E-BOOK
YOUR ULTIMATE ROADMAP TO SUCCESSFUL CLOUD TRANSFORMATION
Today, cloud computing is an essential part of every company’s information technology strategy. It is no longer an option, it is the necessity for businesses that want to keep up with innovations, changing customer expectations, and fast-paced business trends.

2020 has only expedited the adoption of the cloud. In the light of the COVID-19 pandemic and the unexpected rise of the remote work, businesses are speeding up their cloud transformation initiatives. The recent study by MariaDB suggests that 40% of IT leaders claim that COVID-19 is accelerating their move to the cloud. [1] Despite the overall increase in cloud adoption, businesses are often not sure how to approach cloud transformation and make it painless and successful from day one.

Wherever you are on your cloud migration journey, the challenges you face are not uncommon: lack of expertise, uncertainty, cloud-incompatible architecture, outdated technology - you name it. Addressing those on your own can be an uphill struggle.

With a reliable technology partner by your side, however, cloud migration can be a smooth experience. Starting from the cloud migration strategy, taking into account key business and technology factors, to rigorous planning followed by implementation including infrastructure set up, architecture redesign, migration, operation, and maintenance — your migration journey will be easy and safe. You will gain more confidence in your decisions and be able to make the transition faster, resolve issues without delay, and reduce risks at every step of the way. Here at N-iX, we receive dozens of inquiries every year from companies about different types of their cloud migration needs. They range from data migration to application and infrastructure migration. We have proven experience in different types of cloud transformations, and we are ready to share it with you in this e-book.

So it’s no longer a question of whether to undergo cloud transformation, it is a must. And businesses should be rather tasked with questions like what services and operations should be moved to the cloud, how to develop a viable cloud migration strategy, which cloud provider to choose, and how to overcome common challenges out there. The answers to these and many other questions you will find in our comprehensive e-book on cloud migration. Let’s explore the what, why, and how of migrating to the cloud together.
Executive summary

Key stats:  

- >90% of organizations leverage some kind of cloud  
- 53% of companies have reached the advanced cloud maturity level  
- 55% of organizations currently use multiple public clouds  

Sources: [2,3]

In 2020, we are all going to witness the increased adoption of cloud computing among both enterprises and SMBs. Our report reveals that organizations are moving to the cloud because it provides overwhelming advantages from both business and technical perspectives: high flexibility, better availability, elasticity, cost optimization, security, resilience, autonomy, and portability.

Yet, many businesses fail to tap into these benefits as they undertake the spontaneous approach to cloud computing. The success in cloud migration starts with the thoroughly elaborated migration strategy. In our report, we’ve highlighted the importance of a well-thought-out migration plan in the context of your overall corporate strategy.

Almost every organization is using cloud at some level. Organizations currently are using an average of 2.2 public and 2.2 private clouds. In particular, among enterprises multicloud strategies are mainstream. 93% of enterprises have a multi-cloud strategy and 87% have a hybrid cloud strategy.[2]

Across all SaaS, IaaS, and PaaS markets, we see the familiar names of Google, Amazon, and Microsoft. The battle for the best public cloud service provider is ongoing. AWS is taking the first place. Azure is narrowing the gap with AWS, and GCP has shown the most robust growth (70%) among enterprises during 2019.[2]

Whether you’re moving to a public cloud, private cloud, or hybrid cloud, your journey is all around three main pillars of cloud migration: apps, data, and DevOps. Without the effective application modernization strategy, data migration approach and DevOps best practices, you will not be able to drive maximum value from your investment in the cloud.

To achieve success in cloud migration, CIOs must also be aware of the potential risks in cloud migration. To mitigate such risks, companies require sufficient expertise and experience in different types of cloud transformations.

Through 2022, insufficient cloud IaaS skills will delay half of enterprise IT organizations’ migration to the cloud by two years or more.  

Gartner¹

With this in mind, CIOs may find it helpful to partner with trusted IT outsourcing vendors who have proven experience in the cloud. According to Forrester, many customers are consolidating their lists of “strategic” application outsourcing suppliers and switching from separate infrastructure and applications services suppliers to a single supplier.[4] It means that now companies focus more on multiskilled suppliers instead of multisourcing.

N-iX is one of the leading software development companies in Eastern Europe with versatile experience in cloud computing. We have a strong portfolio of cloud projects across a variety of industries: telecom, fintech, healthcare, retail, and more. N-iX has built successful partnerships with Lebara, Gogo, Vable, Orbus Software, and many other leading companies and helped them leverage the benefits of the cloud. With dozens of skilled cloud experts on board, we are fully equipped to help you develop cloud-native apps, Big Data and

¹ 4 Trends Impacting Cloud Adoption in 2020 by Gartner
Analytics solutions or migrate existing ones to the cloud. Starting from cloud readiness assessment and cloud strategy development to infrastructure set up, architecture redesign, migration, and maintenance - our specialists will support you at any stage of your cloud journey.

- **N-iX is a Select AWS Consulting Partner**, a Microsoft Gold Certified Partner, a Google Cloud Partner, and an OpenText Reseller Silver Partner;
- 100% of our cloud experts are certified by industry leaders, 300+ cloud engineers
- N-iX is compliant with PCI DSS, ISO 9001, ISO 27001, and GDPR standards;
- Our expertise in cloud computing includes **cloud-native services**, on-premise-to-cloud migration, cloud-to-cloud migration, as well as multcloud and hybrid cloud management;
- We offer professional **DevOps services**, including Cloud adoption (infrastructure set up, migration, optimization), building and streamlining CI/CD processes, security issues detection/prevention (DDOS & intrusion), firewall-as-a-service, and more;
- N-iX has broad data expertise to design different kinds of data solutions: **Big Data** / Data Warehouse / Data lake development, **Business Intelligence**, **Data Science**, **Artificial Intelligence & Machine Learning**, etc.
- N-iX is trusted in the global tech market: the company has been listed among the top software development providers by Clutch, in the Global Outsourcing 100 by IAOP for 4 consecutive years, recognized by GSA UK 2019 Awards, included in top software development companies by GoodFirms, co, and others.
- N-iX is among the world’s 501 leading managed service providers (MSPs), according to Channel Futures’ 13th annual MSP 501 worldwide company rankings.
- N-iX has been named No. 72 on the 2020 CRN Fast Growth 150 List for the substantial growth and performance over the previous two years.
- As a part of **Corporate Social Responsibility (CSR) activities**, N-iX invests heavily in educational initiatives and the development of talented youth. Since 2018, N-iX has supported 60+ educational initiatives; funded scholarships for 10 UCU students; sponsored EIT (External Independent Testing) preparation courses for children in need. Also, N-iX joins the global fight against COVID-19. The company has created a Charity Fund and raised UAH 3M to support the Ukrainian healthcare system.

So why migrate to the cloud? What cloud migration approach to undertake? Where should you pilot? Which cloud provider to select? How to avoid common pitfalls? Discover this and more in this report.

**Related**
- Top software development vendors in Eastern Europe [2020 White Paper]
- Software development in Ukraine: 2019-2020 IT market report
About this e-book

The e-book gives an extensive overview of the cloud computing market in 2020 and beyond. It explores the main advantages of the cloud, describes key stages and pillars of cloud migration, examines the major players in the cloud arena as well as offers solutions to the top cloud migration challenges supported by real case studies. The research gathers the information and statistics from 35+ sources. It is based on the data provided by international advisory companies, market research firms, business associations, and other reputable sources. The report includes findings by Gartner, Forrester, IDG, IDC, Flexera, O’Reilly, KINSTA, McAfee, and many others.

The paper is also based on our long-term expertise in delivering cloud solutions to SMBs, enterprises, and Fortune 500 companies across the globe. N-iX is helping organizations build a strong cloud foundation. With years of experience in cloud computing, the company experts have elaborated a number of best practices that enable our clients to innovate faster, expand their market reach, reduce costs on the cloud as well as achieve the elasticity and security they require.

Experts who have contributed to the e-book

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Anton Gavrylov
DevOps Engineer at N-iX
Cloud computing is an all-around hype and for a good reason, because it has the potential to transform the way you do business. According to IDG Cloud Computing Survey 2020, companies expect to allocate about a third (32%) of their total IT budget to cloud computing in the next year, compared to 30% in 2018. That’s not a significant change, but considered in dollars, the average cloud investment is up 59% from 2018 to $73.8M in 2020.[3]

If to compare the cloud spend of SMBs and enterprises, SMBs generally have substantially lower cloud bills because they run fewer workloads in the cloud than enterprises. 56% of SMBs spend less than $600,000 annually compared with only 13% of enterprises. So why do companies invest billions in the cloud?[2]

<table>
<thead>
<tr>
<th>Cloud Spend by Organization Size</th>
<th>Percent of all respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enterprise</strong></td>
<td></td>
</tr>
<tr>
<td>Up to $600K</td>
<td>13%</td>
</tr>
<tr>
<td>$600K to $1.2M</td>
<td>13%</td>
</tr>
<tr>
<td>$1.2M to $2.4M</td>
<td>18%</td>
</tr>
<tr>
<td>$2.4M to $12M</td>
<td>36%</td>
</tr>
<tr>
<td>More than $12M</td>
<td>20%</td>
</tr>
<tr>
<td><strong>SMB</strong></td>
<td></td>
</tr>
<tr>
<td>Up to $600K</td>
<td>56%</td>
</tr>
<tr>
<td>$600K to $1.2M</td>
<td>12%</td>
</tr>
<tr>
<td>$1.2M to $2.4M</td>
<td>11%</td>
</tr>
<tr>
<td>$2.4M to $12M</td>
<td>17%</td>
</tr>
<tr>
<td>More than $12M</td>
<td>4%</td>
</tr>
</tbody>
</table>

Source: Flexera 2020 State of the Cloud Report
There are many reasons to consider the migration of applications to the cloud. **Cloud-native apps** are built with great simplicity and high flexibility in mind, which translates into better availability, security, performance, and improved customer experience. Cloud-native architectures with microservices, container-based workloads, and serverless computing offer a sea of benefits both from the business and technical perspectives.

### Business drivers

- **Expanding your market reach**
  As your business grows, you need to be able to break into new markets and reach more customers without the cost and headache of rewriting your applications. With cloud-native development, your apps can support millions of users anywhere in the world, process millions of requests per second ensuring millisecond latency.

- **Faster time-to-market**
  A modern cloud-native application supports the best DevOps processes, where automation is present across the whole software delivery process. Starting from infrastructure setup, and CI/CD to monitoring, logging, and alerting, automation helps avoid manual processes. This helps boost workforce productivity. As a result, you can deliver cloud-native apps at high velocity without compromising quality.

- **Great elasticity**
  In contrast to on-premises apps, cloud-native applications allow dynamic, on-demand scaling. Thanks to elastic infrastructure, automatic scaling, and load balancing, you can easily build resources up or down responding to traffic surges and fluctuations.

- **Cost optimization**
  With cloud-native application development, you enjoy the flexibility in pricing: pay only for the computing resources you use. Expenditure on unused resources is completely eliminated. You don’t need to maintain idle resources in anticipation of a surge. Plus, there are also indirect cost savings that come from the increased resilience and reduced downtime of apps in the cloud.

- **Enhanced security**
  Today’s cloud-native apps follow the DevSecOps approach. Security is incorporated into every step of cloud-native application development to ensure that apps meet industry regulations. Also, thanks to the microservices architecture, cloud-native apps are reliable and have lower operational and security risks of massive failures.
Tech drivers

- **Avoiding vendor lock-in**
  The key benefit of cloud-native applications is their ability to run in any cloud and be easily moved between different clouds. So you don’t need to stick with a specific cloud provider if it no longer meets your business needs.

- **Flexibility to use the technology**
  Your team has the advantage of working with the technology tools that are the best fit for a specific task. They can choose any combination of the operating system, programming language, web application platform, database, and other services as per your business needs.

- **Easy management of infrastructure**
  Compared to traditional monolithic apps, cloud-native applications are easier to manage and maintain. They comprise individual microservices that can be improved incrementally to continuously add new and improved application features.

- **Resilience to failures**
  Cloud-native applications are inherently resilient to failures as they can automatically handle outages, enable corrective actions, and shift workloads. In case an issue occurs, improvements can be made non-intrusively, causing no downtime or disruption of the end-user experience.

- **Standardization**
  Following 12-factor principles for building apps in the cloud, you can standardize the way your platform and services are developed. Containers used in cloud-native apps help unify how apps are deployed and managed. Also, they facilitate code deployment standardization, making it easy to build workflows for apps that run between on-premises and cloud environments.

- **Autonomy for developers**
  A team of developers can develop their code independently of other teams that are responsible for other services. This eliminates a lot of bottlenecks and improves productivity. Especially, this is advantageous for distributed teams working in different locations.
Choosing the cloud strategy

"Gone are the days where IT managers get pushback for opting to deploy workloads in the cloud versus their own private data center," says Eric Knorr, Editor in Chief, IDG Communications, Inc.²

More companies than ever are looking at moving some or all of their workloads to the cloud. Only 10% of organizations claim they don’t use cloud computing at all, according to the 2020 survey of nearly 1,300 companies.[5] All the rest are completely "cloudy". Cloud computing is a popular choice among many enterprises, SMEs, and startups.

Moreover, amid COVID-19, the adoption of cloud is going to increase. More than half of the respondents in the latest Flexera 2020 State of the Cloud Report state that their cloud usage will be higher than initially planned due to the global pandemic.² Cloud computing is one of those few sectors that will emerge much stronger than before after COVID-19.

² The Shift to Cloud Computing Persists as Organizations Use Multiple Public Clouds by IDG
PART II. How to start your cloud migration journey

Change from Planned Cloud Usage Due to COVID-19

<table>
<thead>
<tr>
<th>% of respondents</th>
<th>2%</th>
<th>8%</th>
<th>31%</th>
<th>26%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>2%</td>
<td>9%</td>
<td>29%</td>
<td>30%</td>
</tr>
<tr>
<td>Enterprise</td>
<td>2%</td>
<td>4%</td>
<td>37%</td>
<td>13%</td>
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<tr>
<td>SMB</td>
<td>2%</td>
<td>4%</td>
<td>37%</td>
<td>13%</td>
</tr>
</tbody>
</table>

Significantly lower than planned  Slightly lower than planned  Slightly higher than planned  Significantly higher than planned

But for many, the process behind migration is complicated and burdened with open-ended questions:

- Should I choose a public or private cloud model?
- Do I need to go with a hybrid operational model?
- Which workloads get prioritized?
- Should I move applications to the cloud as-is, in a "lift and shift" model, or refactor them to take advantage of cloud-native architecture?

Answering these questions will help you develop your cloud migration plan and migrate with confidence. If your company has decided to move to the cloud, you need to start with understanding the cloud readiness of your existing applications, defining a strategy, prioritization, and roadmapping - all this is essential for a successful cloud journey.

Cloud Journey

A cloud migration journey starts with articulating your vision and strategy. And only then, can you proceed with planning, execution, and maintenance. Otherwise, you risk ending up with huge expenses and system failures.

It is important to formulate the cloud strategy in the context of your company's overall strategy. Consider where your cloud journey fits into your organization's larger business strategy and find opportunities for the alignment of vision. A well-aligned migration strategy, with a supporting business case and a well-thought-
out migration plan, sets the proper groundwork for cloud adoption success. It should be a living document elaborated by CIO (or the equivalent) and organizational leaders across other business units: procurement, legal, human resources, finance, etc.\[4\]

"Those businesses that don’t have a formal cloud migration strategy will probably develop it by 2022. According to Gartner estimations, 70% of companies will create a cloud strategy by that time. So if you don’t want to lag behind your competitors, start investing in mapping out your cloud roadmap now.

Anton Vasylenko | Solution Architect, Head of Solution Group at N-iX"

Cloud Strategy in Context

Source: Gartner (March 2019)

The main thing is not to get caught in the hype and rush into moving your workloads and data in the ad hoc manner to the most touted cloud platform. What is advantageous for one company can be inapplicable for your business. Without rigorous planning and a clear migration strategy in place, you risk experiencing wasted costs, security issues, and poor performance. Before jumping into cloud computing, you should ask yourself these simple questions:

1. Why do I need to migrate to the cloud?
2. What benefits do I expect to achieve?
3. Do I have mission-critical data that I need to store on-premise?
4. What capacity do I require?
5. How many cloud providers do I need?

In Forrester's report “Gauge Your Cloud Maturity”, you can find a more extensive list of questions that will help you define where you are on your cloud journey, what is your cloud adoption maturity, and what you need to do to get to your desired destination.
Forrester has identified three categories of competencies that every infrastructure and operations (I&O) pro must tackle: people, process, and technology. First, you need to assess whether you have solid cloud skills and sufficient cloud experience to perform cloud migration. Then, it is important to standardize and simplify processes and policies regarding application lifecycle management, financial budgeting, compliance checks, etc. to maximize cloud success. Also, you need to undergo digital transformation and take advantage of new technologies to enable automation, agility, and efficient collaboration. All this will help you make your cloud migration a smooth journey.

There’s a lot to consider when migrating to the Cloud that will define your cloud migration journey and the choice of a specific cloud infrastructure or services. But what matters most, is a strategic decision to benefit from Cloud concepts. This will not only solve today’s pain points, and future-proof your technology, but is becoming a must-have to stay relevant in the modern world.

Yaroslav Novytskyy | Director of Cloud-Native Services at N-iX

Public vs Private vs Hybrid

To make your cloud migration successful, you need to choose the right cloud model for your needs. Today, cloud services are delivered as either public, private, or hybrid cloud. The cloud model you choose depends on many factors, such as which features you find most important, how much you want to invest, etc. Public cloud is the most cost-effective option. It is easy to manage, more scalable, and reliable. Private cloud gives more control over where the data is stored and keeps it more confined at a price of a higher set-up cost. Hybrid cloud offers more flexibility, combining elements of both model types. But it also has a few disadvantages, especially when considering multiple access points (AP) locations. The choice between public, private and hybrid cloud solutions is not an either/or situation. A lot of organizations leverage all three types of cloud solutions considering the inherent value propositions and tradeoffs.

- **Private cloud** is a type of cloud computing that is used exclusively by one business or organization. Users can access, utilize, and store data in the private cloud from anywhere, just like they could with a public cloud. The difference is that no one else can access or utilize those computing resources. Private clouds deliver a higher level of security and privacy through both company firewalls and internal hosting to ensure operations and sensitive data are not accessible to third-party providers. The only thing is that the company that owns the private cloud is responsible for maintaining both software and infrastructure. So private clouds require the same staffing, management, and maintenance expenses as traditional data center ownership.

- **Public cloud** is the most popular cloud deployment model where you buy a “server slice” in a cloud computing environment that is shared with a number of other clients. Public cloud services may be free or offered through a variety of subscription or on-demand pricing schemes, including a pay-per-usage model. In public clouds, essential infrastructure and the operating system remain under full control of cloud providers. This means that they are responsible for all management, maintenance, security, and upgrades.

- **Hybrid cloud** combines a public cloud with a private cloud. It ensures that two platforms interact seamlessly with data and applications moving smoothly from one to the other one. In the age of big data analytics, hybrid cloud is a great option for companies in industries like healthcare or finance. They must adhere to strict data privacy regulations while also using sophisticated algorithms powered by artificial intelligence (AI) to derive actionable insights from huge masses of unstructured data.
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Types of cloud used
% of all respondents

Source: Flexera 2020 State of the Cloud Report
N=750

A hybrid multicloud strategy is the new reality. The market is moving to open, interoperable multicloud environments with the ability to easily connect private and public clouds. To achieve success with cloud, we don’t need to fly solo in clouds and limit ourselves to only one cloud deployment model. A hybrid multicloud approach allows companies to gain visibility and control over all the places where they’re doing business — whether it’s in a public cloud, a private cloud, or on-premises — and introduce innovations in a much more secure and efficient way.

Oleksandr Lazarchuk | Delivery Director at N-iX

Single cloud vs multicloud

More and more companies are using different solutions from different cloud providers. Multi-cloud is on the rise. Forrester’s data indicates that 75% of global infrastructure decision makers would describe their cloud strategy as hybrid. Almost every firm follows a multicloud strategy because of legacy infrastructure (“we have a little bit of everything”) or to avoid vendor lock-in.[8]

Organizations are currently using an average of 2.2 public and 2.2 private clouds. In particular, among enterprises multicloud strategies are mainstream. 90% of enterprises state they’re using at least one cloud service in their organization. Of those using cloud services, 93% have a multicloud strategy that combines multiple public and private clouds, while only 6% are using multiple public ones.[2]

Whether you go with one cloud provider or decide to manage multiple cloud platforms, each strategy has its pros and cons. With one cloud provider, there is a risk of a vendor lock-in. With the multicloud strategy, you can make your code work with more than one cloud provider and balance workloads between several cloud platforms. This option is more expensive and complicated as each provider offers different services and tools for management but it gives a certain degree of freedom and flexibility.
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Number of clouds used on average

<table>
<thead>
<tr>
<th></th>
<th>PUBLIC</th>
<th>PRIVATE</th>
</tr>
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<tbody>
<tr>
<td>Currently using</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Experimenting</td>
<td>1.2</td>
<td>1.7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3.4</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Source: Flexera 2020 State of the Cloud Report
N=750

Types of cloud computing services

The overwhelming majority of organizations (nearly 90%) are using some form of cloud computing.[2] Depending on the deployment model, the company can choose between public, private, and hybrid clouds. Based on service, this can be either Infrastructure as a Service (IaaS), Software as a Service (SaaS), Platform as a Service (PaaS), or Function as a Service (FaaS).

The IDC report identifies SaaS as the largest spending category, capturing more than half of all public cloud spending throughout the forecast period. IaaS is reported as the second largest spending category and is the fastest growing one, with a projected five-year CAGR of 32.0%. PaaS is the lowest spending category, with the second largest five-year CAGR of 29.9%.[3]

- **IaaS** provides foundational computing resources — physical or virtual servers, operating system software, storage, networking infrastructure, data center space — that you use over an internet connection on a pay-as-you-use basis. IaaS lets you rent physical IT infrastructure for building your own remote data center on the cloud, instead of building a data center on premises.
  
  **Examples of IaaS:** Microsoft Azure, Amazon Web Services (AWS), Cisco Metacloud, GCP

- **PaaS** provides a complete cloud-based platform for developing, running, and managing applications without the cost, complexity, and inflexibility of building and maintaining that platform on premises. The PaaS provider hosts everything — servers, networks, storage, operating system software, databases — at its data center. A development team is responsible only for data, applications, and functions hosted in cloud. With PaaS, applications can be released more quickly than usual as you can focus completely on development without having to worry about underlying infrastructure.
  
  **Examples of PaaS:** AWS Elastic Beanstalk, Apache Stratos, Google App Engine

- **SaaS** is a fully-developed software solution that runs in the cloud, and can be accessed via the web or vendor APIs typically for a monthly or annual fee. SaaS is the most familiar form of cloud computing. SaaS apps are highly popular because everything is managed by a vendor: application, runtime, middleware, OSes, virtualization, servers, storage and networking. The client is only responsible for data.
  
  **Examples of SaaS:** Microsoft Office 365, Salesforce, Cisco WebEx, Google Apps

- **FaaS** is a type of serverless computing that allows customers to develop, run, and manage application functionalities without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app.
  
  **Examples of FaaS:** Amazon Lambda, Google Cloud Functions, Microsoft Azure Functions, IBM Cloud Functions
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YOUR ULTIMATE ROADMAP TO SUCCESSFUL CLOUD TRANSFORMATION

Cloud conundrum: AWS vs Azure vs Google

A lot of organizations have already made a shift from on-premises servers to the public cloud. Or at least they have moved a part of their infrastructure to the cloud. According to Gartner, the global public cloud services market is expected to reach $354.6B by 2022, up from $227.8B in 2019.\textsuperscript{[11]}

By 2022, up to 60% of organizations will use an external service provider's cloud-managed service offering, which is double the percentage of organizations from 2018.

\textit{Sid Nag, research vice president at Gartner}

As of today, there are more than 100 cloud service providers, but the market is dominated by AWS, Azure, Google Cloud, IBM Cloud, and Oracle Cloud. According to the report by Canalys and Synergy Research Group for Q4 2019, AWS is the clear market leader globally in the cloud service market (32.3%), followed by Microsoft at 17%, and Google at 6%.\textsuperscript{[12]}

Worldwide cloud infrastructure spending and annual growth Canalys estimates, full-year 2019

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<tbody>
<tr>
<td>AWS</td>
<td>34.6</td>
<td>32.3%</td>
<td>25.4</td>
<td>32.7%</td>
<td>36.0%</td>
</tr>
<tr>
<td>Microsoft Azure</td>
<td>18.1</td>
<td>16.9%</td>
<td>11.0</td>
<td>14.2%</td>
<td>63.9%</td>
</tr>
<tr>
<td>Google Cloud</td>
<td>6.2</td>
<td>5.8%</td>
<td>3.3</td>
<td>4.2%</td>
<td>87.8%</td>
</tr>
<tr>
<td>Alibaba Cloud</td>
<td>5.2</td>
<td>4.9%</td>
<td>3.2</td>
<td>4.1%</td>
<td>63.8%</td>
</tr>
<tr>
<td>Others</td>
<td>43.0</td>
<td>40.1%</td>
<td>34.9</td>
<td>44.8%</td>
<td>23.3%</td>
</tr>
<tr>
<td>Total</td>
<td>107.1</td>
<td>100.0%</td>
<td>77.8</td>
<td>100.0%</td>
<td>37.6%</td>
</tr>
</tbody>
</table>

Source: Canalys Cloud Channels Analysis, January 2019
Since 2006, when AWS was first launched, it has rapidly grown into the dominant cloud platform. Although GCP and Azure entered the market a few years later, they have presented stiff competition to AWS as reliable public cloud providers among both startups and enterprises.

If you are hesitating about AWS vs Azure vs GCP, here we compare the strengths and weaknesses of each provider to help you make a well-informed decision.

### AWS vs Azure vs GCP: Cloud Services Comparison

<table>
<thead>
<tr>
<th></th>
<th>Azure</th>
<th>AWS</th>
<th>GCP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market share</strong></td>
<td>16.9%</td>
<td>32.3%</td>
<td>5.8%</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td>60 geographic regions around the world</td>
<td>24 geographic regions around the world</td>
<td>24 geographic regions around the world</td>
</tr>
<tr>
<td><strong>Partners</strong></td>
<td>Growing partner ecosystem</td>
<td>Extensive partner ecosystem</td>
<td>Its partner ecosystem lags behind those of Azure and AWS</td>
</tr>
<tr>
<td><strong>Compliance</strong></td>
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<td>70+ compliance offerings</td>
<td>50+ compliance offerings</td>
</tr>
<tr>
<td><strong>Security</strong></td>
<td>Azure Security Center</td>
<td>AWS Security Hub</td>
<td>Cloud Security Command Center</td>
</tr>
<tr>
<td><strong>Services</strong></td>
<td>more than 200 services</td>
<td>more than 212 services</td>
<td>more than 90 services</td>
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<tr>
<td><strong>Databases</strong></td>
<td>MS SQL Server; Azure DocumentDB, Azure CosmosDB</td>
<td>Amazon RDS; Amazon DynamoDB, Amazon ElastiCache, Amazon Aurora, Amazon DocumentDB, Amazon Keyspaces, Amazon Neptune, Amazon Timestream</td>
<td>Cloud SQL, Cloud Spanner, Cloud Bigtable, Cloud Firestore, Firebase Realtime Database, Cloud Memorystore</td>
</tr>
<tr>
<td><strong>Big Data</strong></td>
<td>Azure HDInsight, Azure table</td>
<td>Amazon EMR, Amazon Redshift, Amazon Kinesis, etc.</td>
<td>Google Cloud IoT Core, Cloud Dataproc, Cloud Dataflow, BigQuery, etc.</td>
</tr>
<tr>
<td><strong>Storage</strong></td>
<td>Azure storage: Blob, Disk, File, Data Lake Storage, Archive</td>
<td>S3, EBS, EFS, S3 Glacier, FSx for Lustre, FSx for Windows File Server, Backup, Storage Gateway, Data Transfer Services</td>
<td>Google Cloud Storage, Google Persistent Storage, Nearline, Coldline</td>
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<tr>
<td><strong>Serverless computing</strong></td>
<td>Azure Functions</td>
<td>AWS Lambda</td>
<td>Google Cloud Functions</td>
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<td>Virtual Machine</td>
<td>Elastic Compute Cloud (EC2)</td>
<td>Compute Engine</td>
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<td>Virtual Private Cloud (VPC)</td>
<td>Cloud Virtual Network</td>
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<td>Charges per minute</td>
<td>Charges per hour</td>
<td>Charges per minute</td>
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<tr>
<td><strong>Clients</strong></td>
<td>Fujifilm, HP, Johnson Controls, Polycom, Apple, Honeywell</td>
<td>Unilever, BMW, Netflix, Airbnb, Samsung, Expedia</td>
<td>Vodafone, Toyota, LG, Spotify, Forbes, The New York Times</td>
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</tbody>
</table>
PART II. How to start your cloud migration journey

The choice between Azure, AWS, and GCP is not a technology decision. There is no clear winner. They all are highly secure and offer powerful computing, storage, and networking capabilities. Amazon is the most mature cloud provider, which offers the widest set of products and services. Businesses that rely on Microsoft technologies and products like Office and .NET often decide to choose Microsoft Azure. GCP has a solid open source community and offers a great range of solutions for big data, machine learning, analytics, cloud-native applications. So it’s all about your business needs.

Why choose Azure for cloud migration

Azure is available in over 60 regions, more than any other cloud provider. 95% of Fortune 500 companies trust Azure as it offers the largest portfolio of compliance offerings. Also, Azure invests heavily in security to protect customers’ data from cyberthreats - $1B investment per year. Azure Security Center offers a set of services and tools for protecting your on-premises and cloud workloads.

Azure is Microsoft’s solution so it is highly integrated with Windows and other Microsoft software. Those who are using Office 365, Microsoft Active Directory, and Dynamics 365 feel very comfortable using Azure. Azure provides a broad set of services including compute, storage, databases, analytics, networking, mobile, developer tools, management tools, IoT, security, and enterprise applications.

Azure has native integrations with Windows development tools such as VBS, SQL database, Active Directory. But it is catching up with AWS in terms of open source and offers support of a full range of Linux distributions, Hadoop, Kubernetes, Docker, Windows Server, SQL Server, Oracle, IBM, and SAP.

Regarding the pricing, Azure can be less expensive for businesses that have already invested in the Microsoft ecosystem. With Azure, you pay only for the resources you use, and it charges per minute. Azure also offers short term commitments with the option between pre-paid or monthly charges. There are various payment and billing options. The cost of the services depends on the services and the quantity of those services. Using the Azure calculator, you can estimate the overall price of the services you need.

What concerns storing data, Microsoft offers Azure Storage for different data storage scenarios. It provides a massively scalable object store for data objects, a file system service for the cloud, a messaging store for reliable messaging, a NoSQL store, and a virtual hard disk (VHD).

As the leader in hybrid cloud, Azure gives a wide range of products and services to build hybrid solutions. It provides the best support for hybrid cloud services, with platforms like Azure StorSimple, Hybrid SQL Server, and Azure Stack.

Migrating from an on-premises SQL Server to Azure is easy. Microsoft offers several options. An administrator can back up the database and restore it to Azure, using a file or URL. The database can be copied to Azure blob storage. The whole server can be virtualized and uploaded. The Add Azure Replica Wizard can replicate the database. The Azure Import/Export Service is available for offline migration. An organization puts the data on a BitLocker encrypted drive and ships it to an Azure data center.
Strengths & Weaknesses of Azure vs AWS vs GCP

**Azure**

- Great availability around the world
- The largest number of compliance offerings
- Discounts on Azure for enterprises that already leverage other Microsoft’s products
- Comprehensive hybrid cloud support
- Less flexible than AWS in terms of pricing
- Azure is only building its partner ecosystem

**Google Cloud**

- A solid open source community
- A great range of solutions for big data, machine learning, analytics, cloud-native applications
- Excellent integration with other Google services
- The most cost-efficient option
- A small partner ecosystem
- A more limited range of services than in Azure and AWS

**AWS**

- The largest community of customers and partners
- The most established and enterprise-ready vendor
- Highly flexible
- An extensive range of infrastructure applications
- Hybrid options available, but not a priority
- Complex ever-growing AWS ecosystem with a variety of services and features can be difficult to manage

Why choose GCP for cloud migration

GCP is accessible in 73 zones within 24 regions around the world. And it is continuously expanding into new regions.\[^{18}\] In the 2019 fiscal year, GCP saw revenues of $8.9B, up from $5.8M in the previous year.\[^{21}\] Although Google Cloud Platform is the third most-utilised cloud platform behind AWS and Azure, it showed the most robust growth among enterprises during 2019. According to Flexera’s State of the Cloud 2020 report, Google Cloud adoption rates among enterprises rose by 70% - a sizable increase from 2019.\[^{2}\]

Public cloud adoption for enterprise YoY

% of enterprise respondents

\[^{2}\] Source: Flexera 2020 State of the Cloud Report

\[^{18}\] N=554

\[^{21}\]

\[^{2}\]
Google Cloud offers fewer cloud services in security and DevOps than its rivals. However, it pulls ahead in analytics and machine learning. Google's BigQuery and Dataflow bring strong analytics and processing capabilities for companies that work heavily with data, while Google's Kubernetes container technology allows for container cluster management and eases container deployment. Google's Cloud Machine Learning Engine and various machine learning APIs make it easier for businesses to leverage AI in the cloud.

Open-source software is one of Google's key advantages. Google has made 2,000+ open source ventures in the past years and has become the biggest contributor to OSS.[18] In this regard, Google takes over Microsoft and Amazon. Google integrates products such as Kubernetes, Apache Beam, TensorFlow into its Google Cloud Platform and offers them as managed services operated by its partners.

GCP's pricing is its biggest strength. It charges per minute (10 minutes minimum), and you only pay for the compute time you use. Moreover, GCP gives discounted prices for long-running workloads with no up-front commitment required. AWS, by contrast, requires prepay in the form of “reserved instances” to be eligible for the discounts. And Azure only offers a 5% discount on a 12-month prepayment. According to the study by Sandeep Dinesh who did a cost comparison of GCP vs AWS vs Azure, Compute Engine is typically between 40% - 50% cheaper than AWS and Azure.[23]

In 2018, Google introduced Hybrid Cloud Support. It has dramatically increased its focus on hybrid and multi-cloud workloads using Anthos, allowing users to manage workloads on GCP and Google Kubernetes Engine. Google's container offering provides users with a significant advantage as it developed the very Kubernetes standard now utilized by Google's competitors - AWS and Azure.

Google invests heavily in securing its infrastructure. Data privacy and security features are very mature on the Google Cloud Platform. It all starts with physical security of data centers, continuing on to the security of the hardware and software that underlie the infrastructure, and finally, the technical constraints and processes in place to support operational security.

**Why choose AWS for cloud migration**

AWS is present in 77 zones within 24 geographic regions across the globe and has announced plans for nine more Availability Zones and three more AWS Regions in Indonesia, Japan, and Spain.[13] In 2019, it generated revenue of $35.03B.[24]

AWS has the largest community of customers and partners around the world, which makes it number one among other cloud services providers. Plus, it has an edge over other cloud service providers in terms of government cloud offerings.

AWS is a secure cloud computing environment. AWS Security Hub gives you a number of security tools ranging from firewalls and endpoint protection to vulnerability and compliance scanners. For example, these are solutions such as AWS IAM, AWS Directory Service, and AWS CloudHSM.

AWS offers a wide array of services for compute, storage, database, networking as well as ML and AI, data lakes and analytics, blockchain, and IoT. It provides both SQL and NoSQL databases. Amazon RDS is a relational database service that has six database engines: Amazon Aurora, MySQL, PostgreSQL, Oracle, MariaDB, and Microsoft SQL Server. The NoSQL solution from Amazon is DynamoDB. Also, it supports MongoDB, Redis, Memcached, Cassandra.

What concerns storage options, AWS has file storage with EFS, block storage with EBS and object storage offered with S3. Data archiving services are available with Glacier. Scalability with AWS is not a problem as it has the service that monitors your application and automatically adjusts capacity to maintain steady, predictable performance at the lowest possible cost. The issue, however, arises when you can't predict and control when you run out of burst balance of IOPS (Input/Output Operations Per Second). There is no metric for IOPS credit usage. As a result, you go down to the base performance until you buy a new tier of burstable IOPS.
AWS’s primary strength is in the public cloud market. So it is less open to private or third-party cloud providers. It provides hybrid support through partnerships with on-premises providers. In recent years, it has significantly developed its hybrid cloud direction with the solution such as VMware and Outposts. With AWS VPN, you can create IPsec Site-to-Site VPN tunnels from an Amazon VPC to on-premises customer gateway enabling a hybrid environment. AWS Direct Connect (DX) allows you to establish dedicated connections from on-premises to AWS. Amazon Route 53 is a highly available and scalable cloud Domain Name System (DNS) web service. It is designed to give developers and businesses an extremely reliable and cost effective way to route end users to Internet applications by translating names like www.example.com into the numeric IP addresses like 192.0. AWS Systems Manager offers a standard-instances tier and an advanced-instances tier for servers and VMs in your hybrid environment. The standard-instances tier enables you to register a maximum of 1,000 on-premises servers or VMs per AWS account per AWS Region. Amazon EC2 Dedicated Hosts allow you to use your eligible software licenses from vendors such as Microsoft and Oracle on Amazon EC2, so that you get the flexibility and cost-effectiveness of using your own licenses, but with simplicity of AWS.

When it comes to pricing, AWS has a pay-as-you-go model, and you are charged per hour. In AWS like in Azure, you pay for compute, storage and data transfer. In Azure, you always have to pay for a VM no matter whether you actively use it or not. In AWS, you don’t need to pay for a stopped instance. AWS’s compute service is called Amazon EC2. And it has 5 different pricing models depending heavily on your needs: on-demand, savings plans, reserved Instances, spot instances, and dedicated hosts. For storage, you pay per GB you used. For data transfer, you are charged also per GB. But Data transfer charges are incurred when data is transferred out from AWS services to the Internet, or between AWS regions or Availability Zones. You can always calculate your monthly bill using the AWS Pricing Calculator.

Regarding the migration options, AWS offers the AWS Database Migration Service for moving existing databases. It supports both migrations from one platform to another as well as same-platform migrations. Offline migration is also possible with AWS’s Snowball, an appliance that holds 50 or 80 terabytes under 256-bit encryption. For even larger transfers, Snowmobile is available, which can ship as much as 100 petabytes in a truckload.

READ MORE
Scaling your infrastructure in the cloud: How to handle huge traffic spikes
There is no one-size-fits-all approach to migrating solutions to the cloud. There are many paths and cloud services options. However, they are all built around three main pillars of cloud migration: apps, data, and DevOps. Whether you’re moving to a public cloud, private cloud, or hybrid cloud, you need to analyze your application portfolio and settle on the application modernization strategy. Then, you have to find a secure, cost-effective, and efficient method of migrating your data to its new storage location. To make cloud migration successful, you shouldn’t overlook DevOps best practices: Infrastructure as Code, Continuous Integration & Delivery, Monitoring, Logging, and Alerting. They will help you speed up time-to-market and optimize resource usage to save your costs on cloud-native application development.

Cloud migration can be only successful when you bring together best practices around data migration, apps transformation, and DevOps. Otherwise, you risk going round in circles, only increasing your technical debt.

**Application transformation**

Application transformation is the process of modernizing legacy applications to move them to the cloud more effectively. More and more companies are looking to transform their apps by leveraging technologies such as cloud and big data, as well as principles of DevOps, and agile development. Application transformation provides the opportunity to reduce TCO, optimize ROI, reduce complexity, become more flexible, and maintain the competitive edge. According to the Forrester Analytics Global Business Technographics Developer Survey 2019, more companies move their apps to the cloud rather than build new ones. They either decide to move their apps to the cloud and then improve them or first rewrite them and then migrate to a public or private cloud.

“The global application transformation market size is expected to grow from $9.7B in 2019 to $16.8B by 2024, at a compound annual growth rate (CAGR) of 11.6% during 2019–2024. North America will hold the largest market size during the forecast period. Among all industries, retail is expected to grow as the fastest-growing segment.”

<table>
<thead>
<tr>
<th>Practice</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migrating existing workloads into a hosted private cloud</td>
<td>47%</td>
</tr>
<tr>
<td>Migrating existing workloads into a public cloud</td>
<td>47%</td>
</tr>
<tr>
<td>Migrating existing workloads into an internal private cloud</td>
<td>42%</td>
</tr>
<tr>
<td>Building net-new applications in cloud environments</td>
<td>35%</td>
</tr>
<tr>
<td>Complete rewriting of existing workloads into your cloud environment</td>
<td>28%</td>
</tr>
<tr>
<td>Partial rewriting of existing workloads into your cloud environment</td>
<td>28%</td>
</tr>
</tbody>
</table>

Base: 814 infrastructure decision makers from Australia, Canada, France, Germany, the UK, and the US who work at enterprise companies of 1,000 employees or more and whose firms have planned, implemented, or expanded upon cloud strategy.
There are various types of strategies to migrate legacy applications to the cloud. Taken into account classifications by AWS, Oracle, Google, and Forrester\cite{14, 25, 26, 27}, here at N-iX, we have come up with 6 key application transformation methods:

- Re-host (lift and shift)
- Re-platform (lift, tinker and shift)
- Modernize
- Rewrite
- Drop and shop
- Retain

To determine the best application transformation method, first you need to carry out a careful analysis of the application portfolio. You have to assess whether a simple porting is possible or whether the application will require little improvement before/after migration. In some cases, a complete redesign is needed. If none of the aforementioned methods suits, you will need to replace your existing app with services from a SaaS cloud provider.

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Not every application is a good candidate for cloud migration. Before migrating apps, one should consider the application complexity, risks, costs/effort to migration, and ROI. Some legacy apps might simply not require the scale and elasticity offered by the cloud, especially those ones that don’t process huge amounts of data. Other business-critical apps that store sensitive data can not be moved to the cloud due to some legal concerns. Also, sometimes, cloud implementation of an application might be much more expensive than building it from scratch or substituting it with a SaaS solution. So before starting migrating your apps, make sure you assess and prioritize your apps correctly.

Anton Vasylenko | Solution Architect, Head of Solution Group at N-iX

Re-hosting is the easiest one as it requires no coding effort and takes the least time. However, from the long-term perspective, this method doesn’t offer superior scalability and performance opportunities. Re-platforming as a variation of the lift and shift approach involves some further adjustments to improve your landscape in some way, like migration to fully-managed services. Modernizing is a similar approach, but some components of the application are enhanced or changed before or after the migration. Thus, more coding effort is needed. Rewriting is a complex process of application transformation that involves monolith to microservices decomposition.
PART II. How to start your cloud migration journey

Monolith to Microservices decomposition will allow you to enjoy the following benefits:

- Efficient use of skills and technologies per business tasks in separate microservices
- Optimal time-to-market and faster release of new features
- Scalability of development teams by full ownership of microservices and defining interfaces between them
- Efficient use of underlying IaaS/PaaS resources by scaling only those parts of the system that experience high load

Drop and shop is the best option if the ROI to transition a legacy application to the cloud is poor. In this case, it is better to purchase the ready-made solutions that will bring you scalability and performance opportunities you require. Retaining is a passive method as no migration is needed. You keep applications as-is, where they are.

Technology

![Technology logos](aws, azure, google cloud, digital ocean, openstack, kubernetes, docker, DC/OS)

**DISCOVER MORE ON THE TOPIC**
- Microservices vs Monolith: which architecture is the best choice for your business?
- How to implement microservices in telecoms effectively
- Tech companies that outsource microservices development to Ukraine

Data services

Data plays an essential part in the cloud transformation journey. Data services is a broad category of services that help businesses extract actionable insights from diverse data sets — structured and unstructured; in transit or at rest; generated in real time and at a large scale. They include database management, data mining and storage, data processing, data science and BI as well as data security, data optimization for cost, scalability, and processing efficiency. According to the market research firm Mordor Intelligence, Data as a Service Market was valued at $26.23B in 2019 and is expected to reach $46.50B by 2025, at a CAGR of 10% over the forecast period 2020 - 2025.[29]

**Data as a Service Market**

<table>
<thead>
<tr>
<th>Year</th>
<th>CAGR 10%</th>
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<tbody>
<tr>
<td>2020</td>
<td>![Blue bar chart]</td>
</tr>
<tr>
<td>2025</td>
<td>![Orange bar chart]</td>
</tr>
</tbody>
</table>

Source: Mordor Intelligence
Whenever you are migrating from on-premises to cloud or building your cloud data solution from scratch, you will need support in managing data and making the best use of it.

Data solutions

- Big Data storage: Data Warehouse/Data lake
- Real-time and Batch Data Processing
- Data Science
- Business Intelligence and Data visualization
- Artificial Intelligence & Machine Learning
- Classical SQL and NoSQL DBMS
- Big Data storage: Data Warehouse/Data lake
- Real-time and Batch Data Processing
- Data Science
- Business Intelligence and Data visualization
- Artificial Intelligence & Machine Learning
- Classical SQL and NoSQL DBMS

With a proprietary big data framework combined with popular open-source technologies like Apache Hadoop, Spark, and Kafka, etc. you will be able to get vital insights from previously untapped data assets. By putting the right technology in place, businesses can significantly reduce costs, improve ROI as well as save time and effort on data collection, analysis, and visualization.

Cloud enables big data processing and makes machine learning at large scale efficient. It frees up companies to focus on running their business, rather than running a room full of servers, and allows business intelligence and data science teams to deliver faster and better insights due to improved access, scalability, and performance. That’s why businesses choose to build data warehouses and data lakes in the cloud.

Igor Tymchuk | Delivery Director at N-iX
By using advanced data analytics techniques powered by ML & AI algorithms, business owners can unlock the value of Big Data. Data scientists can shape actionable models from existing data to predict possible scenarios and help companies determine which actions will bring the best results.

Benefits of data services:
- Preventing equipment failures
- Personalization
- Preventing fraud
- Increasing sales
- Product price optimization
- Improving customer experience and loyalty

Cloud is not only about data storage. It helps build complex, scalable, customizable data analytics systems that process the data close to real-time. And this allows making commercial use of data collected from its multiple sources.

Volodymyr Tatsakovych | Team Lead at N-iX

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- Using big data analytics for predictive maintenance: how enterprises slash downtime
- How Data Analytics can help your business respond to the impact of COVID-19

DevOps

DevOps is the third pillar of cloud migration which is as important as application transformation and data services. Forrester predicts that in 2020, the business value of DevOps will overtake velocity as a favored metric. And even more companies will automate their operations and adopt cloud. According to Global Market Insights, DevOps Market size exceeded $4B in 2019 and is poised to grow at over 20% CAGR between 2020 and 2026.

DevOps market

Source: Global Market Insights

Whether you build hybrid cloud, migrate from on-premises to public cloud or move from one cloud provider to another, DevOps is at the center of it all. Starting from infrastructure setup, and CI/CD to monitoring and security, it helps build a highly automated environment that allows development teams to deliver applications and services at high velocity. DevOps not only boosts development efficiency but also enhances security, speeds up time-to-market, reduces resource utilization, and improves scalability.
As demand for DevOps services increases, so does the variety of tools available on the market. These are the tools for setting up infrastructure, building and streamlining CI/CD processes, security issues detection/prevention (DDOS & intrusion), and more.

**DevOps tech stack**

**Public & Private Clouds**
- AWS
- Azure
- Google Cloud
- DigitalOcean
- openstack

**Infrastructure as a Code**
- HELM
- Terraform
- Ansible
- puppet
- CloudFormation

**Automation and Orchestration**
- BASH
- Jenkins
- Bitbucket
- AWS CodePipeline
- AWS CodeDeploy

**CI/CD**
- CHEF

**Monitoring & Logging**
- Nagios
- Splunk
- Datadog
- Prometheus
- Elasticsearch
- Kibana
- Grafana
- Amazon CloudWatch

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- DevOps services in Ukraine: How to choose the best company
In a rush to move to the cloud, companies often underestimate risks in cloud migration that could heavily impact cloud migration outcomes. And the first ones are encountered at the very planning stage. The complexity of the existing infrastructure, wasted costs, security, data loss, downtime, latency, vendor monopoly - all this makes it difficult to move to the cloud.

If you want to migrate your applications and data securely to the cloud, you should understand all the nuances of the process and have sufficient expertise to be able to prevent upcoming issues. And here we describe how.

If you are looking to take advantage of the cloud, follow these guidelines to ensure a successful migration.

**#1 Incompatibility of the existing architecture**

All companies have an IT architecture, but few of them control it. Instead, it grows organically: new software and equipment are deployed and purchased spontaneously to satisfy the needs of separate business units with little regard for the impact on the company's overall IT ecosystem. Eventually, the IT architecture becomes a complex system with many duplicated systems, inconsistent data, and inefficient processes.

And when it comes to cloud migration, many CIOs claim that the complexity of their current IT architecture poses one of the major risks of moving to the cloud. It slows their migration to the cloud as understanding business operations, all the relationships around business applications and databases that support them as well as the equipment and services that run the applications requires solid IT skills. According to Flexera 2020 report, understanding app dependencies and assessing technical feasibility are the two top cloud migration challenges. [2]
PART III. How to tackle key challenges of cloud migration

Cloud migration challenges
% of all respondents

<table>
<thead>
<tr>
<th>Challenge</th>
<th>% of all respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding app dependencies</td>
<td>63%</td>
</tr>
<tr>
<td>Assessing technical feasibility</td>
<td>47%</td>
</tr>
<tr>
<td>Assessing on-prem vs cloud costs</td>
<td>41%</td>
</tr>
<tr>
<td>Rightsizing/selecting best instance</td>
<td>39%</td>
</tr>
<tr>
<td>Migrating the app and data</td>
<td>38%</td>
</tr>
<tr>
<td>Optimizing costs post-migration</td>
<td>37%</td>
</tr>
<tr>
<td>Knowing implications of BYOL</td>
<td>35%</td>
</tr>
<tr>
<td>Prioritizing apps to migrate</td>
<td>32%</td>
</tr>
<tr>
<td>Selecting the right cloud provider</td>
<td>29%</td>
</tr>
<tr>
<td>Managing the app post-migration</td>
<td>26%</td>
</tr>
</tbody>
</table>

Source: Flexera 2020 State of the Cloud Report
N=750

Take action: Prepare your architecture for migration

To rationalize your IT architecture and make it “fit for the cloud”, you should conduct a root cause analysis, resolve tech debt, figure out interdependent parts, and create profound documentation. The main goal is to make your architecture agile, secure, scalable, and cost-efficient. The best way to do it is to design the application as a collection of microservices - easily manageable and autonomous constituents, each of which addresses a particular task.

For businesses that have already adopted microservices architecture and orchestrated their containers with tools like Kubernetes or Docker engine, it is easier to make a transition to the cloud. Popular cloud providers such as AWS, GCP, and Azure offer specific assistance for Kubernetes as well as other engines that further help in the migration process.

Infrastructure as code (IaC) is a key enabler of efficient migration of legacy systems to the cloud. Thanks to it, you can automatically manage and provision computers and networks (physical and/or virtual) through scripts instead of manually configuring them.

LEBARA, a leading UK-based telecommunications company, needed to modernize its IT architecture that would allow for business expansion and innovation. The company has partnered with N-iX to ensure a smooth transition and avoid common risks associated with on-premises-to-cloud migration.

For products hosted on Azure, N-iX has helped the company to design a two-stage migration process. First, we have redesigned the logic without disrupting databases. Next, we have restructured the very services reducing the number of steps in each business flow. Also, we have undertaken microservices orchestration, monitoring and set up automatic alarms.

For other products, we have built microservices architecture on AWS, with the help of Lambda and ESC clusters. Each service has its own table of data. Services are connected with the help of RESTful APIs. In more complex cases, Amazon SQS or SNS are applied.

As a result, moving to the cloud has significantly saved infrastructure costs (around 25-30%) and improved scalability with 80+ microservices on AWS and Azure. It has allowed consolidating the applications for all countries and channels and enabled Lebara to further expand its market reach and business operations fast and efficiently.
#2 Wasted costs

According to 2020 Flexera report, respondents estimate that their organizations waste 30% of the cloud spend. However, on average, the actual waste is 35% or even higher. Thus, cloud cost optimization is a top initiative regardless of cloud maturity both for enterprises and SMBs.

The pricing models of cloud providers are flexible but often difficult to understand especially if you are a novice in the field. In cloud computing, you pay for compute, storage and data transfer. And each cloud vendor offers a range of different instance types, storage services, and transfer options depending on your use case, cost requirements, and performance expectations. Finding the best one can be a complex challenge. Companies that fail to figure out what they need usually waste their costs because they don’t fully use the possibilities they have and pay for the resources they don’t use in fact.

Take action: Optimize your cloud costs with the best DevOps practices

DevOps practices can help companies optimize their costs involved in software development, deployment, and maintenance. With the help of DevOps, you can assess what resources you are using (Audit), analyze what areas can be optimized and how to do it (Plan), monitor spending of IT costs (Implement), and investigate new services that will help you reduce costs and optimize your infrastructure usage even more (Improve).

Cost optimization with DevOps practices

If you don’t know how to optimize your costs, find a partner who can help you with cloud cost optimization. There are a lot of best practices for cloud cost optimization. Here we highlight the most common ones:

- Reduce infrastructure usage in the areas where it can be reduced;
- Start using third-party services which allow you to reduce operational overhead and save costs;
- Automate the CI/CD process and provisioning of IT infrastructure;
- Delete underutilized instances;
- Rightsize your workloads;
- Take advantage of autoscaling;
- Move infrequently accessed storage to cheaper tiers;
- Set alerts for crossing predetermined spend thresholds;
- Explore whether hosting in a different region could reduce costs;
- Invest in reserved instances;
- Leverage spot instances for serverless and parts that don’t require high availability;
- Make use of discounts.
Cloud providers offer different types of compute and storage resources with different payment options and tiers. For example, AWS-based service, which provides compute resources called EC2, allows you to choose different types of instances: Dedicated, On-demand, Spot, or Reserved ones. Choosing the right type of instance for a specific case allows optimizing costs significantly.

**EC2 cost models**

Customers can combine multiple purchase types to optimize pricing based on current and forecast capacity needs.

- **ON-DEMAND**: Pay for compute capacity by the hour. No long-term commitments.
  - Spiky workloads

- **RESERVED**: Pay upfront in exchange for hourly prices that are 50-75% lower than On-Demand.
  - Committed utilization

- **SPOT**: Bid for unused Amazon EC2 capacity.
  - Time-insensitive workloads

- **DEDICATED**: Launch instances in VPC on dedicated customer hardware.
  - Highly sensitive workloads

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### #3 Security threats

There is a myth that moving to the cloud means sacrificing security. And it needs to be debunked. According to Gartner, by 2021, public cloud infrastructure workloads will have 60% fewer security incidents than traditional data centers. But the belief that everything in the cloud is 100% protected is also a common misconception.

Moving data and apps to the cloud involves a lot of security risks: compliance violations, contractual breaches, insecure APIs, issues on the provider’s side, misconfigured servers, malware, external attacks, accidental errors, insider threats, etc. And as data shows, the majority of these risks come from business users, hackers, and IT staff rather than from contractors or cloud providers.

**Cloud security threats**

<table>
<thead>
<tr>
<th>Source: Netwrix Cloud Data Security Report 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business users</td>
</tr>
<tr>
<td>Hackers</td>
</tr>
<tr>
<td>IT staff</td>
</tr>
<tr>
<td>Contractors</td>
</tr>
<tr>
<td>Cloud provider</td>
</tr>
<tr>
<td>Don’t know</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>
Some organizations are aware of common security pitfalls and take proactive measures to avoid them. But cloud maturity of the majority of organizations is still relatively low. As a result, they are struggling to resolve security issues as they don't have enough skills for that. According to the Cloud Security Threat Report, 92% of respondents say they need to enhance cloud security skills, while 84% confirmed they needed to add staff to close the gap. Only 27% of responding organizations were confident in their ability to address all cloud security alerts.\[35\]

Take action: Prepare your architecture for migration

Popular cloud providers such as Azure, AWS, GCP provide security as a service. They ensure that your physical assets are protected from unauthorized access. The majority of cloud vendors have strong portfolios of compliance offerings including ITAR, DISA, HIPAA, CJIS, FIPS, etc. They invest heavily in security to protect customers’ data from cyberthreats. Also, they offer robust solutions to secure your data and information during cloud migration. However, you need to have experienced DevOps engineers and a security team who can make necessary configurations and ensure the long-term security of your data and apps in the cloud. Here are a few simple things about security in the cloud everyone should know:

- Encrypt data assets in transit and at rest;
- Leave sensitive data on-premises;
- Isolate individual workloads to minimize any damage an attacker could cause;
- Configure a Firewall;
- Plan for security across heterogeneous environments;
- Make use of intelligent automation technologies such as RPA, Big Data, AI, IoT, etc.;
- Avoid shadow IT;
- Implement necessary controls;
- Enable multi-factor authentication and set up user access policies;
- Update passwords;
- Don’t use one password for all tools;
- Update anti-virus software;
- Don’t open susceptible links;
- Upgrade software to the latest installation.
- Train others on how to maintain security in the cloud.

It’s one thing to have the tools you need at hand for securing your data and apps in the cloud. And major cloud providers such as AWS, Azure, GCP offer them in abundance. But it is another thing to configure them correctly and be able to use data to drive insights that will help out-think and outmaneuver any attacker.

Anton Gavrylov | DevOps Engineer at N-iX
PART III. How to tackle key challenges of cloud migration

Six Functional Areas of Cloud Security Readiness

If you want to evaluate your cloud security maturity, take a look at Forrester’s Cloud Security Maturity Assessment. Forrester identified six major competencies and their weightings: governance (20%), measurement (10%), people (10%), process (10%), strategy (10%), and technology (40%) along with subsets of activities for each. It is a 20-question assessment that will help you define your cloud maturity level and strengthen your cloud security posture.

#4 Data loss

Before the migration, it is vital to make sure that all your data is backed up, especially the files that you'll be migrating. During the migration process, you may encounter such issues as corrupt, incomplete, or missing files. And if you have a backup, you’ll be able to easily correct any errors by restoring the data in its original state.

Take action: Configure backup of migrated data

Anything from a power outage at a data center to a security breach may cause data loss. If you have backups of databases stored on a server or in the cloud, you can quickly restore all the data. Plus, if you use multiple cloud providers, you don’t need to worry about unexpected downtime of service of the particular provider. You will always be able to deploy an independent replica of your application on another cloud provider’s infrastructure. Some cloud providers offer cost-effective storage services you can use for the backup.

Configuring backup of migrated data can save you a lot of time and money. It is important to back up your old system to be able to find any missing files if necessary.

Keeping on-premises infrastructure for legacy backup tape, database, and email systems tie up valuable space in your data center and is quite expensive. Cloud backup, however, is the most secure and cost-efficient backup method. Cloud gives you high-speed, budget-friendly infrastructure needed to move your data safely and ensures that your business data is converted into the right formats for secured retention and easy access.

Dmytro Denysov | DevOps Engineer at N-IX
#5 Latency

Unwanted latency is one of the most underestimated risks in cloud migration. It can occur when you access applications, databases, and services in the cloud. Latency is especially critical for IoT devices, e-commerce websites, video streaming solutions, and cloud gaming platforms where customer experience is crucial. If you have applications that require immediate responses, **delay in a few seconds can pose serious damage to your business.** It can not only lead to frustration and disappointment but also impact your brand reputation.

**Take action: Utilize optimization techniques**

To prevent latency issues, first you need to understand what causes them: the geographical distance between client devices and servers or misconfigured Quality of Service (QoS). There are several ways of how you can fix latency issues:

- Localize and optimize the network;
- Segment traffic flows;
- Establish multicloud connectivity;
- Offload the Internet at the edge;
- Connect to business partners and ecosystems for digital commerce and/or data exchanges.

If the above-mentioned methods don't help or are expensive for you, consider keeping such applications on-premise.

Our client **WEINMANN**, a Hamburg-based medical technology company, had an issue with high CPU latency at the device start-up. A portable defibrillator must be able to give an electric shock not later than in 10 seconds after the boot. Due to a number of improvements and new features that were implemented, a processor couldn’t ensure the timely boot. We have resolved this issue by delaying the initialization of some drivers. Also, we have ensured high-level security of the product and its compliance with a number of other healthcare regulations.

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#6 Lack of visibility

The lack of visibility is among the top risks in cloud migration. It affects network and application performance. When you rely on your own on-premises data centers, you take full control over your resources including physical hosts, networks, and data centers. But when switching to external cloud services, the responsibility for some policies moves to cloud providers depending on the type of service. As a result, the company **lacks visibility into cloud workloads.**

According to a recent survey from Dimensional Research, 95% of respondents say visibility problems have led them to experience an application or network performance issue. 38% state that insufficient visibility is a key factor in application outages and 31% - in network outages.

Visibility in private and public clouds

<table>
<thead>
<tr>
<th>20%</th>
<th>55%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have complete, timely access to data packets in public clouds</td>
<td>Have adequate visibility in private clouds</td>
</tr>
</tbody>
</table>

**Take action: Improve network and application performance monitoring**

Today, there are many tools that can help network and application performance monitoring. Cloud service providers and third-party security vendors offer a variety of solutions for that. Here are a few requirements for effective monitoring tools:
PART III. How to tackle key challenges of cloud migration

- Basic monitoring capabilities without any need for manual configuration;
- A monitoring solution should integrate easily with your other solutions;
- Powerful analytics;
- Possibility to configure different kinds of alerts;
- A steep learning curve;
- Automatic response to certain types of alerts and threats.

N-iX has helped its partner GOGO improve its operational efficiency by ensuring visibility into application performance and health. With the help of CloudWatch, we monitor mission-critical resources on AWS such as EMR clusters, EC2 instances, DynamoDB tables, and RDS instances. Also, this service helps us collect and track metrics, log files, and set alarms. With HostedGraphite, we have access to more-detailed dashboards that help us collect and review metrics from different sources in real-time with built-in alerting. Besides, we have also designed end-user health dashboards that give insights to managers, reporting and other teams on a high level. For example, it tracks issues like satellite breakdown, equipment maintenance and data processing issues that could significantly influence income or can help to identify potential issues that might impact in-flight connectivity availability and quality.

#7 Cloud vendor monopoly

Cloud vendor lock-in is a concern of many companies that are considering migration to the cloud. Overreliance upon a service provided by a single cloud vendor causes constraints that prevent businesses from switching to another cloud provider. According to Flexera 2020 CIO Priorities report, 68% of CIOs are worried about vendor lock-in regarding public cloud.\[37\] Many companies are concerned with the difficulty and cost of switching to a new vendor if their current cloud provider doesn’t meet their future needs, fails to meet service level agreements, or incurs a data breach.

Level of Concern About Vendor Lock-In

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Very Concerned</th>
<th>Somewhat Concerned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public cloud</td>
<td>36%</td>
<td>32%</td>
</tr>
<tr>
<td>On-premises software</td>
<td>31%</td>
<td>45%</td>
</tr>
<tr>
<td>SaaS</td>
<td>30%</td>
<td>48%</td>
</tr>
<tr>
<td>Outsourcing services</td>
<td>26%</td>
<td>42%</td>
</tr>
<tr>
<td>Networking services</td>
<td>26%</td>
<td>41%</td>
</tr>
<tr>
<td>System integrators</td>
<td>25%</td>
<td>41%</td>
</tr>
<tr>
<td>Managed service providers</td>
<td>25%</td>
<td>50%</td>
</tr>
<tr>
<td>Hardware</td>
<td>25%</td>
<td>37%</td>
</tr>
<tr>
<td>Open source software</td>
<td>25%</td>
<td>32%</td>
</tr>
<tr>
<td>Development tools</td>
<td>23%</td>
<td>43%</td>
</tr>
</tbody>
</table>

Source: Flexera 2020 CIO Priorities Report Survey  
N=302
Take action: Take control of your apps and data to minimize your vendor lock-in risk

If you don’t want to lose control of your business critical data and infrastructure, determine your business requirements and thoroughly assess your cloud vendor offerings. Pay special attention to their service level agreements, data transfer processes, and costs. Although there is no magic bullet for avoiding lock-in, there are several things that you can do:

- Design your application to be portable and aligned with open source standards;
- Maximize portability of your data: avoid proprietary formatting, standardize the documentation, categorization, and indexing of data;
- Consider a multi-cloud strategy;
- Implement DevOps tools and processes: IaC, CI/CD, container technology like Docker and CoreOS, configuration management tools like Chef and Puppet, etc.;
- Develop a clear exit strategy.

One of our clients, a Fortune 500 industrial supply company, addressed N-iX with a request to build an AWS-based big data platform from scratch. One of their requirements was the high portability of a solution — its ability to run in any cloud and be easily moved between different clouds. So the whole development process has been designed to ensure that the client can easily change the cloud provider in the future. For example, we use Terraform as it is suitable for all cloud vendors — AWS, Azure, and Google Cloud. Also, we have preferred Snowflake to Amazon Redshift as it ensures cloud neutrality: it can easily scale up and down any amount of computing power for any number of workloads and across any combination of clouds.
The Challenge
The client wanted to migrate their not scalable expensive on-premises data solutions to the cloud, make them scalable, and improve the customer experience using big data analysis.

The Solution
N-iX team has performed a complete transition of Gogo solutions to the AWS cloud platform and built a unified data platform. We’ve helped the client to optimize operations, completely rebuilt the solution using open-source technologies, such as Spark, streamlined the system of predicting failures and replacing devices, and built several highly efficient analytics platforms. As a result, we have helped reduce the number of no-fault-founds by 8 times and significantly cut maintenance costs.

The Challenge
Orbus Software needed to modernize its key product iServer to improve its scalability and performance. The client needed to set up production-grade infrastructure in Azure, implement multi-tenancy, set up orchestration processes, and fix legacy on-premises infrastructure issues.

The Solution
Using the latest Microsoft technology stack such as .Net Core and Azure services, we have helped Orbus Software build the new generation of iServer product that functionally matches the old back-end, works with the existing UI, and can be exposed via API for use by Orbus clients.
N-iX team has implemented infrastructure as code to all Azure resources and migrated legacy infrastructure to IaC. We have ensured a quick and easy set up of the environment and built a fully automated CI/CD from Git commit to delivering the app to production. First and second line support engineers take care of the Orbus iServer in Azure-hosted environment and help troubleshoot the product and infrastructure issues with Orbus customers.
YOUR ULTIMATE ROADMAP TO SUCCESSFUL CLOUD TRANSFORMATION

**The Challenge**
Vable wanted to expand its market reach to cover the greater scope of business cases and serve a wider range of customers. Thus, they needed to move its on-premises content automation platform to the cloud to ensure high scalability, availability, and flexibility.

**The Solution**
N-iX has helped Vable rethink the business idea of their on-premises solution and migrate it to the AWS cloud platform. We have designed a new software architecture, moving from the traditional backend monolith to microservices, developed cloud data services for the product, and built new functionality. As a result, the platform is highly flexible and ready to expand to new markets.

**Lebara** is a UK-based company that offers a powerful content automation platform for creating curated newsletters and monitoring their delivery through analytics. It helps companies manage information from various sources in one place and deliver the most relevant content to their audience.

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**The Challenge**
Lebara has partnered with N-iX to improve scalability, high performance, and maintainability of their products and services. They wanted to reduce the lead time from code commit to production, which consisted of too many manual steps and took days, decrease deployment time for all environments, avoid vendor lock-in, and ensure effective monitoring and alerting in the cloud.

**The Solution**
N-iX team has helped the client mitigate the risks of dependence on a single provider by implementing the multi-cloud strategy. Also, containerization has enabled flexibility to change the cloud provider in the future. Thanks to the introduction of DevOps best practices, time-to-market has been significantly improved. With Infrastructure as a Code, the client can use template-based solutions and doesn’t need to spend hours manually provisioning the IT infrastructure. By fully automating the CI/CD pipeline in Azure and AWS, lead time has decreased to a few hours.

Implementation of 80+ AWS and Azure microservices allowed consolidating the applications for all countries and channels and enabled Lebara to further expand its markets and business operations fast and efficiently.

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**Lebara** is one of Europe’s fastest-growing mobile companies with 5 million active customers, 1,400 employees worldwide, and operations in 9 countries.
The Challenge

Currencycloud needed to ensure the scalability and security of the solution, its flawless performance, and compliance with fintech regulations. As a part of their AWS cloud adoption, the company required a team with strong engineering skills and cloud expertise to enhance and support its payments platform.

The Solution

Our team has contributed to the development of an efficient and secure payments platform that processes over $400M in 35 currencies every month. N-iX has helped the client build a secure and flexible AWS-based web application on the basis of the Payment Engine as well as develop a new, improved version of Currencycloud RESTful API.

The Challenge

cleverbridge decided to migrate its desktop app to the cloud with updated features to ensure that clients on different platforms and devices can easily access the application.

The Solution

N-iX has helped the client go omnichannel to expand market reach. The web-based application is now available across different operating systems, browsers and mobile devices. New UX design improved the convenience and experience of using the app thanks to the lean UX approach and involvement of cleverbridge customers in various stages of new design. Also, we applied our extensive knowledge in Power BI and built an informative BI analytics for the cleverbridge's largest clients.
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N-iX is an Eastern European provider of software development services with 1000+ expert software engineers onboard that power innovative technology businesses. Since 2002 we have formed strategic partnerships with a variety of global industry leaders including OpenText, Novell, Lebara, Currencycloud and over 50 other medium and large-scale businesses. With delivery centers in Ukraine, Poland, Bulgaria, and Belarus, we deliver excellence in software engineering and deep expertise in a range of verticals including finance, healthcare, hospitality, telecom, energy and enterprise content management helping our clients to innovate and implement technology transformations.

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