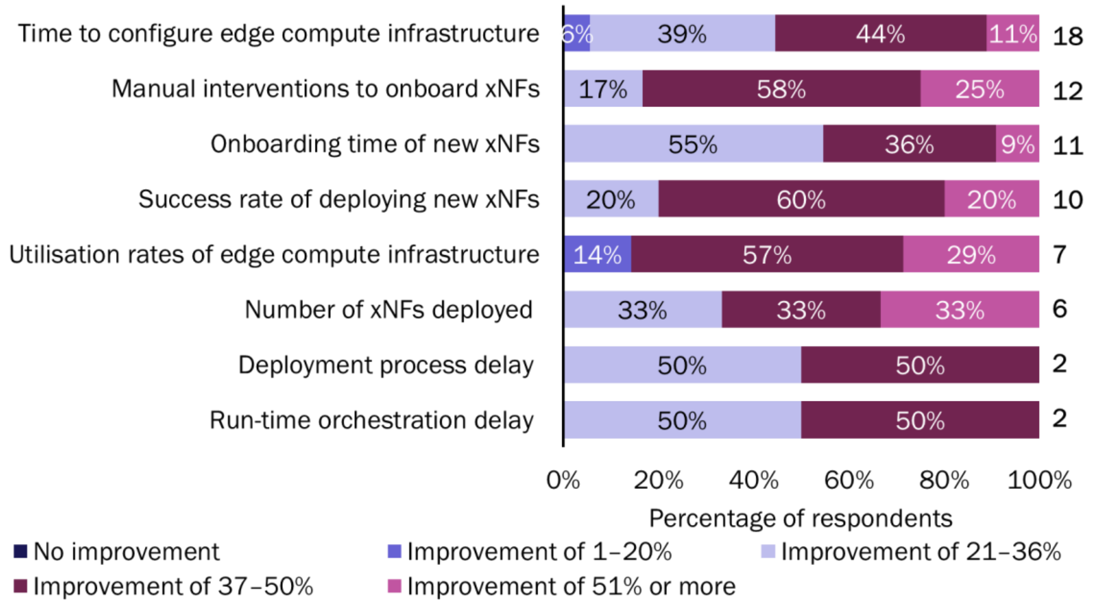
Figure 4.1: Improvements in the KPIs that CSPs rank as one of their top two KPIs for the network plan to build virtual infrastructure process since 2020, worldwide, 2022[11]



Source: Analysys Mason

11 Question: "What KPIs are you using to measure the success of automation in the network plan to build virtual infrastructure process? For your top two KPIs, what result have you observed since 2020?"; *n* = 34. Note that respondents did not spell out whether the edge infrastructure was referring to RAN or vCPE/SDN. Given the current pace of the market development, it is likely that the current focus is on RAN/SDN and in the next 24 months the focus could shift to vCPE.

Figure 4.2: Expected improvements in the KPIs that CSPs rank as one of their top two KPIs for the network plan to build virtual infrastructure process in the next 24 months, worldwide, 2022[12]



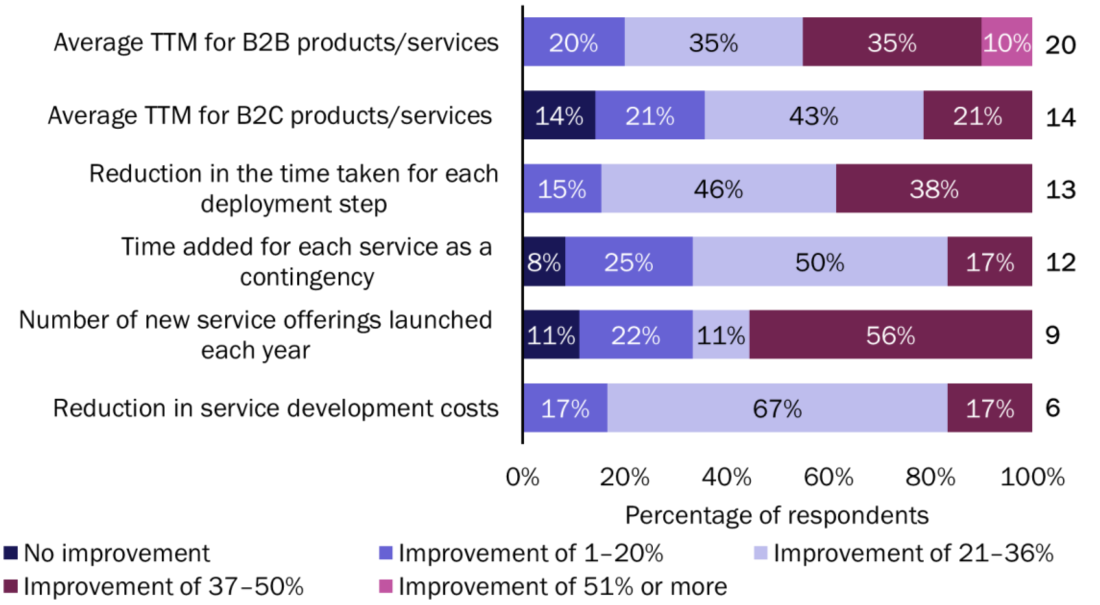
Source: Analysys Mason

Service design to build

The time taken to deliver new services is the most commonly used KPI to measure of the success of automating the service design to build process. Specifically, the average time to market (TTM) for B2B products and services is the most popular KPI for this process. CSPs have seen large improvements in this KPI since 2020 (Figure 4.3), and further improvements are expected over the next 24 months (Figure 4.4). The average TTM for B2C products and services is the second most-popular KPI, but 14% of CSPs that ranked this as one of their top two KPIs for the service design to build process have not seen any improvement in performance since 2020 (Figure 4.3). Nonetheless, more than half of CSPs expect improvements of 37–50% for this KPI in the next 24 months (Figure 4.4).

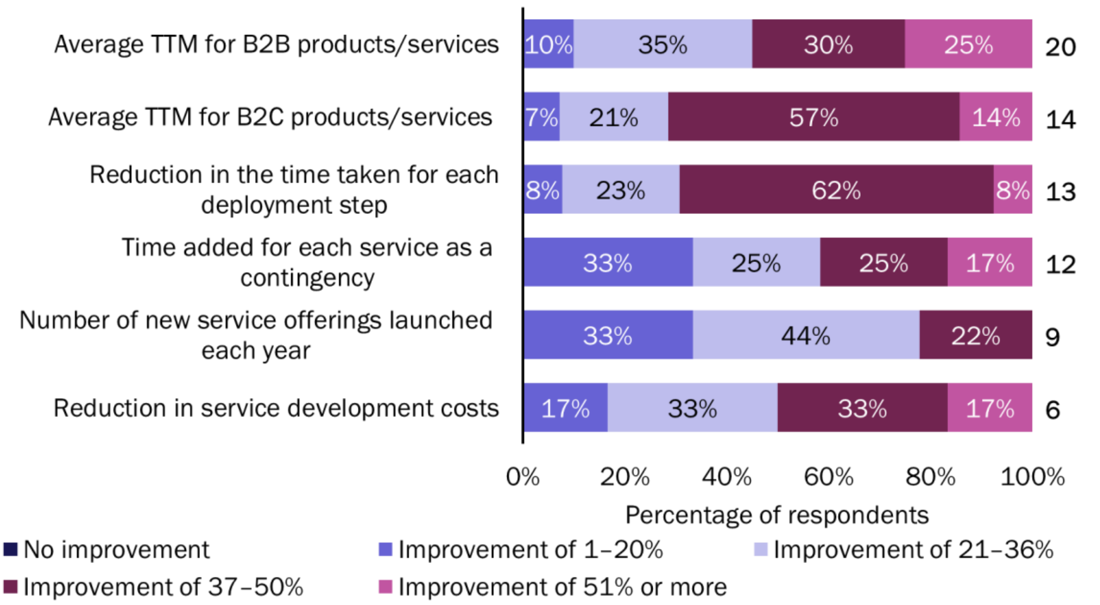
12 Question: "What KPIs are you using to measure the success of automation in the network plan to build virtual infrastructure process? For your top two KPIs, what is your desired goal for the next 24 months?"; n = 34. Note that respondents did not spell out whether the edge infrastructure was referring to RAN or vCPE/SDN. Given the current pace of the market development, it is likely that the current focus is on RAN/SDN and in the next 24 months the focus could shift to vCPE.

Figure 4.3: Improvements in the KPIs that CSPs rank as one of their top two KPIs for the service design to build process since 2020, worldwide, 2022[13]



Source: Analysys Mason

Figure 4.4: Expected improvements in the KPIs that CSPs rank as one of their top two KPIs for the service design to build process in the next 24 months, worldwide, 2022[14]



Source: Analysys Mason

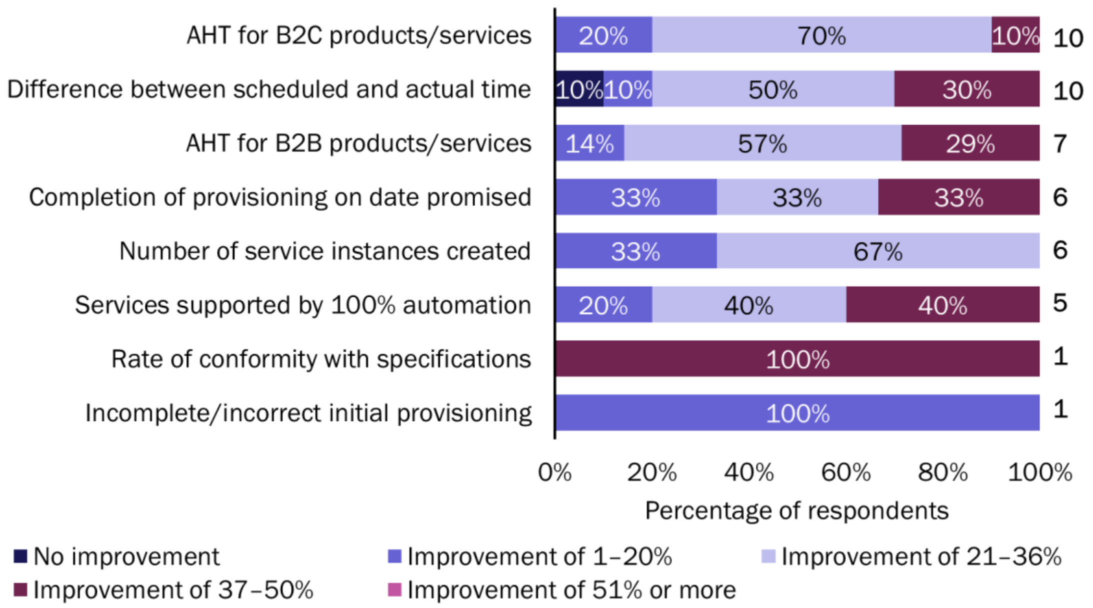
13 Question: "What KPIs are you using to measure the success of automation in the service design to build process? For your top two KPIs, what result have you observed since 2020?"; *n* = 37.

14 Question: "What KPIs are you using to measure the success of automation in the service design to build process? For your top two KPIs, what is your desired goal for the next 24 months?"; *n* = 37.

Order to activate

The average handling time (AHT) for B2C products/services and the difference between the scheduled and actual provisioning time of service instances are the most commonly used KPIs to measure the success of automating the order to activate process. 70% of CSPs that ranked the average handling time for B2C products/services as one of their top two KPIs for the order to activate process have seen a 21–35% improvement in this KPI since 2020 (Figure 4.5), and 60% expect an improvement of 37–50% by 2024 (Figure 4.6).

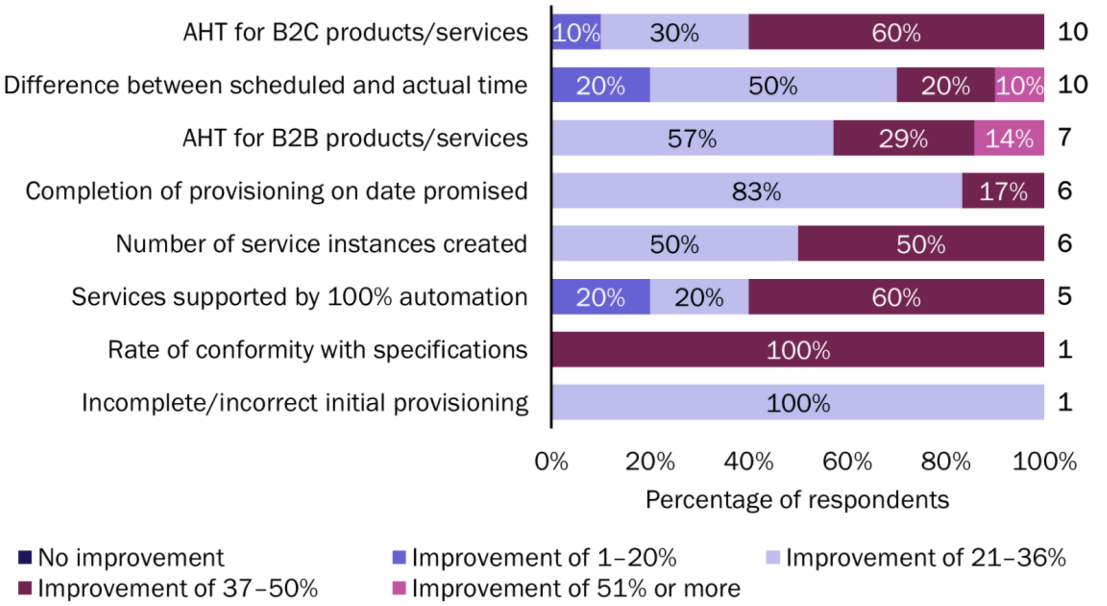
Figure 4.5: Improvements in the KPIs that CSPs rank as one of their top two KPIs for the order to activate process since 2020, worldwide, 2022[15]



Source: Analysys Mason

15 Question: "What KPIs are you using to measure the success of automation in the order to activate process? For your top two KPIs, what result have you observed since 2020?"; *n* = 23.

Figure 4.6: Expected improvements in the KPIs that CSPs rank as one of their top two KPIs for the order to activate process in the next 24 months, worldwide, 2022[16]



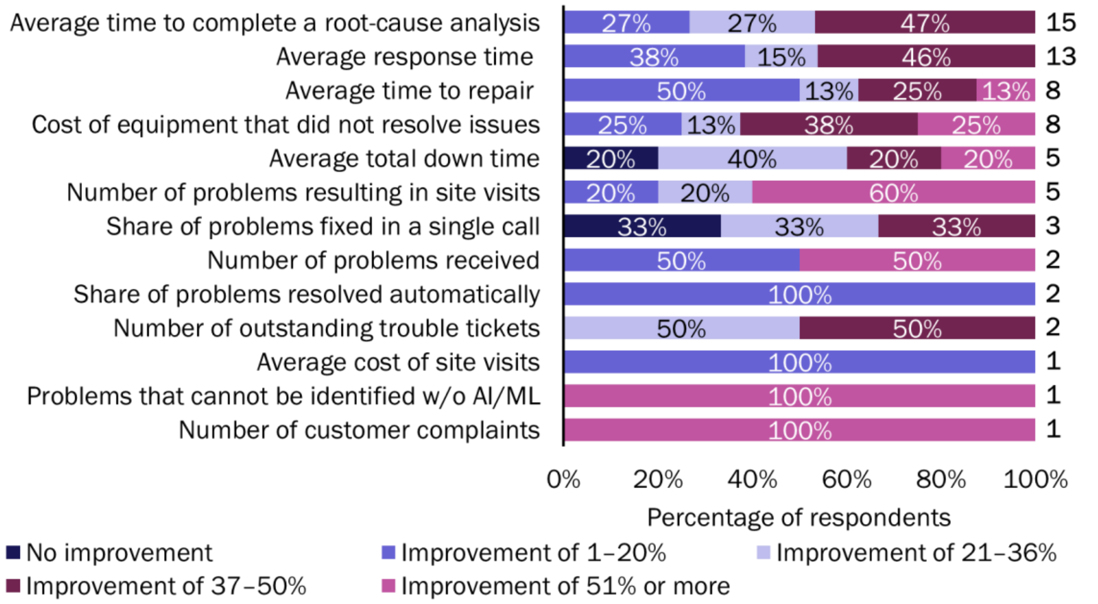
Source: Analysys Mason

Problem to resolution

The average time to complete a root-cause analysis is the most commonly used KPI to measure the success of automating the problem to resolution process, followed by the average response time (the amount of time it takes to provide results to a request by user or customer), and then by both the average time to repair (also referred to as the mean time to resolution) and the average cost of equipment dispatched per service that did not resolve customer issues. CSPs that ranked any of these KPIs as one of their top two KPIs for the problem to resolution process have noted improvements of 1–50% since 2020 (Figure 4.7), but improvements of at least 21–35% and as high as 51% or more are expected in the next 24 months (Figure 4.8).

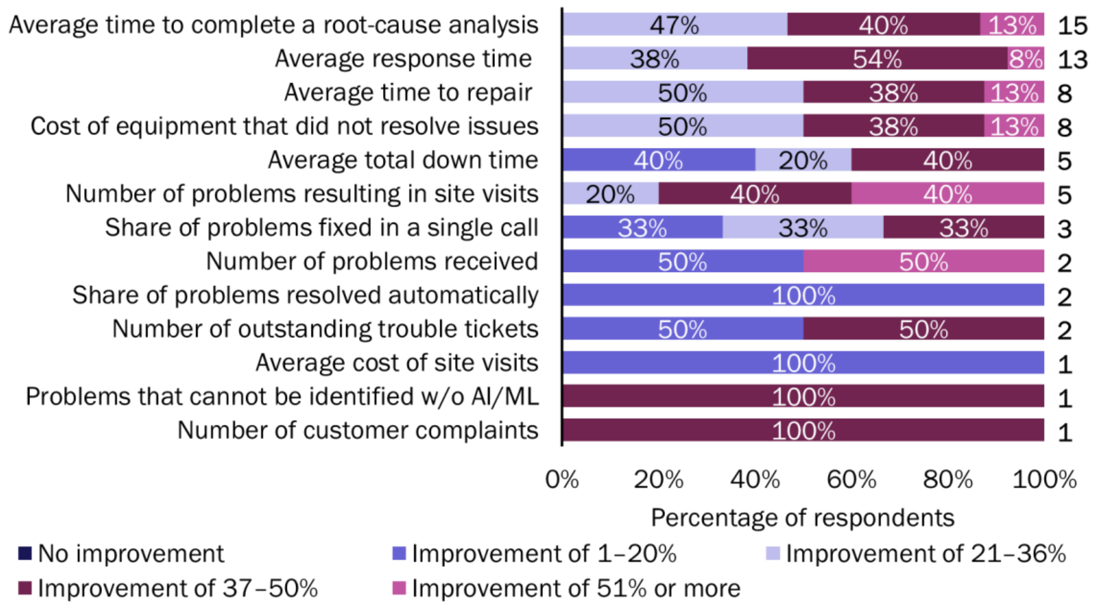
16 Question: "What KPIs are you using to measure the success of automation in the order to activate process? For your top two KPIs, what is your desired goal for the next 24 months?"; *n* = 23.

Figure 4.7: Improvements in the KPIs that CSPs rank as one of their top two KPIs for the problem to resolution process since 2020, worldwide, 2022[17]



Source: Analysys Mason

Figure 4.8: Expected improvements in the KPIs that CSPs rank as one of their top two KPIs for the problem to resolution process in the next 24 months, worldwide, 2022[18]



Source: Analysys Mason

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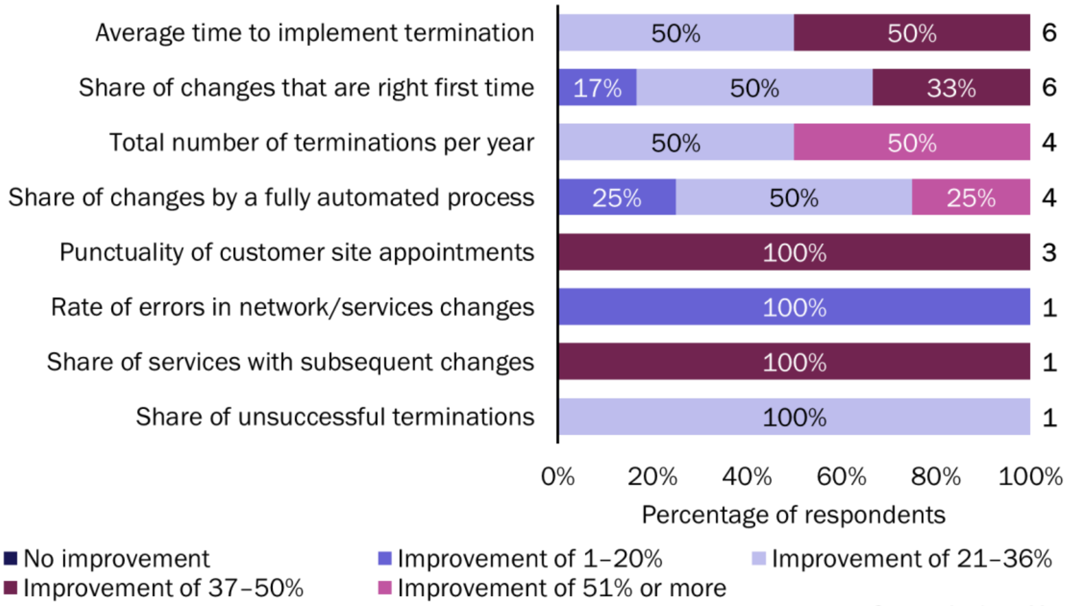
17 Question: "What KPIs are you using to measure the success of automation in the problem to resolution process? For your top two KPIs, what result have you observed since 2020?"; *n* = 33.

18 Question: "What KPIs are you using to measure the success of automation in the problem to resolution process? For your top two KPIs, what is your desired goal for the next 24 months?"; *n* = 33.

Termination to confirmation

Most of the KPIs used to measure the success of automating the termination to confirmation process have shown significant improvements since 2020 (Figure 4.9) and are expected to improve further in the next 24 months (Figure 4.10).

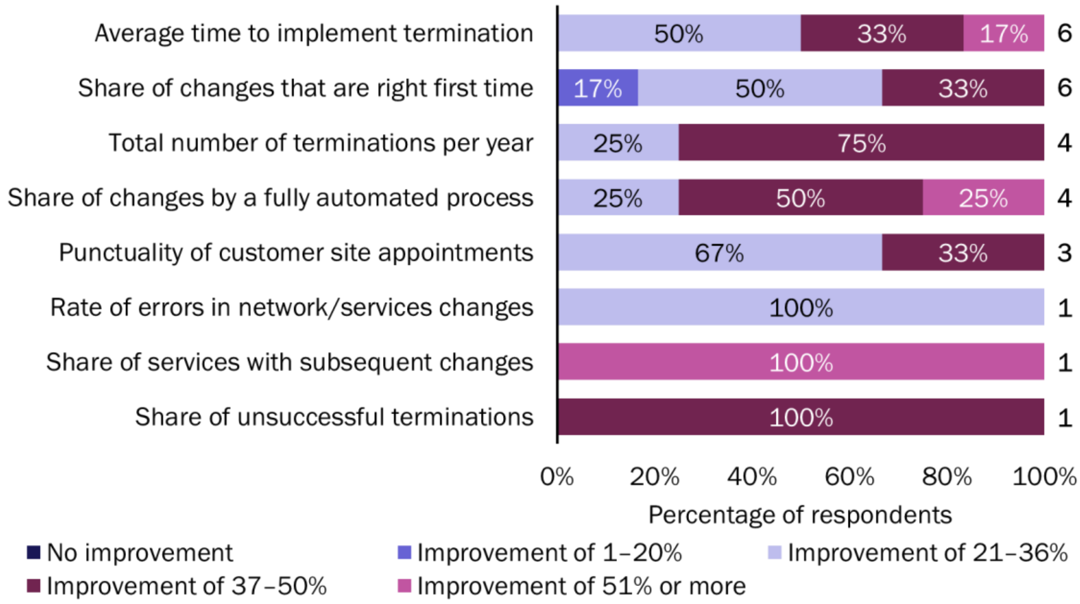
Figure 4.9: Improvements in the KPIs that CSPs rank as one of their top two KPIs for the termination to confirmation process since 2020, worldwide, 2022[19]



Source: Analysys Mason

19 Question: "What KPIs are you using to measure the success of automation in the termination to confirmation process? For your top two KPIs, what result have you observed since 2020?"; *n* = 13.

Figure 4.10: Expected improvements in the KPIs that CSPs rank as one of their top two KPIs for the termination to confirmation process in the next 24 months, worldwide, 2022[20]



Source: Analysys Mason

> *"We discussed with our partners, and the ones that are quite optimistic have a goal to achieve 80% automation. Today, our status is 50% and our target is 70%, so it is feasible to reach 80-90%. Capex optimisation is the initial process, and then the opex. After an opex solution for the lifecycle, we have a cost estimate that we can save up to 20–30% of our current cost on lifecycle management."*
>
> ***Director of IT/Network Strategy and Transformation for the Middle East and Africa, Tier-1 CSP, Europe***

4.3 Expected improvement across all lifecycle processes

It is worth highlighting that almost all CSPs expect to see further improvement in their automation KPIs in the next 24 months, regardless of the specific processes and KPIs. For example, 90% of CSPs that use the average TTM of B2B services as a KPI to measure the success of automating the service design to build process expect to see an improvement in this KPI of more than 20% in the next 24 months, compared to 80% of CSPs that have seen such improvements since 2020.

5. Recommendations

End-to-end automation and orchestration of the network and service layers is a key priority for 5G operations, thereby allowing CSPs to accelerate the time to launch and flexibly scale up the monetisation and delivery of

20 Question: "What KPIs are you using to measure the success of automation in the termination to confirmation process? For your top two KPIs, what is your desired goal for the next 24 months?"; *n* = 13.

new 5G services. Our recommendations for CSPs who are on their journey to full network automation are as follows.

- **CSPs should increase their emphasis on automating the service design to build process using cloud-native CI/CD tools.** Networks are becoming increasingly disaggregated and CSPs are faced with new challenges in streamlining their IT processes to support the testing, acceptance and delivery of new network services, software and applications. CSPs should collaborate with vendors to implement an effective CI/CD pipeline by moving to agile NetDevOps approaches and automating manual processes for network updates, testing and validation.

- **CSPs that wish to increase their end-to-end business process automation capabilities should use components from a single vendor to integrate their assurance and orchestration processes.** 70% of respondents agreed that it is beneficial for assurance and orchestration processes to be integrated by the same vendor and most CSPs are currently deploying single-vendor VNF orchestrators. CSPs should select a technology partner that has the expertise to deliver all aspects of an end-to-end automation solution. The partner should provide business and design consulting, custom development and systems integration in order to manage and deliver all aspects of the project, including solution integration and migration, requirements gathering and specification and process and workflow design. The partner should also support various deployment models for different modules or solutions, such as on-premises, cloud-native, managed service and SaaS. Managed services enable the outsourcing of KPI management that many CSPs are trying to achieve.

- **CSPs should deploy a vendor-agnostic, zero-touch automation solution to enable integration with third-party APIs and achieve a centralised network management and orchestration platform.** Vendor-agnostic architecture can deliver significant benefits to CSPs by simplifying operations and enabling programmatic network control and extreme automation across network domains and silos. This results in full NetDevOps transformation and aligns with the preference of 60% of the surveyed CSPs. This architectural approach provides more flexibility to select best-of-breed products and applications, and will in turn support CSPs' objectives to reduce the TCO of existing networks.

6. About the authors

Justin van der Lande (Research Director) leads the Applications practice. He specialises in business intelligence and analytics tools, which are used in all telecoms business processes and systems. In addition, Justin provides technical expertise for Analysys Mason in consultancy and bespoke large-scale custom research projects. He has more than 20 years' experience in the communications industry in software development, marketing and research. He has held senior positions at NCR/AT&T, Micromuse (IBM), Granite Systems (Telcordia) and at the TM Forum. Justin holds a BSc in Management Science and Computer Studies from the University of Wales.

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Hansang (Andy) He (Manager) is a Manager in our Research division, based in London. He has advised various clients across the telecoms value chain, but has a primary focus on equipment and software vendors including Amdocs, Ciena, Cisco, Ericsson, Fujitsu, Huawei, Nokia, Red Hat and VMware. Andy has recently managed engagements related to network automation and cloudification, artificial intelligence, private wireless networks and edge computing to support clients' decision-making concerning product development, go-to-market strategies, and their establishment of thought leadership. Andy works closely with subject matter experts in our Research division to provide clients with recommendations that are based on market opportunity forecasts, competitive benchmarking and primary research – entailing expert and executive interviews, as well as enterprise and end-user surveys.

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