

India's cloud and data revolution

From adoption to enabling innovation

August 2023



Foreword



The Indian economy is going through fast-paced reforms and growth in digital infrastructure. Enterprises are increasingly adopting advanced technologies such as cloud computing, advanced AI data analytics, edge, quantum, AR/VR, Internet of Things (IoT), etc. and increasing their investments in these technologies. Every digital or traditional technology will need a cloud platform to run on. Cloud has moved from being a facilitator and emerged as a catalyst to drive innovation, agility and business growth. It is helping organizations scale and adapt at a greater speed while seamlessly integrating data and services to achieve business transformation. This year's EY-FICCI cloud and data survey delves deep into the various avatars of cloud computing in India, evolution from an enabler of cost optimization and operational efficiency to innovation, new businesses, and monetization of data.

This report highlights how organizations are using cloud to enable modernization, go digital and accelerate revenue opportunities. For example, enterprises can forge new partnerships and expand into other geographies, unlock new and significant monetization opportunities with industry cloud, software as a service (SaaS) and API-based business models.

Our survey sheds light on the drivers that propel the seamless migration of business-critical applications to the cloud for organizations across various sizes. However, finding the right talent and cost optimization remains a challenge for Indian enterprises.

Looking over the next few years, with India's population growth and the subsequent data deluge, the cloud ecosystem will advance and mature, and new models will evolve. While hybrid cloud allows organizations to unlock themselves from proprietary technologies allowing flexibility and security, the heterogenous nature of products like multi-cloud and the industry cloud permits further scope for invention and business model redesign. New workloads will be deployed in a cloud-native environment and everything non-cloud will become legacy. I hope you find our report insightful, engaging and thought-provoking.



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FICCI

The advent of cloud technologies has fundamentally transformed the operational landscape for businesses and individuals, enabling greater efficiency, scalability, and innovation. India, with its flourishing digital ecosystem, has become a pivotal player in the global market for cloud computing. Over the past years, our cloud computing market has demonstrated remarkable growth, driven by increased internet penetration, government initiatives, and the emergence of a vibrant startup ecosystem.

One of the primary catalysts behind this growth is the rapid digitization efforts undertaken by the Indian government. Digital India Mission and subsequent initiatives have created an enabling environment for the adoption of cloud computing. Government agencies are increasingly embracing cloud services to enhance service delivery, optimize costs, and promote data-driven governance. The rise of Indian startups has also played a pivotal role in shaping the cloud computing landscape. Motivated by innovation and agility, startups have harnessed the power of cloud computing to disrupt traditional industries and drive digital transformation. Moreover, a collaboration between global cloud service providers and local enterprises has led to the adoption of cloud technologies and nurturing of a dynamic ecosystem of cloud-based services and solutions.

FICCI appreciates the transformative potential of cloud computing and encourages businesses across sectors to leverage its capabilities for enhanced productivity, innovation, and competitiveness. It is crucial that we continue to cultivate an environment that promotes cloud adoption, invests in robust infrastructure, and facilitates skill development to effectively harness the benefits offered by cloud technologies.

This report provides valuable insights and recommendations for businesses, policymakers, and stakeholders interested in harnessing the full potential of cloud computing. It outlines the opportunities and challenges faced by organizations in their cloud adoption journey, provides best practices and case studies, and offers strategic guidance for successful implementation. I extend my heartfelt appreciation to the authors and contributors of this report for their diligent research and thoughtful analysis. I trust that this report will serve as a valuable resource, inspiring organizations and decision-makers to embrace cloud computing and navigate the evolving digital landscape with confidence.



Shailesh K Pathak

Secretary General
FICCI

Executive Summary

Exponential trajectories of growth in the India cloud computing landscape

India 2047

India is projected to become a US\$ 26 trillion GDP economic superpower by 2047. By 2023, it will also become home to the largest, youngest, most digitally savvy population in the world. About 1.64 billion consumers will demand digital services in all areas of their lives. The digital arena - from Artificial Intelligence (AI) to Metaverse - will become their natural workplace as well as playground.

We can already see this happening and Indian enterprises are amping up their digital services at a speed and scale never seen before. Consumer-facing technology is being revamped to become context aware and intelligent, using advanced AI and Machine Learning (ML) algorithms to sell and service consumer needs. Supply chain platforms are moving to real-time and resilient architectures. Knowledge workers across industries are being armed with smart, AI-enabled co-pilots to work more productively. All this is being done in an agile mode, characterized by frugal innovation models.

At the core of all these services lies the cloud, which has revolutionized the way services are offered by both the government and enterprises. The next generation of cloud is evolving, powered by innovations developed in India in response to consumer needs.

Factors influencing cloud growth

- Traditional companies moving to cloud
- Growth of cloud-native companies
- Wider government to citizen services and programs
- Emerging technologies such as generative AI
- India becoming a hub for GCCs

The digital innovations are not restricted to Indian consumers alone - India is now a hub for designing and offering those services globally. Global Capability Centers (GCCs) have become cloud engineering hubs for global companies. As these companies move to modern applications and data architectures, they seek to locate new to firm capabilities in India. India has a vibrant cloud ecosystem and a fertile cloud talent base. Interestingly, talent available across cloud architecture engineering, data analytics, AI platforms and others are cross-pollinating to develop new services and innovations in modern data formats and technologies. We are witnessing the golden era of disruptive technologies in data and technology.

Cloud computing to leapfrog Indian enterprises

Cloud computing, in particular public cloud, is the basic fabric that will enable enterprises to leap into the future. A few years ago, in India the use of the public cloud was at best tentative. Moving to the cloud was seen as a cost reduction strategy as companies attempted to reduce their infrastructure cost. Data privacy concerns were widespread and regulation fuzzy. While digital natives (essentially born in the cloud) made full use of this paradigm, CXOs at larger enterprises were more cautious.

Today, the picture is very different. As COVID accelerated digital adoption, a host of technology companies invested significantly into enhancing their cloud offerings. With edge computing, high-performance computing and AI/ML models coming in, companies are investing in many areas like cloud-based data infrastructure solutions, data applications, and AI solutions. For India's massive COVID-19 vaccination drive, the government used cloud to quickly deploy and scale. Similarly, after a decade of quadrupling its usage year over year, a free healthcare program called Aarogyasri, which is run by the state government of Telangana for low-income families, achieved the needed scalability by migrating the program's infrastructure to cloud.

Cloud service providers (CSPs) are setting up new cloud regions in India to offer more cloud-native services to domestic and global enterprises.

Companies are also investing heavily in Generative AI. Creation of such models necessitates extensive data and computational resources, a gap effectively filled by cloud computing. For example, a leading payment services company in India uses a cloud AI service, to extract text and data instantly and accurately from users' identity document images for registration purposes. Generative AI's reliance on vast datasets and demanding computing infrastructure, both of which are fundamental aspects of cloud technology, will result in a surge in data usage and higher consumption of cloud resources. Furthermore, this paradigm shift toward leveraging unstructured data necessitates the use of scalability and specialized tools offered by cloud, as on-premise solutions lack the capability to effectively process unstructured data.

Similarly, India has become a potentially big market for cloud service providers (CSPs) as they search for growth. CSPs have been quick to set up new cloud regions (Mumbai, Chennai, Hyderabad and Pune) in India and bring all their offerings, which vastly expands cloud-native services available to Indian enterprises.

Cloud engineering for the world - Made in India

With highly complex solutions and offerings, cloud technology requires a wide array of skills. According to a Nasscom report, India's talent pool of cloud professionals across various industries is expected to more than double from 608,000 in 2021 to 1.5 million by 2025. As per a study by a consulting company and a cloud hyperscaler, advanced digital workers who are skilled in technologies like cloud earn 65% more than non-digital workers. Demand for talent with cloud skillsets, especially as more organizations migrate to cloud, will intensify, leading to a clamor for experts in cloud solution architecture, migration analysis, DevSecOps engineering, cloud security designing, and more. This will be in addition to the existing pressure for professionals in AI and ML, big data, and various cloud platforms.

The demand for cloud skills stems from the fact that traditional Indian enterprises are rapidly adopting the available cloud services; many have evolved to become 'cloud first'. Start-ups have been adopting the cloud first approach for a couple of years now. Bigger enterprises that were early adopters of cloud computing have moved from using the cloud mostly for cost optimization and operational efficiency to leveraging them to build their next-generation digital platforms.

Enabled by the next generation of cloud technology, enterprises are launching new products and services faster. In EY-FICCI survey, as many as 63% companies said they have adopted cloud for monetization of data and to get valuable insights.

Almost all companies investing in new data platforms are building them on the cloud. For 80% organizations, cloud helps enable data and analytics capabilities; 78% organizations already have more than 30% data on cloud; and 58% are focusing on new workloads for modernization initiatives.

Moving to cloud



80%

use cloud for data and analytics



78%

companies have more than 30% data on cloud



58%

are moving new workloads to cloud

Cloud computing trends

As one looks to the future it is possible to discern the contours of what we believe will become a unique paradigm in Indian cloud computing - as opposed to the global template-driven deployments we are seeing today.

Newer cloud trends are emerging. Industry cloud facilitates organizations in choosing and stitching together the many components that CSPs provide. We believe we will see significant progress in an Indian industry overlay on this model. Domain clouds that provide solutions to run one function, for instance, CRM, and sustainability clouds that help organizations reduce carbon emissions, use resources more efficiently and lessen environmental footprint are creating value for companies to scale and grow.

In the EY-FICCI survey, around two in every five organizations follow a hybrid approach, which is becoming a popular choice as it provides scalability and security

The government is already a big player in the cloud space. India today boasts of one of the most evolved and digital Government to Citizen services model in the world with services such as Aadhaar, UPI, DigiLocker and the emerging stacks in healthcare and education, which is boosting cloud adoption.

India is turning into a hub of cloud first companies that thrive on a cloud focused talent pool, which is helping them scale, innovate and create unique applications to create a fertile cloud ecosystem for the world.

That said, our survey also shows that cost optimization remains a challenge. About 20% of cloud consumers in India have not achieved any cost savings using cloud computing. Many companies are paying two to three times more than their on-premise costs. To avoid such overruns, enterprises must understand and plan their workloads and consumption. CSPs, too, need to be transparent in their costs and billings. Another solution is for organizations to take the FinOps approach to manage cloud environments more effectively.

Another challenge is that even if the cloud talent base is growing in the country, it is not enough to meet the increasing demand. At the same time, there is shortage of employees to support legacy applications too. Therefore, talent has become a double whammy. Given the aspirational adoption rate, India needs to overcome this challenge.

Conclusion

In the past few years, cloud hyperscalers have seen multi-fold growth and, as the survey shows, organizations are moving beyond proof of concept. Cloud is now becoming critical infrastructure for enterprises. This will be instrumental as India strives for sustained economic growth with a strong focus on digitization and Indian organizations spearhead delivery of differential growth. The momentum will come from Indian enterprises that adopt cloud to innovate, scale and grow sustainably as they gain competitive advantage.



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Cloud: The macro-economic growth

The role of cloud technologies is evolving rapidly in India. The prime reasons for enterprises to adopt cloud have moved beyond cost savings to growth, agility, and innovation. However, many other factors too are spurring cloud adoption – from the government’s expanding use of digital technology in public services delivery to the need for organizations to be more flexible and innovative even as they start new business and revenue models.

This chapter highlights developments that are influencing the direction of cloud technologies’ evolution, which includes India’s economic growth and digital expansion coupled with data explosion, transformation of GCCs as cloud engineering hubs, evolution of traditional enterprises into modern organizations and rise of cloud native enterprises. These macro trends are not only redefining the reasons for cloud adoption but reshaping the cloud technology itself.

State of the nation

Despite an economic recession and a global pandemic over the past few years, India has grown at an average of 6% over the last two decades to become the fifth largest economy in the world. With its ambitious growth plans and digital initiatives, the Government of India has set the goal for the country to become an economic superpower by 2047. Acceleration of economic reforms, wider adoption of digital technologies, various Digital India initiatives such as DigiLocker, e-governance, Unified Mobile Application for New-age Governance (UMANG), mobile e-health

services, digital finance services and so on are further transforming India into a digitally empowered society and a knowledge-based economy.

The country's highly scalable Digital Public Infrastructure has started yielding economic benefits even as it gives rise to further innovation and entrepreneurship. India's mobile data consumption is among the highest in the world and increasing. The size of the digital economy in India is estimated to grow from US\$200 billion in 2017-18 to a staggering US\$1 trillion by 2025.

Going forward, technology has great potential to address many of our most persistent development challenges, both in the private and the public sectors. Be it generating employment, improving access to healthcare and education, or delivery of public services, modern technology will play a crucial role. Digitization and data usage are poised to change every sector of India's economy, creating significant economic value rapidly and radically by making the country competitive and creating new businesses and products.

India's growing cloud base

US\$26 trillion

India's GDP by 2047-2048 in market exchange rate terms

Source: EY India@100 report

India to continue being the **fastest growing large economy** in the medium term

15.6%

Growth in India's digital economy (2014-19)

Digital India in numbers

Digital businesses



108
Unicorns in India



99,000
No. of start-ups

Digital financial services



58.3 million
Income tax returns filed
(till 31 July 2022 for FY22)



52 billion
No. of UPI transactions Jan-Jun 2023

Digital public platforms

1.35 billion
Aadhaar numbers
issued (till Nov 2022)

175.49 million
No. of DigiLocker users
(as of 11 July 2023)

418.7 million
No. of Ayushman Bharat Health
Accounts (till July 2023)

281 million
No. of health
records linked

Sources: Invest India, UIDAI, DigiLocker, National Health Authority, NPCI, Income Tax India

Historically, technology has been at the heart of economic growth. The intensity of the growth, however, depends on the speed and magnitude of adoption. With the pandemic, most organizations have become faster in acquiring and adopting new technologies. Investment in advanced technology solutions, including cloud computing, AI in general and generative AI in particular, ML, and other data solutions is growing multi-fold as these technologies are enhancing business efficiencies by helping organizations respond to market requirements and seamlessly connect with their internal systems as well as external clients, vendors, and customers.

Cloud computing is now embedded at the heart of any new digitalization initiative because of the scalability and flexibility it offers and its ability to get to market faster. By adopting cloud, organizations reap the benefits of using the best breed of technology while growing sustainably. India's large population, very high volumes of data generated and the need for low-cost design will further increase cloud usage and data-led innovation. Additionally, the National Digital Communications Policy 2018 and national government's cloud and data center vision aim to establish India as a global hub for cloud computing, data centers, content hosting and delivery, as well as for data communication systems and services.



Large-scale public digitalization goals

- Financial inclusion
- New digital payment system
- Digital financial services in rural areas
- National e-commerce policy
- Digital industrial policy
- eCourt project to modernize delivery of judicial services
- Digital certificate repository DigiLocker

GCCs driving cloud growth

India currently hosts 1,500 Global Capability Centers (GCCs), making up 45% of global GCCs. In the next two years, around 200 new GCCs are expected to open in India, particularly in sectors such as banking, financial services, and insurance (BFSI), telecom, IT consulting, healthcare, pharma, and hospitality, where companies are focusing on modern disruptive technologies. GCCs are developing cloud-based engineering and technology capabilities in India, with a mature and proven model that can offshore work globally. Consequently, they are increasingly seeking cloud-based talent from India.

About 200 new GCCs are expected to open in India in the next two years and the country's cloud ecosystem is an opportunity for them to collaborate and cross-pollinate in cloud technologies and talent.

As GCCs are currently driving emerging technologies and ideating on breakthrough opportunities, they are playing the role of transformation catalysts. This trend is expected to accelerate further as they add new capabilities, leading to higher demand for talent with specific skillsets and domain expertise. With India's young population base, the country is positioned well to become the next global hub of cloud talent. According to Nasscom, the country's installed talent base is projected to reach 1.5 million by 2025. With rigorous upskilling and reskilling programs and considering India's large pool of qualified technical graduates, the country could even build a talent pool of 2.3 million in the next two years.

In addition, India has a vibrant cloud ecosystem. Cloud is expected to add value worth US\$ 310-380 billion to India's GDP in 2026, accounting for approximately 8% of relative GDP, according to a Nasscom report. It could also create about 14 million direct and indirect employment opportunities.

Over the last few years, the country's standing as a start-up ecosystem in the world has improved significantly, ranking third after the US and China. Among these, cloud-native start-ups are a Software-as-a-Service (SaaS) hub for the world, creating disruptive solutions. India is now home to more than 80,000 active start-ups and 107 unicorns with a total valuation of almost US\$341 billion. The country has over 1,000 SaaS companies, with the top-notchers' valuations being almost 8-10 times their revenue figures. The strong start-up ecosystem has added employment, investment, and elevated competitiveness to the mix.

Not only start-ups, but small and medium-scale businesses (SMBs) in India are also digitizing fast and need simple, easy-to-deploy-and-use solutions, which will further drive cloud growth. According to IDC, 35% of SMBs will shift one-third of their core workloads to the cloud to drive business agility and future resilience by 2024.

Therefore, India's cloud ecosystem presents an excellent opportunity for GCCs and new-age Indian companies to collaborate and cross-pollinate in cloud technologies and talents, further accelerating the entire cloud-based innovation journey. There is no better time than now to take the necessary steps to achieve this vision.

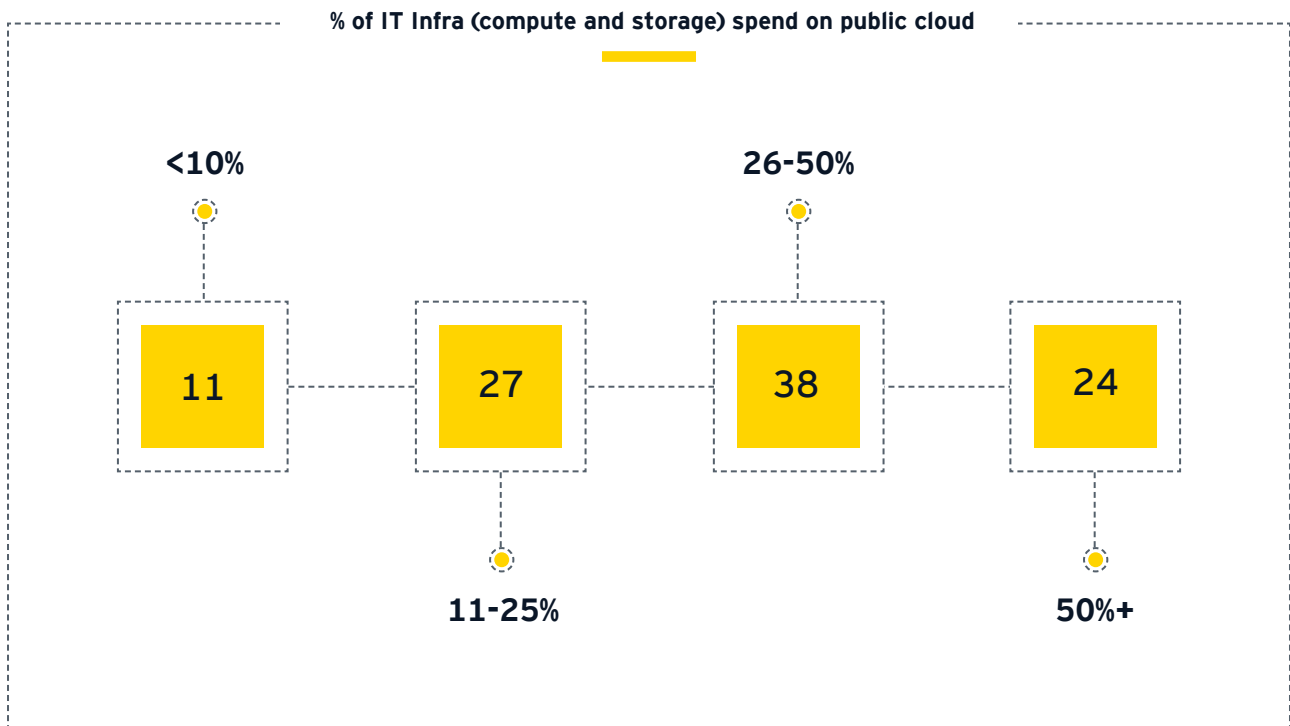
State of the enterprise

Over the last few years, digitalization and a supportive policy environment in the form of Digital India, Start-up India etc., have further strengthened the entrepreneurship culture, giving a new and unprecedented scale to Indian enterprises. While traditional enterprises are evolving into modern organizations, digitally native companies, including start-ups, are reaping the benefits of being born and nurtured on the cloud.

Adoption of advanced digital technologies is helping Indian businesses become more efficient and globally competitive even as they explore new markets and create new business models.

As per a recent EY India survey, organizations are increasingly spending on public cloud services. An average of 36% of their IT infrastructure (compute and storage) is for public cloud - this indicates a shift toward a "cloud-first" policy for deploying new applications using a public cloud service.

Average % of IT Infra (compute and storage) spent on public cloud is 36%



The overall public cloud services market in India is projected to reach US\$13 billion by 2026, with verticals such as BFSI, manufacturing, government, software, and media being the key drivers, according to IDC. Consequently, with India being a crucial growth market, cloud service providers (CSPs) are expanding their offerings by unveiling new data centers and cloud regions, thus enhancing their service delivery capabilities. Additionally, there has been a surge in adoption of cloud-based AI platforms and cloud-native application development.

From enabling operations to cost optimization, cloud has taken center stage in business strategy and developed new aspects such as platforms and on-demand environments. Indian organizations too have changed the way they think about the cloud. Unlike the earlier days of cloud, the purpose of adoption is not just cost saving or business continuity, but also business growth, transformation, security, and innovation.

The exponential growth in data footprints of organizations has opened opportunities for newer data monetization techniques.

To facilitate this process, companies must modernize their data infrastructure to derive sharper insights and monetize data, while simultaneously improving its quality and consolidation.

Cloud as an imperative

Organizations today have embraced cloud adoption for mature purposes, including cloud-led agility and growth. As India gears up for further development, the next surge of growth will be fueled by data modernization and data-led innovation.



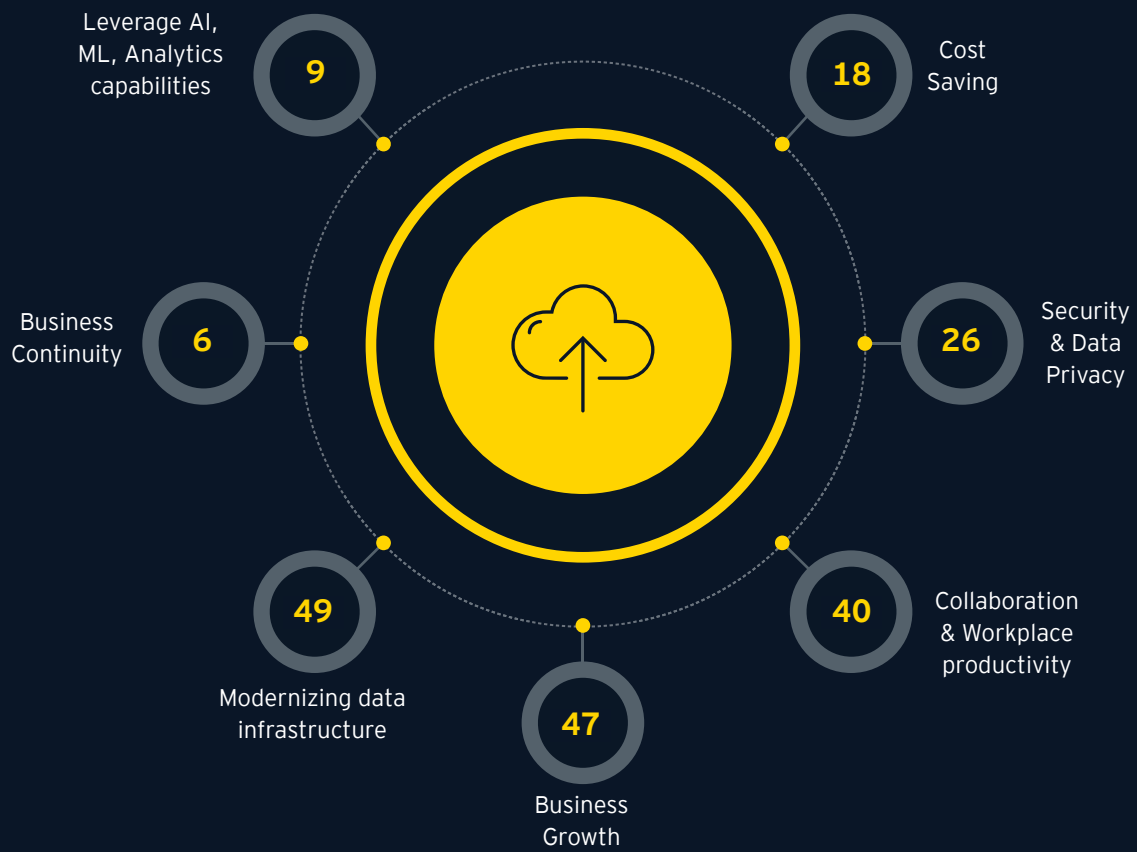
Evolving reasons for cloud adoption



Cloud is expected to replace legacy on-premise systems in many organizations in the next few years and become the platform of choice for business operations. The purpose for cloud adoption has evolved from cost-saving and agility earlier to it being a facilitator for rapid innovation, new product development, building new customer experiences, and increasing collaboration for growth.

Gartner forecasts end-user spending on public cloud in India to grow 27% in 2023 alone. Companies are rapidly investing in new cloud-based digital channels and analytics to improve operational efficiencies. For example, spending on data center systems is expected to reduce in 2023 as businesses opt for public cloud services. Clearly, this trend is going to drive additional investments in the cloud.

Business drivers for moving to cloud



Figures in rank score out of 100

Source: EY survey

As public and private organizations adopt cloud for varying reasons, cloud computing has become a critical driver of economic development globally, revolutionizing the way businesses operate and interact with their customers.

With the adoption of cloud computing, there are lower entry barriers for new businesses as they can compete effectively with established players. For instance, many well-funded Non-banking Financial Companies (NBFCs) are now leveraging cloud to increase their reach and offer new services, thus competing with traditional banks that rely on on-premise (on-prem) solutions. Using cloud-based applications and services, organizations can offer products and services online, reaching a wider audience and tapping into new markets. One of India's largest NBFCs was looking at ways to move away from siloed systems, excessive paperwork, and multiple legacy systems to an all-digital loan origination CRM platform. The cloud solution it adopted not only helped the company automate customer acquisition and enable high employee productivity, it also digitally transformed the entire lending ecosystem at a lower total cost of ownership.

Similarly, development of services such as Open AI has enabled service-based innovation, especially in AI and ML. As a result, enterprises of many hues are participating more effectively in the digital economy, both locally and globally.

The rise of SaaS has created a new market for cloud-based applications that are easier to use and maintain than traditional on-prem software. The growth of cloud computing will not only allow organizations to become agile and grow but also scale sustainably as it optimizes use of resources, thus reducing the operation's carbon footprint.

Fueled by products and services that leverage AI, ML and newer solutions like industry cloud and functional clouds, we can expect the overall cloud ecosystem to become wider and stronger. With data disruption, increased participation in digital economy, and a fertile talent base, the Indian cloud computing market is poised to ride the next wave of growth.

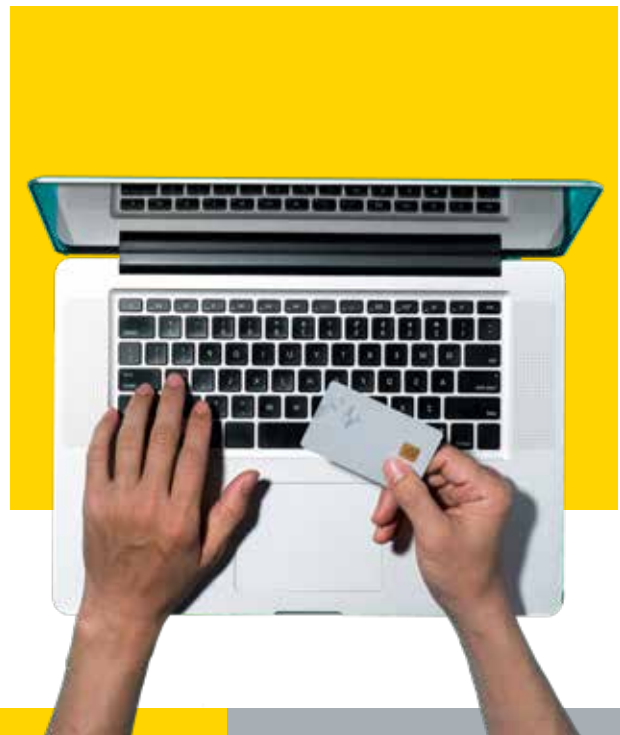
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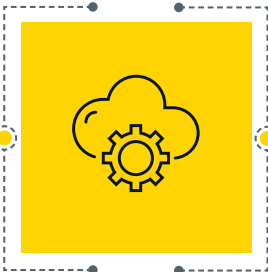
Key Findings

The EY India cloud survey saw participation from 700 companies from across more than 20 sectors in seven Indian cities. Through the cloud survey, they shared various aspects of their cloud adoption journey, including cloud strategy, drivers, reasons for data monetization and app modernization, and cost optimization challenges. Following are the key highlights from the survey and the crucial cloud trends observed.

Size of Enterprise Sample Size

Large	207
(> INR20,000 crore revenue)	
Medium	341
(INR5,000-20,000 crore revenue)	
Small	152
(INR1,000-5,000 crore revenue)	
Total	700





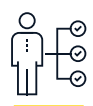
Major cloud drivers



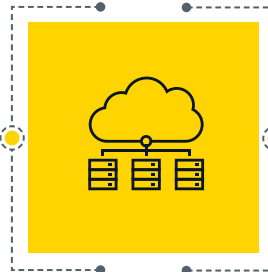
49%
To modernize data infrastructure



47%
For business growth



40%
For collaboration and workplace productivity



Data Modernization



78%
Organizations with **30%** data on cloud

Drivers



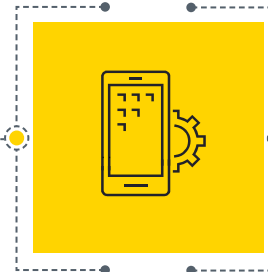
63%
Monetization of data



51%
Developer productivity



43%
Innovation & Incubation



App Modernization



78%
Organizations building a strategy



72%
Use third parties to validate modernization initiatives



21%
Started execution



Cost Saving



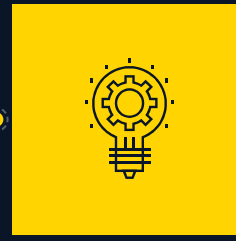
80%

Organizations that were able to save only over 10% cost by adopting a hybrid approach



85%

Organizations that use automatic scaling for cost control



Observability



67%

Organizations that have deployed tools for observability



42%

Organizations that are in the predictive phase of cloud observability adoption



Optimization



49%

Organizations that analyze telemetry data for possible optimization



30%

Companies that use telemetry data and run ML algorithm for self healing and right sizing cloud infrastructure



□ Key cloud trends observed

- Global Capability Centers (GCCs) are becoming cloud engineering hubs
- Enterprises are leveraging cloud to launch new products
- Indian enterprises are at a tipping point to become cloud-native with their architecture and cloud native talent base
- Demand for cloud talent will intensify as organizations modernize their data and applications
- India has a very fertile cloud talent base
- As organizations are maturing, they are opting for industry cloud, domain cloud, sustainability cloud and distributed cloud (*Explained further in Chapter 4*)
- Cloud provides indispensable storage and computational resources for leveraging new technologies like Generative AI

3

Cloud drivers



Cloud capabilities are undergoing significant transformation as organizations adopt them for integration of data, application capabilities, agility, and composable architecture. This year these capabilities will be the primary reasons for companies to shift to cloud to fulfil modernization initiatives and achieve long-term digital transformation, finds the EY-FICCI survey

The major drivers and enablers that prompt organizations to adopt cloud technology are not just cost optimization or business continuity anymore. This chapter examines the larger goals that companies want to achieve by adopting cloud, which includes data modernization, application modernization, agility, business growth, and innovation.

The survey reveals that organizations are increasingly using the cloud for data infrastructure modernization, to derive benefits from their data, and gain new insights. Additionally, they are looking at business growth, increased collaboration, workplace productivity, security, and data privacy. These drivers are consistent across organizations irrespective of their size.



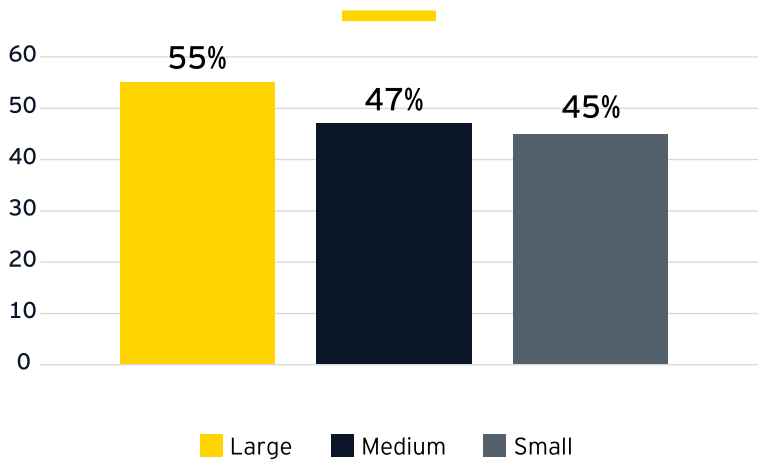
Major cloud drivers



Data modernization

Legacy systems can lead to data silos, inconsistencies, and poor data quality, which hinders effective decision-making. Therefore, organizations are now moving their on-prem data warehouses and lakes to cloud-based data platforms that have advanced AI and ML capabilities. This shift helps streamline their data with better governance, apply analytics, and derive deeper and wider insights from the data. Moreover, moving data to cloud will enhance scalability and flexibility. The survey states that 49% organizations adopt cloud to modernize their data infrastructure. This figure is higher among larger organizations at 55%.

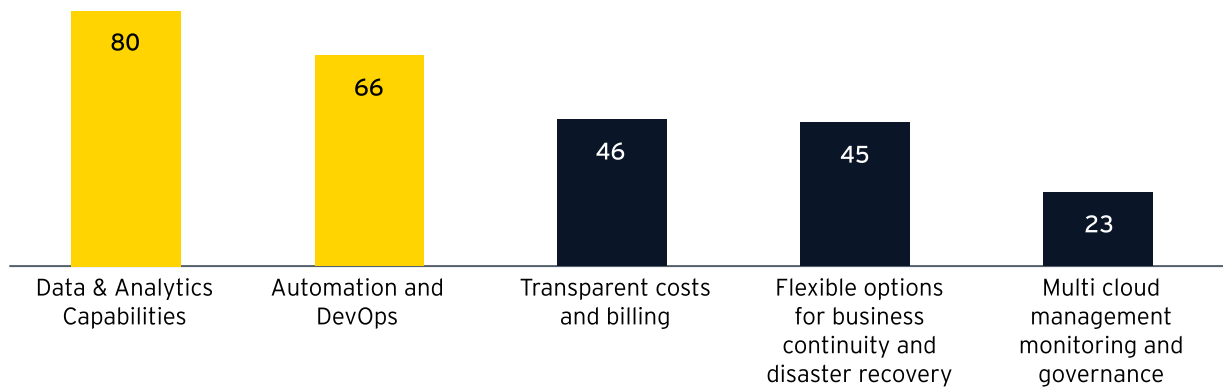
Cloud as a driver for modernization of data infrastructure by organization size



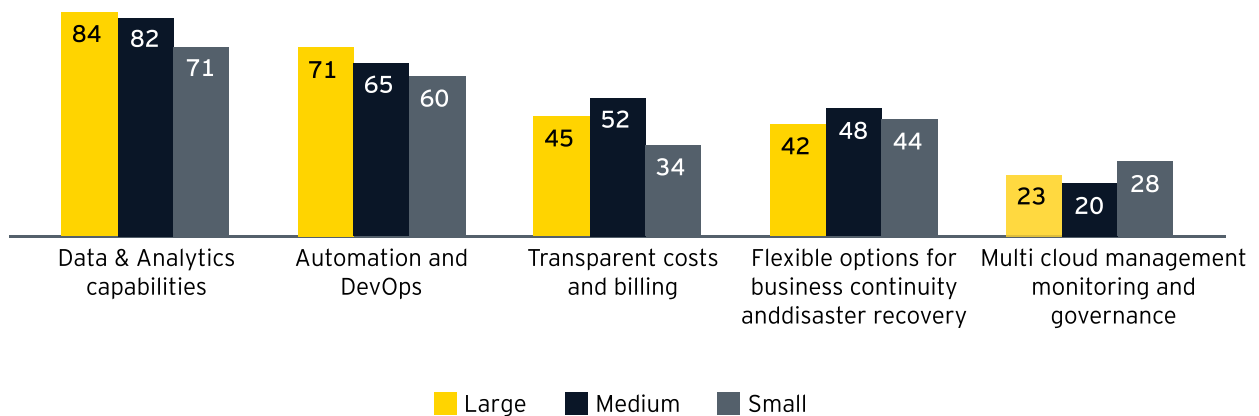
Figures in %

Similarly, data and analytics capabilities are major enablers for approximately 84% of larger enterprises to adopt cloud. The levels are high for other types of companies as well - 82% of medium level companies and 71% smaller organizations. Automation and DevOps capabilities are the other top enablers.

Data and analytics capabilities followed by automation and DevOps have enabled accelerating cloud adoption.



Figures in %



Figures in %

Data modernization involves not only breaking down silos but also making data easily accessible through established platforms with robust security. With data modernization, businesses can monitor various data streams in real-time, clean and standardize data, and ensure its accuracy and completeness. This approach thereby proactively mitigates risks by providing insights in real-time, enabling organizations to innovate and grow. It also opens opportunities for Indian companies to tap into new markets, diversify their revenue streams, and become data-led organizations. For example, one of the nation's largest conglomerates adopted cloud for its new content distribution platform for billing modernization, customer portal, and big data applications. The company not only increased its scalability and agility but also improved its response to spikes in customer demand and providing customer-centric experiences.

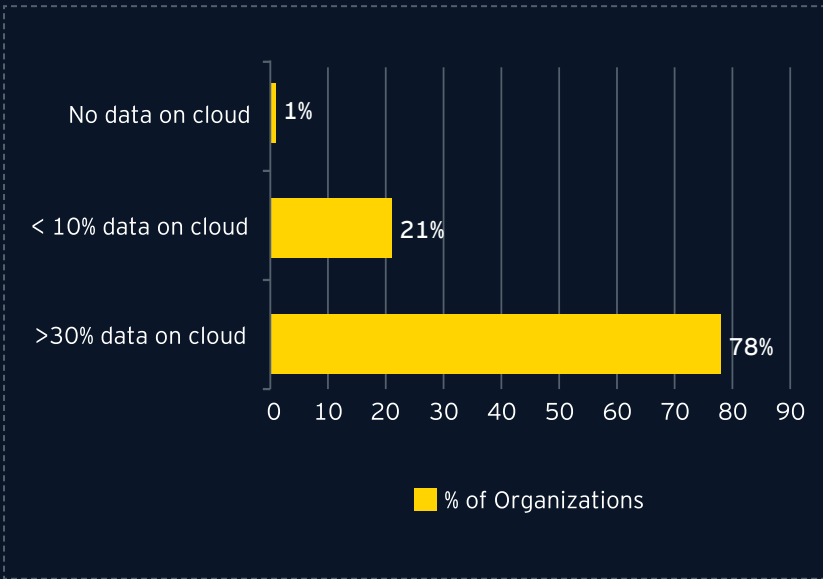
At its core, data modernization serves to enhance the scale, quality, and volume of data that companies can capture. It also improves accessibility, efficiency, and overall data quality, empowering organizations to optimize data processing and derive insights that facilitate the customization of their services for customers. An illustrative example can be observed in a multinational streaming platform, which captures data from each customer at 90-second intervals and applies real-time analytics to refine its recommendation engine. This enables the platform to hyper-personalize services, enhance customer retention rates, augment content creation efforts, and optimize marketing strategies.

Newer data workloads on cloud

The survey results show a growing trend of storing data on the cloud, with 78% of organizations having over 30% of their data on cloud while for only 21%, the level is less than 10%. Only a small percentage of companies (1%) has no data stored on the cloud. Large and mid-sized companies are ahead in this trend compared to smaller organizations. As many as 80% of larger companies and 83% of mid-sized companies have more than 30% of their data on the cloud, while only 66% of small companies are doing so as of now.

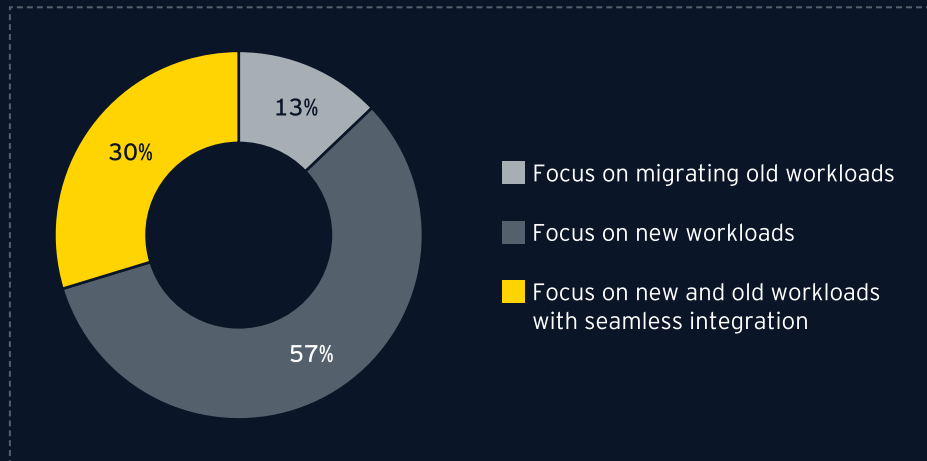


Organization's data on cloud

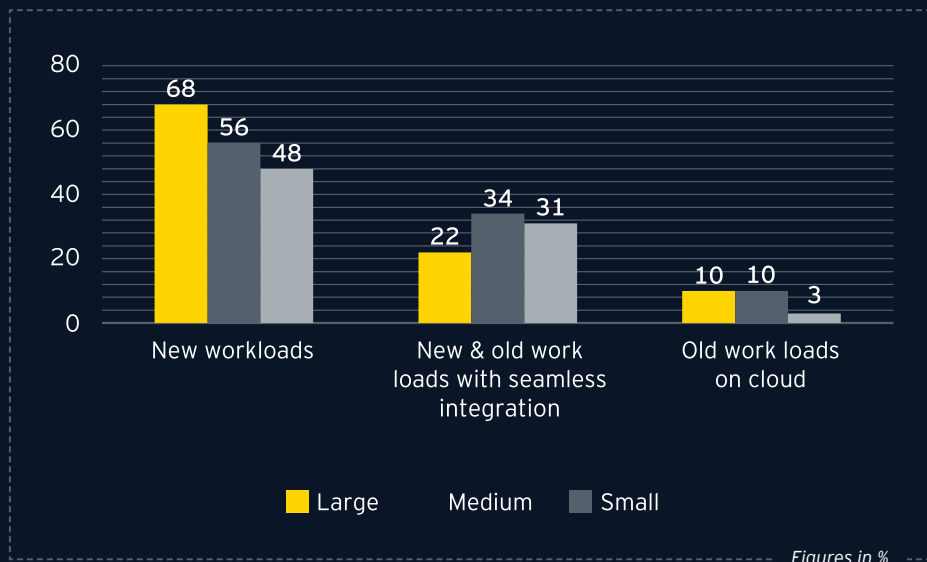


Not just data storage, most organizations are also putting new workloads on the cloud. Though the trend is visible across companies, it is more prevalent in larger organizations. The survey reveals that more than half (58%) of the companies focus on new workloads on cloud while 30% focus on new and old workloads with seamless integration. Only 13% focus on migrating old workloads to cloud.

Current data workload modernization initiatives



Data workload modernization by size of organization



Figures in %

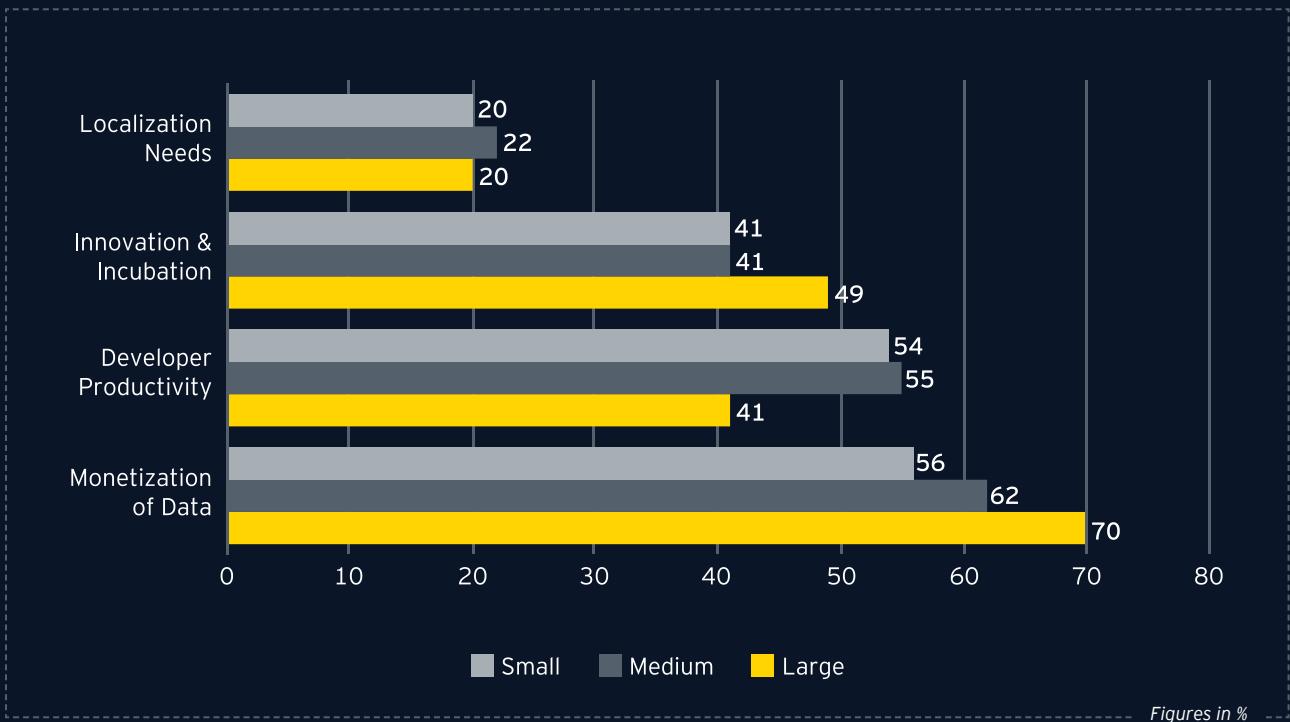
Monetizing data

Shifting data workloads to cloud holds various advantages. The primary motivators among these are monetization of data (63%), developer productivity (51%), and innovation and incubation (43%). A handful of companies are also migrating for their localization needs and for better scalability.

Why companies are moving data workloads to cloud?



Drivers for migrating data workloads according to organization size



The advent of advanced and comprehensive data insights empowers organizations to extract substantial value from their data reservoirs through various avenues. They can harness the potential of data marketplaces, generating lucrative opportunities by capitalizing on their data assets. Moreover, these insights enable the creation of novel products, along with the provision of providing data services to external entities. For example, moving to cloud helped a government backed platform that builds AI solutions to perform large-scale data processing at optimal costs. It uses the cloud solution to filter out high-quality data from the dataset to achieve higher accuracy and efficiency in the models.

Organizations can further cultivate an environment conducive to innovation by constructing application programming interfaces (APIs) that grant third-party developers access to their data, facilitating the creation of innovative applications and services.

Consider, for instance, a prominent non-banking financial company (NBFC) that harnesses its vast repository of customer data in conjunction with state-of-the-art cloud-based analytics. This empowers the NBFC to conceive innovative products and tailor solutions that cater to the unique needs and preferences of its clientele. By capitalizing on the potential that data modernization offers, it is unlocking new revenue streams and solidifying customer relationships through enhanced offerings. Similarly, an online recharge and bill payments platform, is now using a data analytics and visualization platform, to extract granular insights from data and quickly improve product performance, instead of having to wait 24 hours previously for the data.

Likewise, a health-tech enterprise harnesses its trove of data to extract invaluable information, which is subsequently leveraged by pharmaceutical companies to inform and optimize business strategies.

Companies can also continuously improve their data products based on customer feedback and changing market conditions, share it with organizations, and ensure that they remain relevant and valuable. Say, a company shares its data and insights with its affiliated entity. This collaborative approach opens avenues for the sister company to create original products, cultivate innovation, improve customer service, and strengthen revenue streams. Through a consistent process of refining their data products, guided by customer feedback and response to changing market dynamics, organizations guarantee the continued relevance and value of their offerings.

Data democratization is a crucial benefit of data modernization. The survey highlights that the democratization of data stands as a significant outcome of modernization efforts.

More than half (52%) of the participating organizations have specialized analyst teams to democratize their data and generate valuable self-servicing insights. The number is higher among smaller companies (65%).

With data democratization, everybody in an organization has access to data and can effectively utilize the insights in their day-to-day work processes in a self-service manner, which helps in improved decision-making, accomplish tasks on time, and deliver better customer experience.

Organizations engage in extensive report generation across their various service lines, encompassing finance, risk, support services, and more. The democratization of data presents an opportunity for them to optimize data utilization and enhance overall workflow efficiency along with faster and cost-effective report generation. For example, a prominent bank leverages data democratization to autonomously produce diverse reports spanning its internal functions. Looking ahead, the integration of generative AI will further empower companies to employ self-service tools using natural language interfaces.



Application modernization

Cloud computing has become a key enabler for application modernization due to its scalability, flexibility, and cost-effectiveness. By deploying existing platforms, internal architecture, and features in containers, organizations can modernize their applications and drive innovation. Many organizations are either developing cloud-native applications based on containers or transforming their monolithic applications into containers using a lean modernization approach.

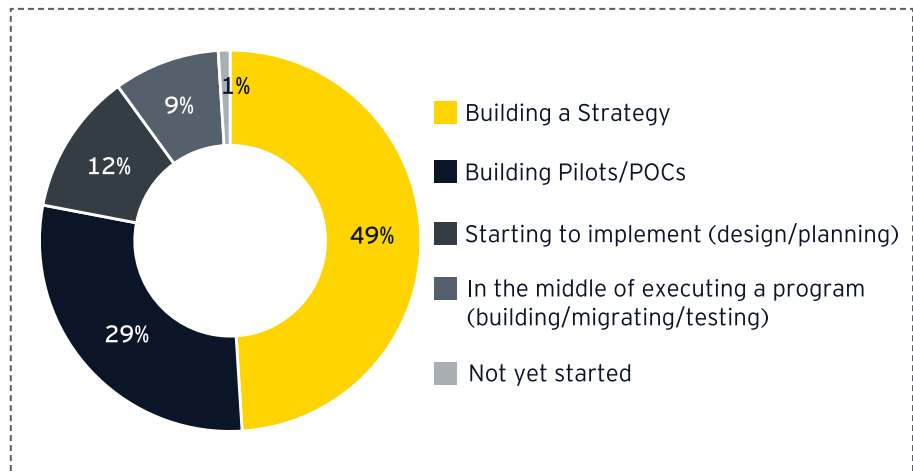
Legacy applications can be slow and inflexible, making it challenging to adapt them to changing business needs. Application modernization on the cloud enables enterprises to quickly develop applications, providing the agility necessary to stay ahead of the competition. It also simplifies the go-to-market process.

However, modernization exercises are not always about “out with the old and in with the new.” They can involve rethinking processes and finding more efficient ways to achieve present goals by redirecting technology spends toward growth and innovation instead of just maintaining existing systems. The benefits are even greater when the overall architecture supports agility, interoperability, and integration.

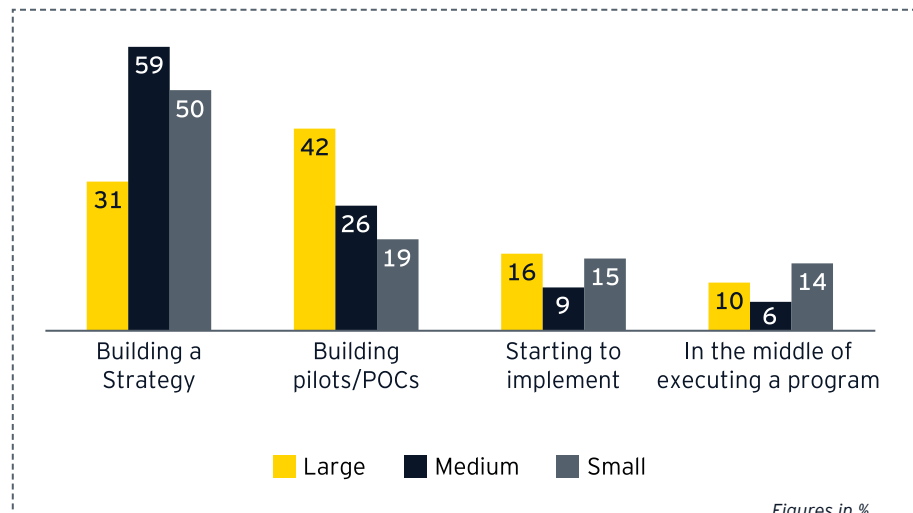
According to the EY-FICCI survey, a majority of organizations have taken steps toward application modernization. While 9% of the companies are already executing it, a substantial number is building a strategy (49%) or conducting pilots (29%).

Where are different companies in their app modernization journey?

App modernization journey



App modernization journey by size of the organization





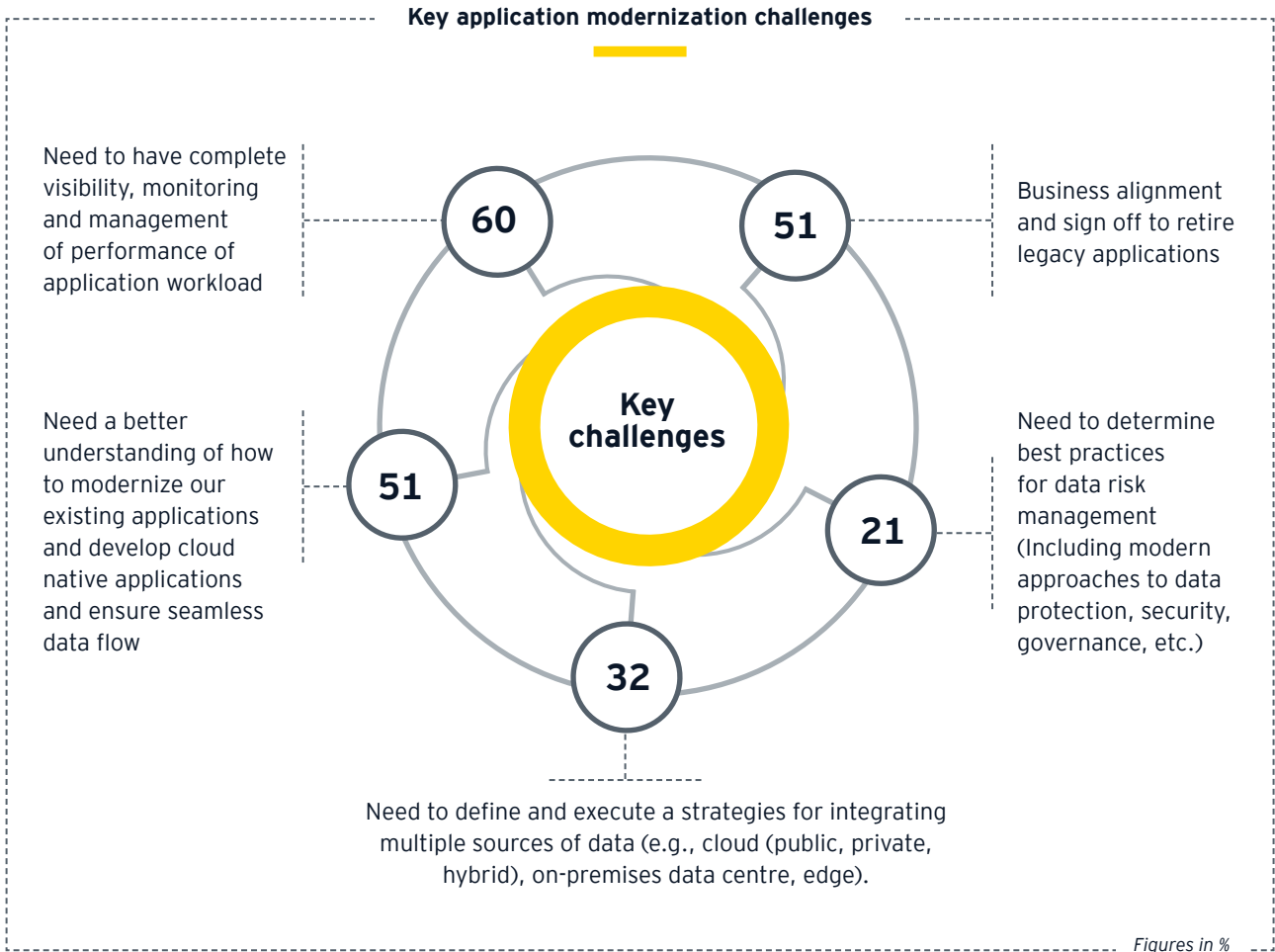
While 42% of larger organizations have already started building pilots, 50% of small companies and 59% of medium-sized companies are building a strategy around app modernization, the survey shows. In fact, some companies, from across different sectors, have already started implementing their strategies.

The purpose of application modernization is to increase agility, scalability, operational efficiency, and optimize costs. For instance, a large central public sector enterprise is leveraging cloud to manage operations, maintenance, and other aspects in manufacturing to bring in operational efficiency in its manufacturing process as well as the overall system.

However, there are a few challenges at present. The two biggest roadblocks are lack of complete visibility and difficulty in monitoring and managing the performance of application workload on the cloud. Many CIOs have indicated in the survey that there is a need to better understand the ways in which their existing applications can be modernized, and cloud-native applications developed to ensure seamless data flow.

Key challenges in app modernization

Majority of CIOs face difficulty in having complete visibility, monitoring and management on performance of application workload



The survey reveals that mid-sized (68%) and large organizations (56%) feel they need better visibility of application workload performance on the cloud as well as higher ability to monitor it. For many small companies (58%), the challenge lies in understanding how they can modernize their existing applications as well as develop cloud-native applications to ensure seamless data flow. In addition, a significant share of companies across all sizes (38% small organizations, 21% medium, and 28% large) need a strategy to integrate their multiple data sources.

While the trend of moving data and application on the cloud is increasing, with larger and mid-sized companies being ahead of smaller organizations, overall, it is clear that cloud technology has become an essential tool for organizations of all sizes to innovate, grow, and succeed in the modern business landscape. Companies that adopt cloud for data modernization and application modernization will be better positioned to take advantage of emerging trends, insights, and opportunities, ultimately driving their growth and success and making the organization resilient.



4

Cloud strategies

“Organizations understand that cloud offers scalability, cost-effectiveness, and efficiency. But a ‘move to the cloud’ or ‘cloud-first’ strategy requires organizations to consider several aspects of the operating model. This chapter describes the various strategies that organizations adopt in their cloud journey and the new cloud solutions and monitoring tools that are emerging in this space to meet higher demand and specifications.

Application modernization strategy

A successful application modernization strategy starts with the business needs and then focuses on supporting technologies. Companies need to formalize their modernization roadmap into discrete increments that focus on five phases: assessment, rationalization, modernization, migration, and sustenance. The survey shows that half of the organizations not only have a clear strategy and defined roadmaps for application modernization but are in the process of executing the strategy. More than half of the large organizations have passed the pilot stage to prove proof of value.

This is different from before when organizations preferred a lift-and-shift approach to shift to cloud. But as they mature, they are adopting other strategies like refactoring or modifying applications to make them cloud compliant; rearchitecting or building advanced workloads and new applications using cloud-native Platform as a Service (PaaS) technologies; and rebuilding or rewriting the application from scratch. That said, lift-and-shift remains the most popular choice (79%), followed by refactoring (70%). Lift-and-shift is more prevalent among large organizations (82%) as they have more legacy applications.

Business needs dictate application modernization strategy



79%
Lift and shift



50%
Rearchitecting to
cloud native



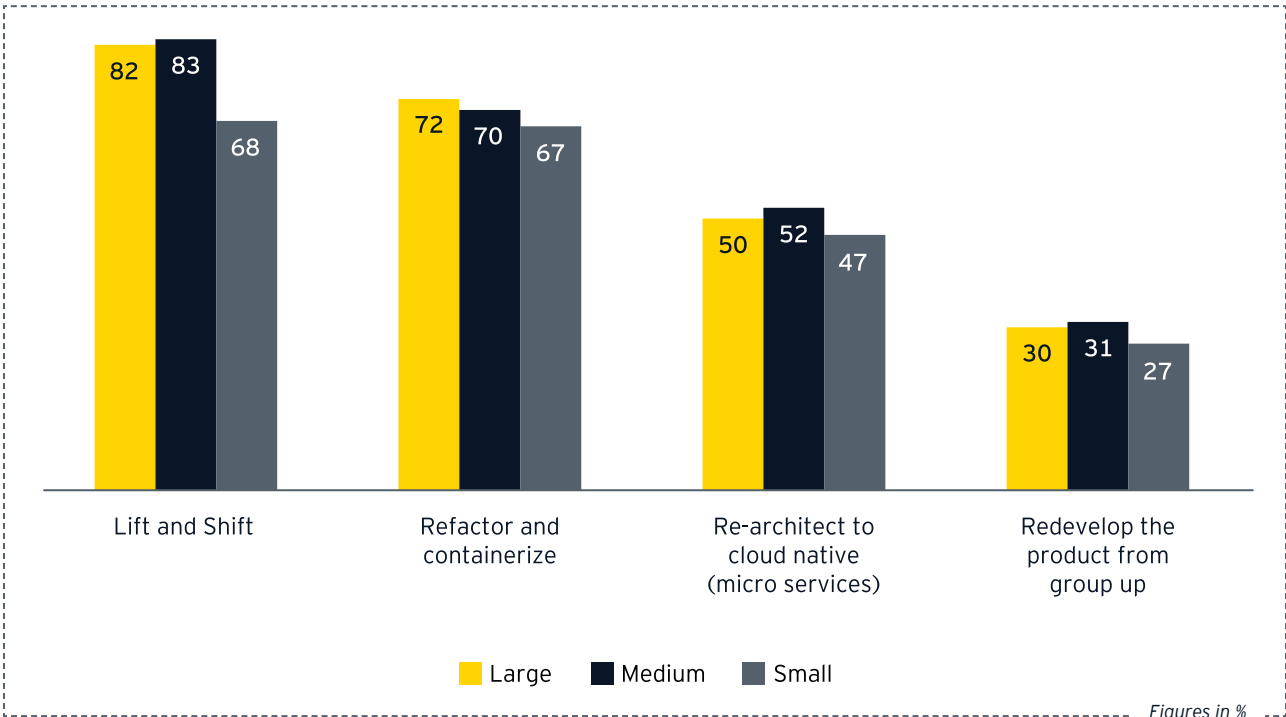
70%
Refactoring



30%
Redevelop

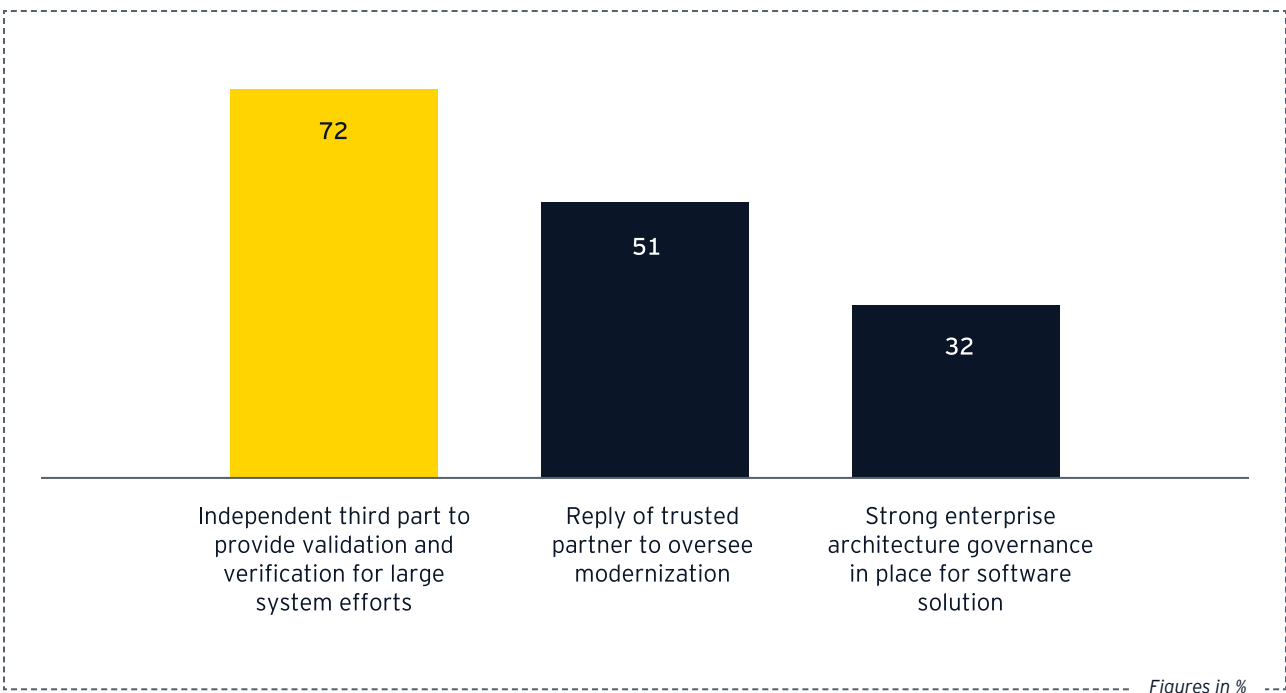


App modernization strategies by size of the organization



Moreover, according to the survey, most Indian organizations depend on third parties to validate and verify their legacy systems for modernization. While 72% of companies use independent third-party services, 51% rely on a trusted partner. The reliance on strong enterprise architecture governance for software solutions is still low (32%) for companies of all sizes.

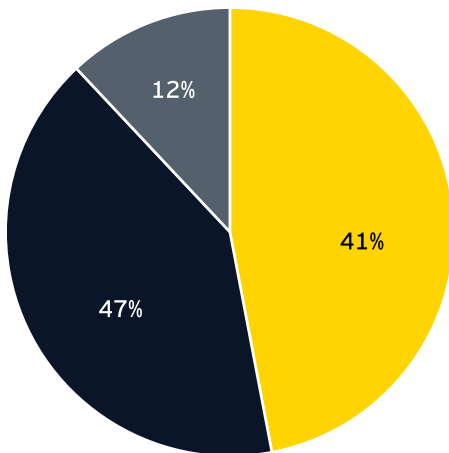
High dependence on third parties for validation



Data modernization strategy

Data modernization is also an important motivator for companies but their approach to it varies. In the survey, almost half the companies (47%) have a fragmented landscape approach with different functions and lines of business making different choices to manage their data workloads. This is especially seen in large organizations where three in every five have a fragmented landscape approach. In contrast, medium and small organizations prefer a centralized data platform approach. A small section (12%) of the companies prefers to adopt a federated data mesh with central governance and standards.

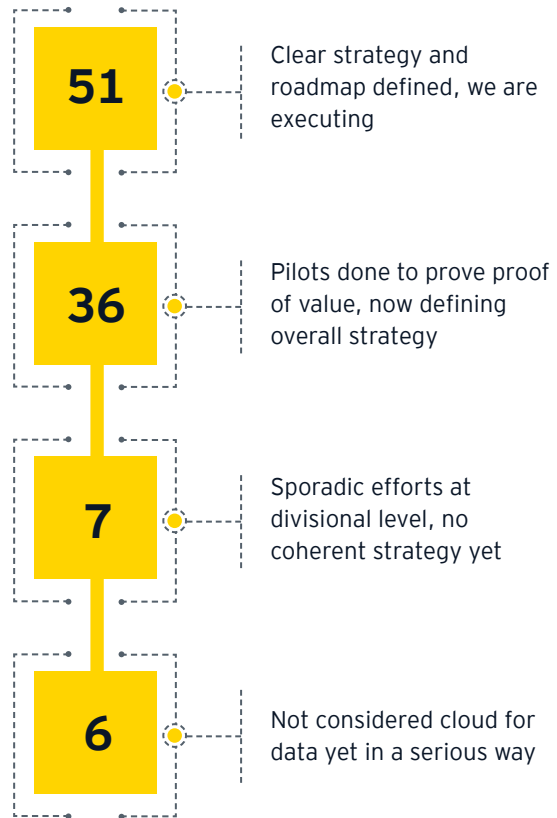
Preferred approaches for data workloads on cloud



- Fragmented landscape approach
- Centralized data platform
- Federated data mesh with central governance

Given the wide variety of approaches to managing data workloads, successful data modernization starts with a clear, well-defined roadmap. In the survey, while half the organizations have clear strategies and defined roadmaps for data modernization, the other half (large organizations) has mostly conducted pilots to prove proof of value, and a few companies have made some or no effort.

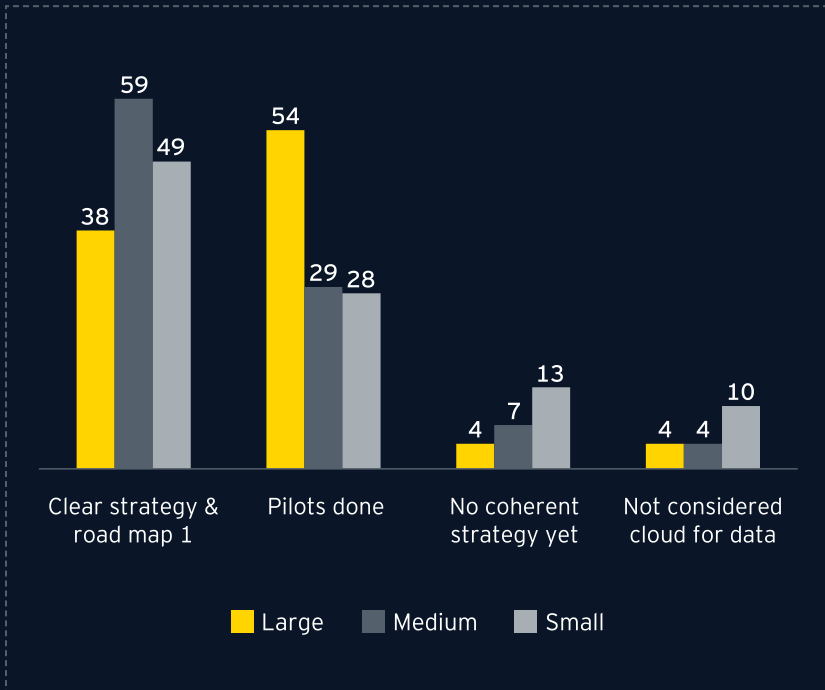
Plan of action



Figures in %

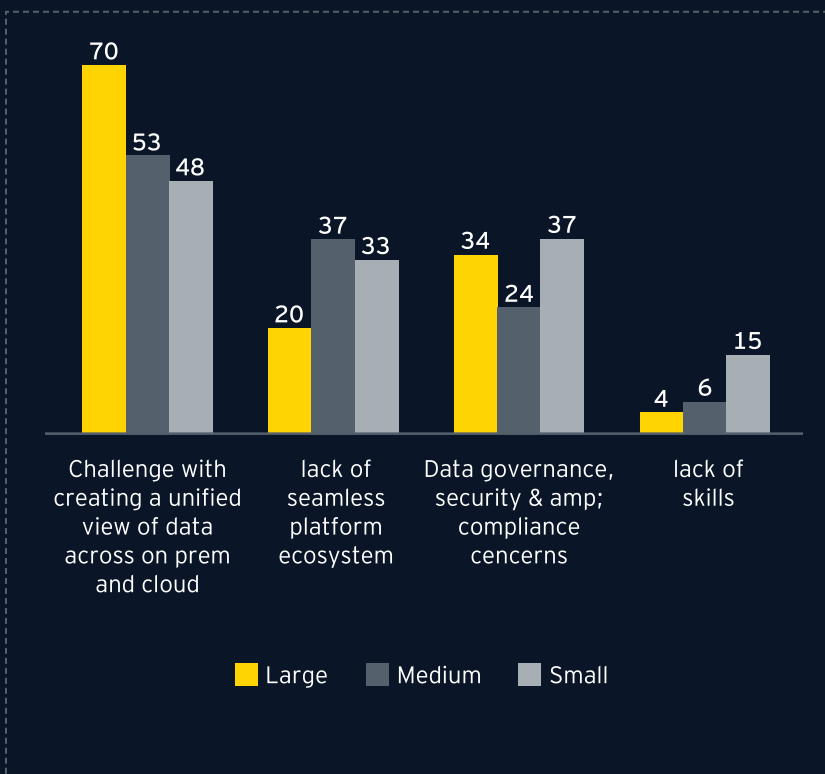


Data modernization journey by organization size



Although many organizations have chosen to rapidly move ahead on their data modernization journey, there are some roadblocks on the way. Creating a unified view of data across on-prem and cloud is the biggest challenge in migrating data workloads with as many as 57% organizations facing this issue. Lack of a seamless platform ecosystem (31%); data governance, security, and compliance concerns (30%); and lack of skills (7%) are the other roadblocks that companies are facing in this journey.

Key challenges and roadblocks in migrating data workloads



Therefore, to complement their data modernization initiatives, enterprises must create a strong and clear strategy while also assessing the overall maturity of the security and compliance elements and emphasizing the development of a platform ecosystem.

Shifting shapes of cloud technologies

Over the years, companies have been pushing more workloads on to cloud. As the overall quantum and specifications of demand increase, some cloud-related technologies are gaining popularity as companies adopt them to increase agility and growth. Catering to the increasing demand, cloud service providers (CSPs) have come up with new offerings.



Industry clouds

The rise of industry clouds that are tailored for specific verticals instead of a one-size-fits-all approach is gaining momentum post-pandemic, especially in retail, BFSI, and manufacturing sectors. Hyperscale CSPs and large Global-System Integrators (GSIs) are coming up with vertical cloud platforms that are hosted on public clouds and are a combination of Software, Platform, and Infrastructure-as-a-Service (IaaS) to provide specific solutions. This approach allows companies more agility in managing workloads and being equipped to adapt their industrial processes and applications faster.

While many start-ups and new-age companies are cloud-first or cloud-native, larger organizations are adopting multi-cloud (the use of two or more cloud computing services that enable migration between cloud providers or operating concurrently across cloud providers) as well as more specialized industry-specific cloud solutions.



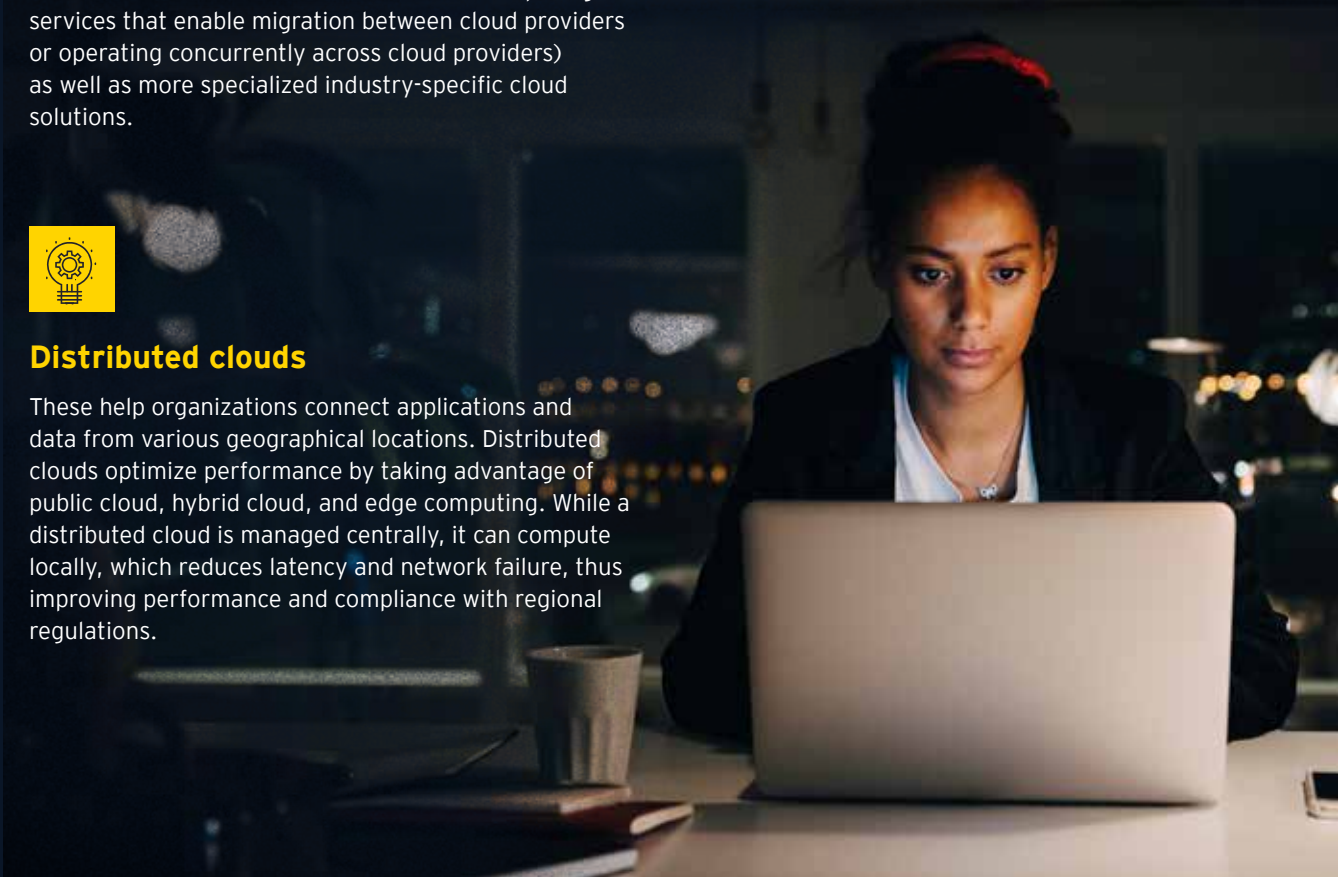
Distributed clouds

These help organizations connect applications and data from various geographical locations. Distributed clouds optimize performance by taking advantage of public cloud, hybrid cloud, and edge computing. While a distributed cloud is managed centrally, it can compute locally, which reduces latency and network failure, thus improving performance and compliance with regional regulations.



Domain clouds

Domain-specific clouds are designed to cater to the specific requirements of a domain or a function. These solutions offer a wide range of benefits, including improved security, compliance, and performance. For instance, solutions like CRM cloud or ERP cloud that can be adopted across verticals provide greater functionality and compliance, which makes them more secure than generic cloud solutions.





Sustainability clouds

Organizations have historically derived financial, security, and agility benefits through cloud services. However, sustainability is becoming an imperative for organizations. Sustainability clouds use data-driven solutions to monitor and improve system performance while reducing carbon emissions, energy use and costs, water consumption, and waste. For example, companies are experiencing up to 40% reduction in carbon emissions. They also position companies to deliver on new commitments, attain ESG goals, and pursue responsible innovation.

Cloud observability

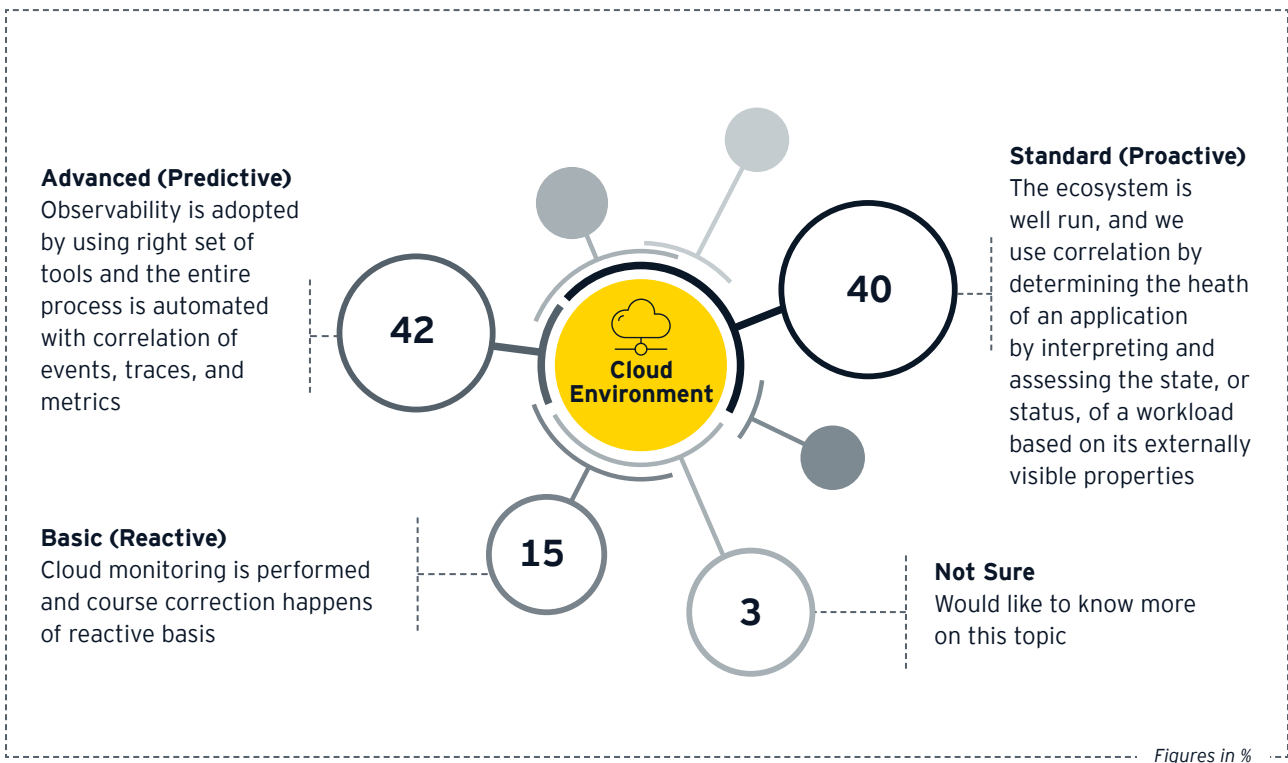
As enterprise cloud options are expanding, so are the functions that can be performed on cloud. The challenge, however, lies in monitoring the cloud as dynamic system architectures increase in complexity and scale. One of the main issues is monitoring DevOps related to compliance, security, cost, speed, and quality.

As industries move to next-generation cloud adoption, pressure is mounting on IT teams to track and respond to conditions and issues across multi-cloud environments. Single-pane-of-glass management tools now act as an interface layer, helping companies monitor and manage their cloud usage to ensure portability across cloud vendors. The EY-FICCI survey shows that for 23% of companies, multi-cloud management, monitoring, and governance are cloud enablers.

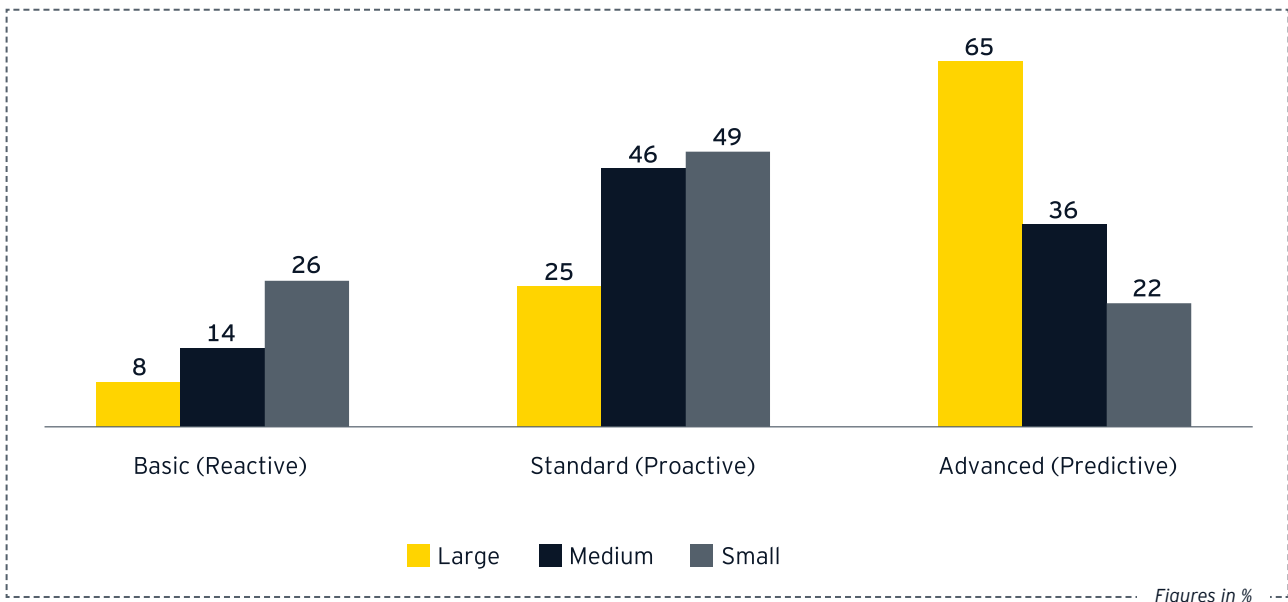
Most organizations have moved beyond basic cloud monitoring to actively analyze their applications' health or have automated the entire observability process by using the appropriate set of tools.

Cloud observability relies on telemetry data derived from instrumentation that comes from the endpoints and services in an organization's multi-cloud computing environment. About 40% of companies have already started adopting a standard tool for cloud observability.

Adoption of observability



Adoption of observability by size of the organization

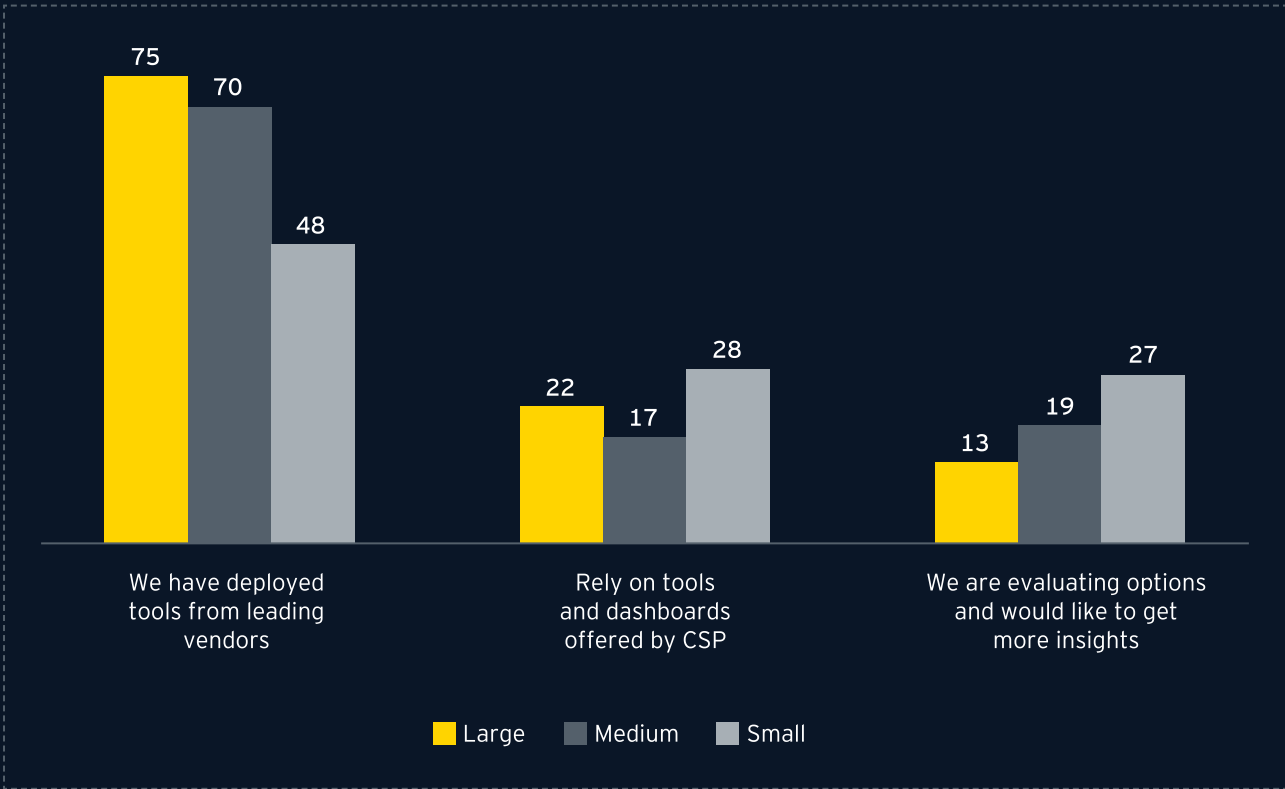


The survey shows that half of the small and medium organizations are proactively observing their cloud environment while two-thirds of the large enterprises have reached the predictive phase of cloud observability.

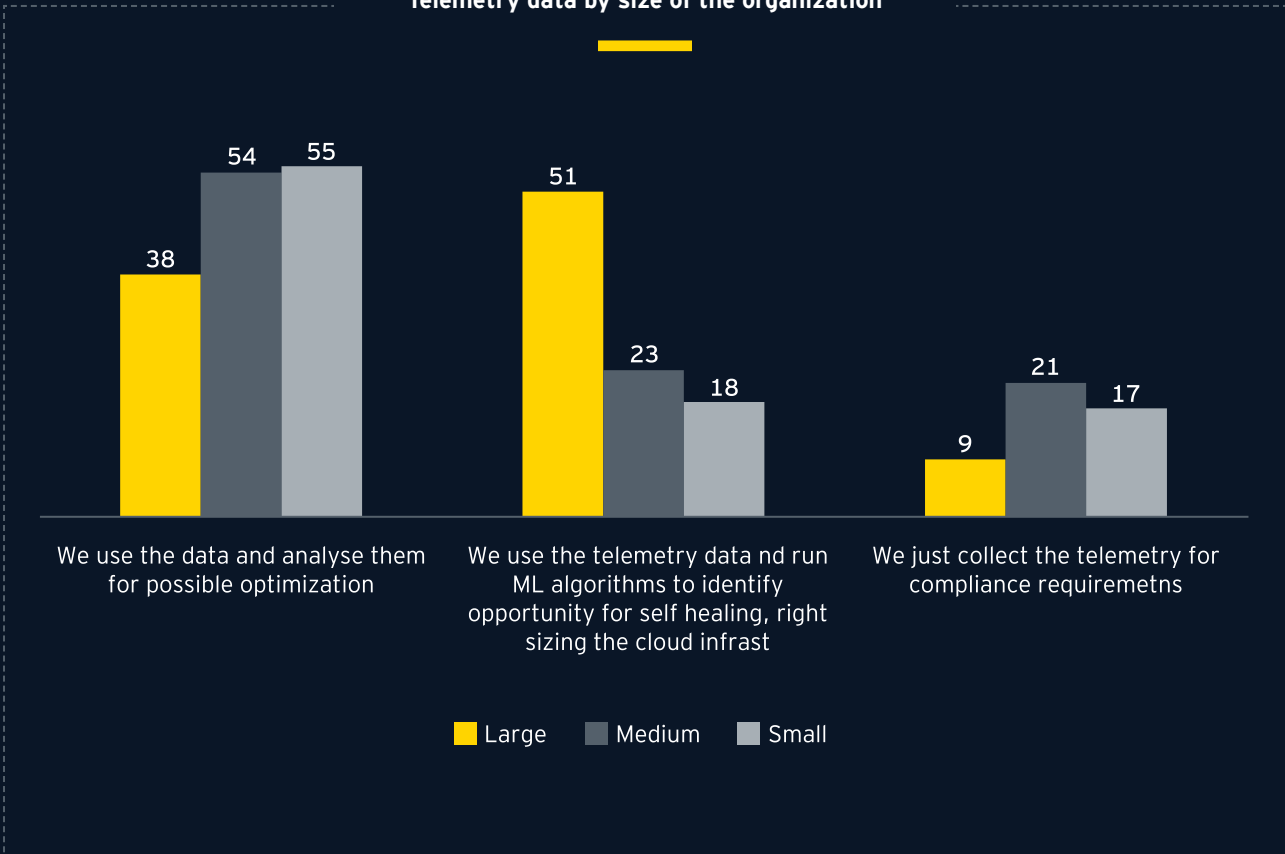
Leading vendors are the popular choice for observability tools as about two-thirds of the organizations have deployed tools from them. At present, only about one-fifth of the companies rely on tools and dashboards from CSPs while a similar number is evaluating options to get insights.



How organizations adopt observability tools and use telemetry data?



Telemetry data by size of the organization



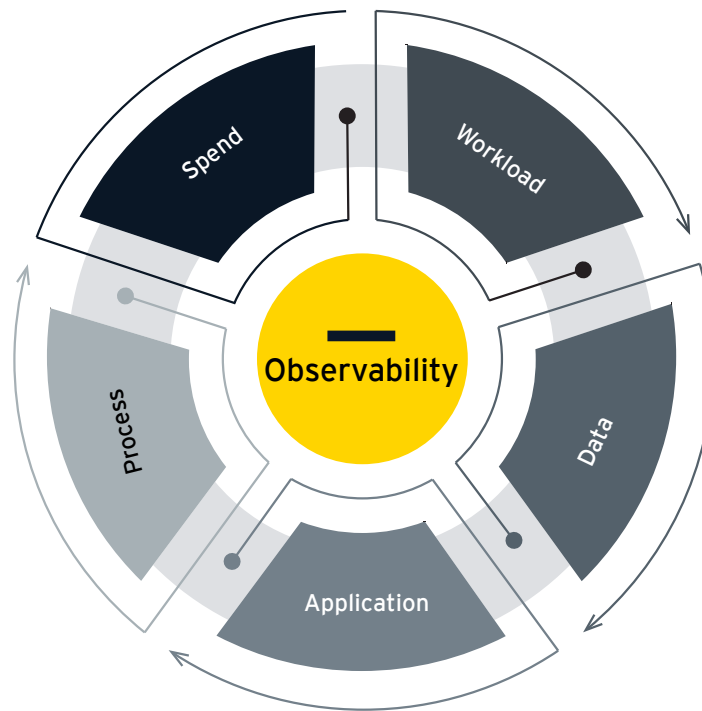
In the next-generation cloud environments, every hardware, software, and cloud infrastructure component and every container, open-source tool, and microservice generates records of each activity. In such a scenario, cloud observability will play an even bigger role as it helps organizations understand the processes and functions taking place across all environments and among different technologies. This visibility helps organizations detect, resolve, and even self-heal issues, thus maintaining the systems' efficiency and reliability.

The EY-FICCI survey reveals that two in every three organizations have deployed observability tools from leading vendors while around half use telemetry data,

which is then analyzed for possible optimization. Large enterprises already use telemetry data and run ML algorithms to identify opportunities for self-healing, right sizing the cloud infrastructure, and cost optimization. For example, a leading Indian online stock brokerage used specialized tools on cloud to save US\$1 million annually.

Using single-pane-of-glass tools, organizations can observe various levels of functions, monitor, get insights into their performance as well as the impact that diverse types of issues can have on business.

How single-pane-of-glass helps



By adopting observability, organizations can gain a more comprehensive view of their cloud situation and create clarity out of a complex cloud environment, making it resilient, optimal, and proactive.

5

Cloud computing woes and solutions



Organizations that lack a comprehensive cost optimization strategy may overspend on cloud services, resulting in lower Return on Investment (ROI) and budget constraints. Furthermore, talent shortages and security are significant issues in the modernization journey. This chapter discusses various methods to optimize cloud costs and address talent gaps and security concerns.

Cost optimization

The common perception is that running applications on cloud can significantly reduce IT budgets to almost 30-40% as it allows companies to consume less resources, scale up or down as per usage and leverage out-of-the-box capabilities to establish real-time consumption and cost insights. However, left unchecked, cloud costs can rise unexpectedly, compromising ROI and consuming constrained IT budgets. In such a situation, the economics of using cloud will not seem profitable.

Major factors that cause cloud budget overruns

- Unanticipated usages
- Idle infrastructure when not in use
- Wrong sizing
- Suboptimal designs
- Ungoverned costs

While adopting cloud could generate substantial value when done right, many companies are now spending almost 20% more on their cloud budget every year. For many organizations, as much as a third of their cloud budget is misspent. To keep the cost under check, organizations must overhaul budgeting and accounting processes meant for legacy technology infrastructure as they are not apt for modern ways of consuming technologies.

Using appropriate processes will address the lack of alignment between finance, procurement, and IT. It will also prompt organizations to look for ways to resolve the issue of insufficient expertise in analyzing and optimizing technology costs, including cloud spends.

Businesses should be fully conscious of all details of cloud economics. This includes all the associated costs, such as fees for data transfer, support, storage, license, migration, security, and compliance. These factors have a bearing on cloud costs. In addition, many organizations may not fully comprehend the current method of conveying pricing. As companies actively ramp up cloud migration, measuring return on cloud investments is a growing concern.

Our study reveals that while larger organizations achieve cost optimization of about 20% from cloud, medium and small-scale organizations are falling short of meeting their cost-saving goals. As companies are not able to reap the expected cost benefits from cloud, they are eager to know more about and avail services from trusted partners on cost management. Our survey reveals that 73% of the companies want trusted partner services. This figure is higher in the case of mid-sized companies (77%).

- --- A well-managed, cost-optimized cloud solution can be cheaper for organizations than on-premise, but if the companies skip the step of establishing good cost governance and optimization of cloud architecture, they will not achieve the desired results.

- --- 47% medium and 43% small companies achieved 10-15% cost saving by adopting cloud
- --- 20% small companies did not receive any cost benefits



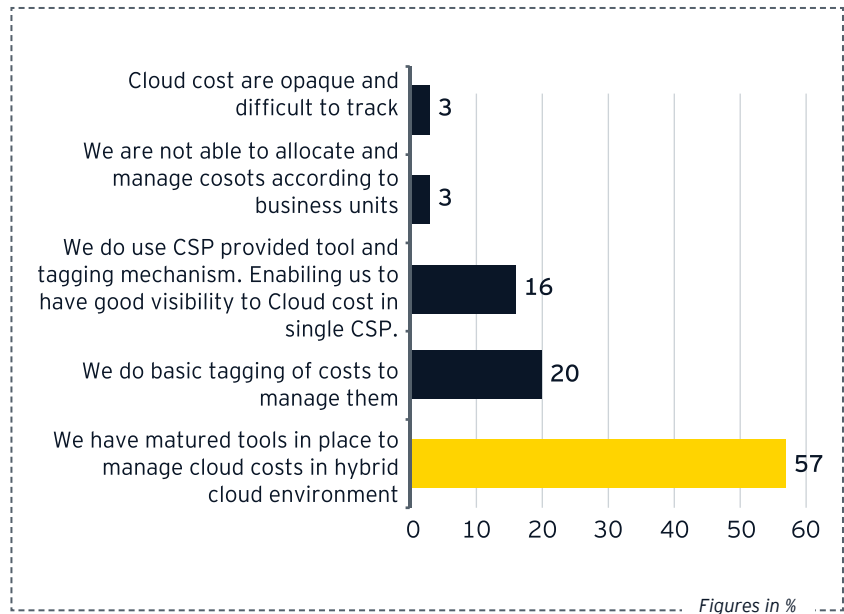
Cost optimization tools and tagging

There are various tools that companies can use to gain cloud cost-related intelligence and make the most of the technology investment.

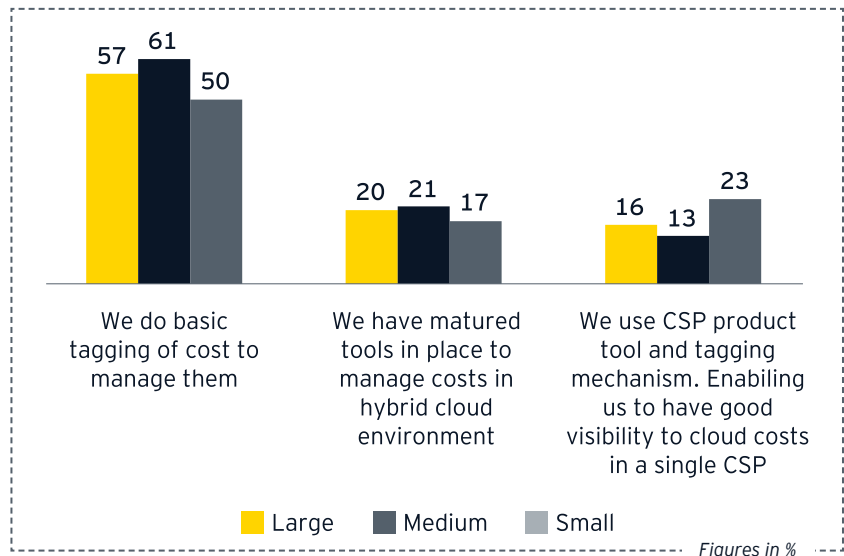
To monitor and optimize cloud costs, organizations must tag resources. Tags are usually used to organize resources and cost allocation tags track cloud costs to a high degree of detail. Resources can be tagged appropriately at the time of commissioning and connected to a specific program or business unit. This will provide accounting of resource utilization based on business unit, application, and/or individual. It also establishes a foundation to implement a charge-back program, which is critical for long-term ROI.

The survey reveals that most organizations across sizes do basic tagging of costs to manage the track. Around 57% organizations do basic tagging while 20% of the companies use mature tools to manage costs in hybrid cloud environment. In comparison, a smaller share of companies, 16%, use CSP-provided tools and tagging mechanisms to get a clear visibility of cloud costs in a single CSP.

Current state of cloud cost management



Current state of cloud cost management by size of the organization



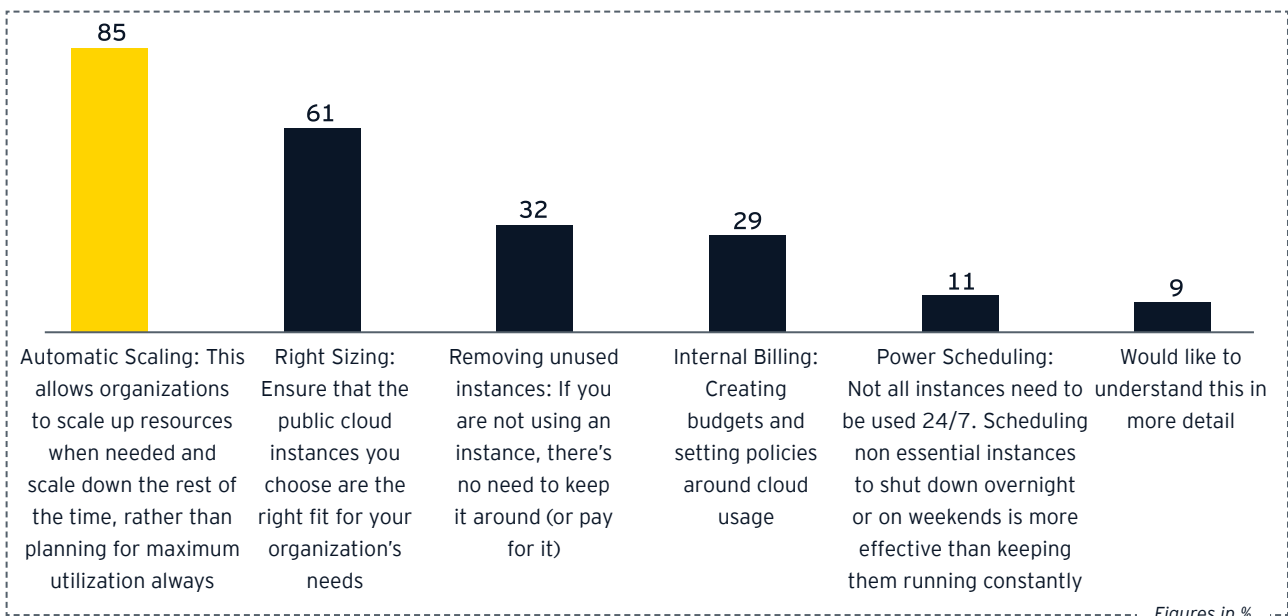
Automatic scaling and right sizing

The survey finds that as many as six in every seven organizations use automatic scaling to have complete control on cloud costs. Among the larger companies, 89% use autoscaling.

Another widely used option is to adopt right-sizing tools. The survey shows that about 62% of the small

and medium organizations and 61% of the large companies use right-sizing techniques to optimize costs. Companies also remove unused instances and do internal billing to create budgets and set policies around cloud usage and power schedules (scheduling non-essential instances to shut down overnight or on weekends, for example).

Strategies adopted to have complete control on cloud costs



While these tools and measures offer ways to control cloud costs, several organizations are still unable to keep their cloud cost under control and need a more comprehensive option.

FinOps approach

Many companies make one-off or ad-hoc investments such as short-term analysis or engineering remediation to optimize costs. These tools deliver cost relief but usually need to be repeated as the issue may re-emerge after a few months. A single initiative or cost optimization software cannot by itself manage a cost-effective and high-value cloud platform for the long term. It is, therefore, necessary to adopt a more holistic approach like FinOps, which goes beyond deploying new cost management tools and processes to operate and govern large-scale cloud environments more effectively.

- Organizations can use FinOps, a cloud financial management discipline, to get maximum business value from cloud by helping engineering, finance, technology, and business teams collaborate on data-driven spending decisions.

The FinOps roadmap should begin with a comprehensive view of the infrastructure and software assets within the business that will help shape the larger strategy and cost-benefit economics.

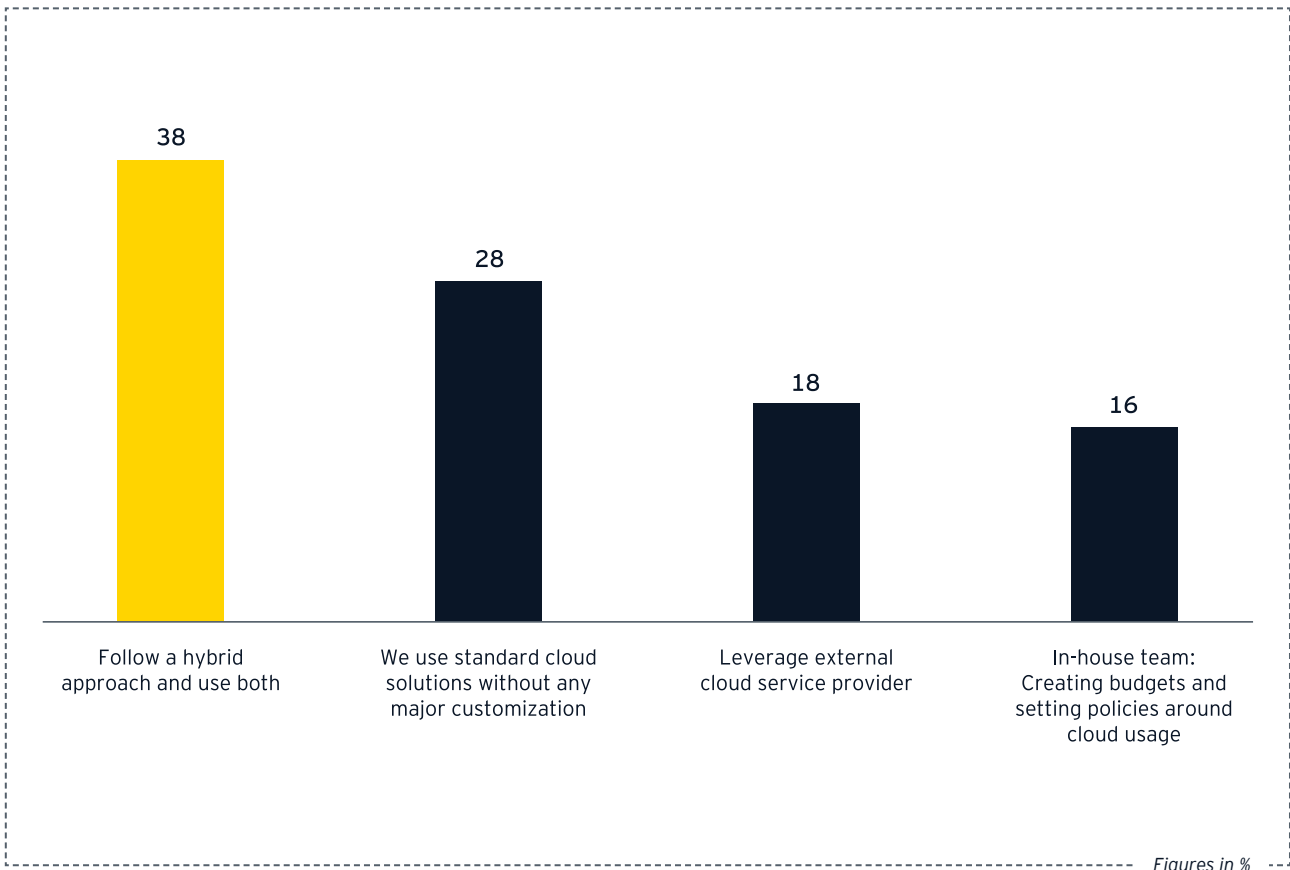
In addition to that, building a FinOps team can drive a culture of increased awareness of cloud cost optimization, prompting everyone about the crucial role they play in cutting cloud costs. A successful FinOps program not only keeps costs in check but also identifies areas where spending could be optimized. This is especially useful in a situation where internal cloud resources are limited.

Reverse migration and hybrid approach

Many large enterprises have invested significant amounts of time and money in adopting on-prem systems and many of their functions continue to be based on those solutions. Therefore, many such organizations choose to take a hybrid approach as it gives them the best of both worlds: the flexibility of a public cloud and the security of a private cloud.

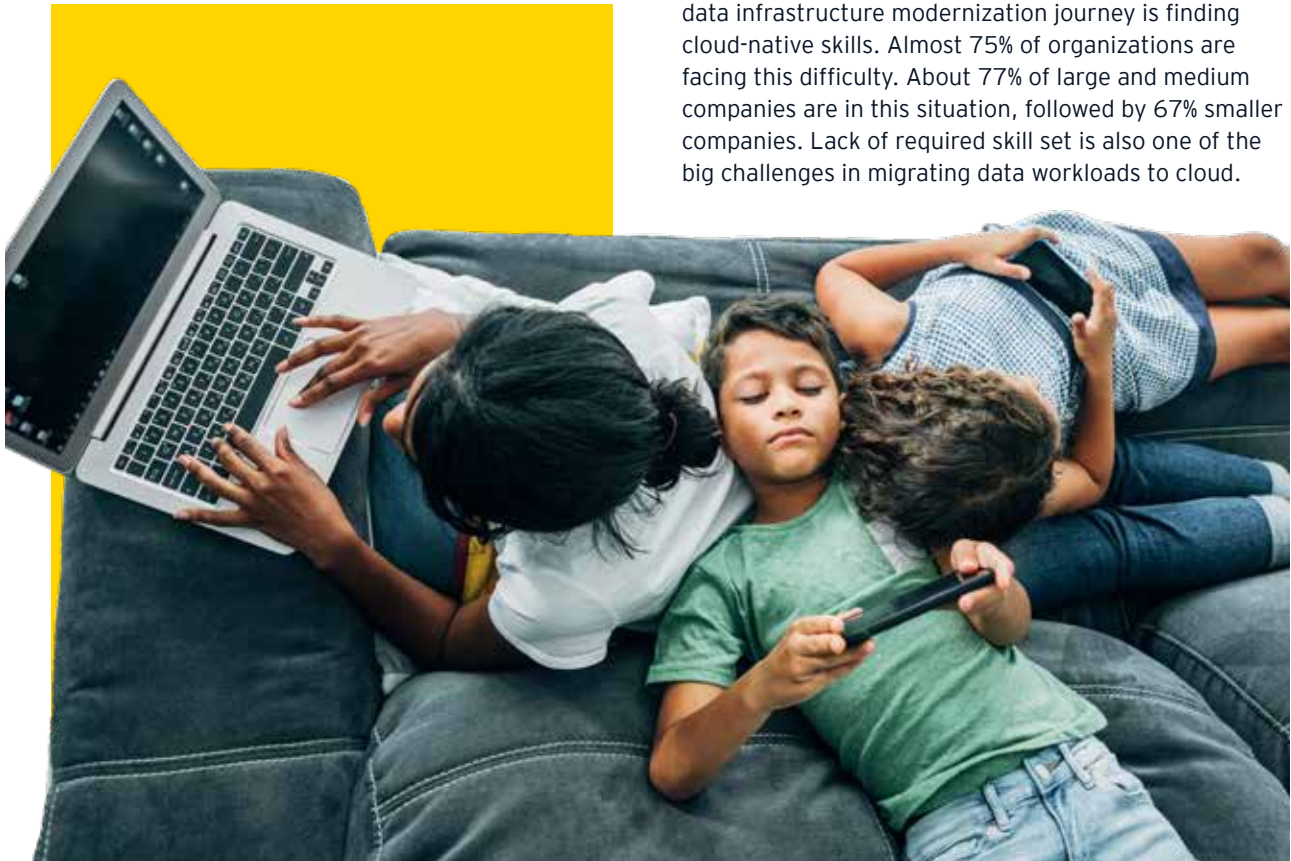
- Hybrid cloud offers best of breed capabilities across on prem, public and multi cloud.

Best of both in-house and external services



In the survey, around two in every five organizations follow a hybrid approach of in-house plus external CSP's capabilities to customize and deploy cloud-based services and solutions. As many as 42% of medium organizations choose a hybrid approach while 37% of small companies follow this method. For larger organizations, a hybrid cloud is also the first step to completing public cloud adoption. A large majority of organizations across sizes, about 80%, have been able to save over 10% of cost by applying mostly hybrid approaches or using standard cloud solutions.

In addition to the hybrid approach, there is a growing trend among organizations to shift some of their applications from cloud to on-prem. This is especially true for cases where application workloads are more predictable. Flexibility is the foremost reason, but there are other reasons too, including cost, performance, security, and compliance. Reverse cloud migration, also known as cloud repatriation, involves moving cloud applications back to an on-infrastructure setup or to a private cloud. As many companies transfer parts of or all their business components from a public cloud to a local data center to suit reverse migration, application architecture should be flexible. Therefore, hybrid architecture will become a new normal as it helps in optimal usage of resources, controls costs, and accommodates dynamic business needs.



Plugging the talent gaps

The speed and scale of change required to support existing as well as new technologies is high, and success rates depend on the organization's pool of talent.

Due to the huge shortage of talent, finding good workforce has become extremely difficult, especially for organizations that run on legacy applications. Even if there is a fertile talent base in cloud computing, it is not large enough to meet the ever-growing demand. Talent is proving to be a double whammy for organizations across sectors.

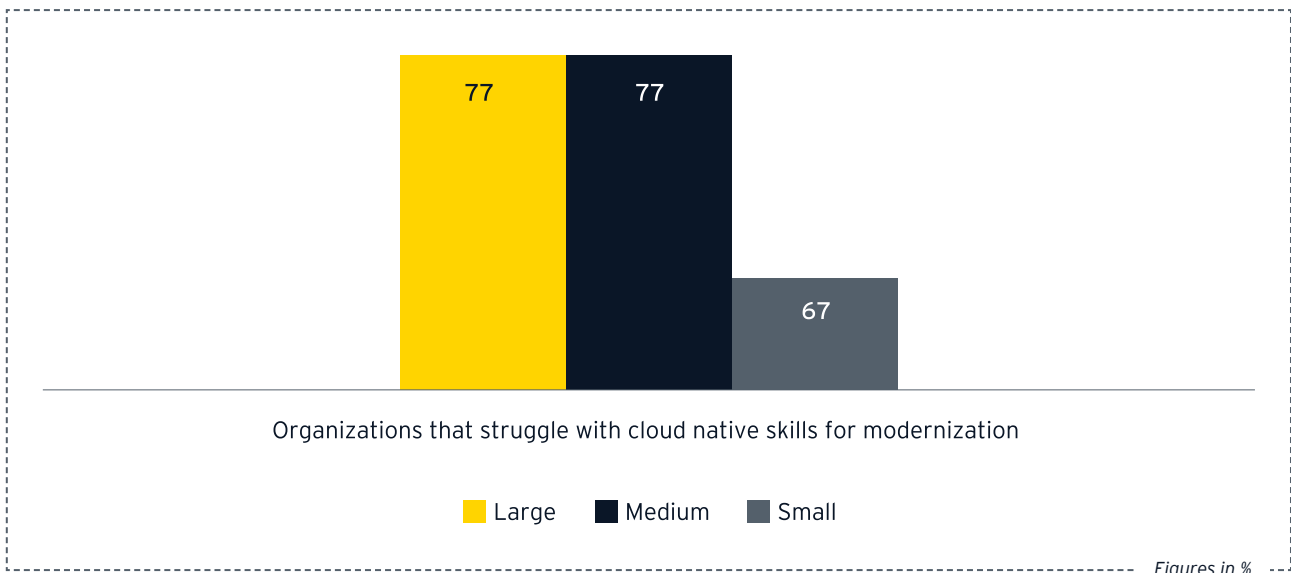
Organizations are losing market share and revenue due to lack of cloud expertise, which prevents them from gaining the benefits that cloud and other emerging technologies have to offer. The ongoing dearth of skilled cloud workforce is making cloud transition even more arduous. Apart from causing delays in project implementation, it also results in cost overruns. This affects companies' ability to innovate and compete.

For professionals, too, the rapid pace of technological advancements in cloud computing makes it difficult for them to keep up with the latest trends and technologies.

The EY-FICCI survey finds that one of the biggest challenges that organizations of all sizes face in their data infrastructure modernization journey is finding cloud-native skills. Almost 75% of organizations are facing this difficulty. About 77% of large and medium companies are in this situation, followed by 67% smaller companies. Lack of required skill set is also one of the big challenges in migrating data workloads to cloud.



Talent search



Shortage of skilled professionals is hampering CSPs' ability to provide high-quality cloud services to customers. This is leading to a loss of customer trust and a decline in revenue. There is an abundant supply of fresh STEM graduates from our universities each year. To address the talent shortage, companies can expand their apprenticeship or internship programs and on the job training to upskill these fresh graduates to build relevant experience. India also has untapped supply of good cloud talent in tier 2 and tier 3 cities which organizations can tap into. Within companies, too, building a comprehensive learning ecosystem with a suite of learning solutions, instructors, digital platforms, and development strategies would facilitate both formal and informal learning, which is critical for a continuous learning approach.

Security by design

As cloud technology matures, organizations face ever increasing levels of threat to security and data privacy. Inadequate threat notifications and alerts, along with misconfigurations of security systems are some of the major concerns. In the EY-FICCI survey, more than half (53%) of the organizations shared that they consider data and cyber security a challenge.

CSPs are addressing this by implementing security by design in cloud. This is a proactive approach to cybersecurity and considers security at every stage of the software development process. Implementing security by design in the cloud requires a comprehensive approach that addresses all aspects of cloud security, including understanding the requirements, implementing controls, using secure development practices, establishing incident response procedures, and staying up to date with cloud security best practices. Implementing security by design in the cloud can also help organizations save on costs and ensure compliance, which leads to gaining competitive advantage.



6

Generative AI, Data, and Cloud

“Generative AI holds immense potential to transform business innovation and operations. Yet, organizations that neglect cloud computing may face challenges harnessing the full advantages of Gen AI. This chapter examines how Generative AI heavily relies on large datasets and robust computing infrastructure, which are inherent features of cloud technology. As a result, the adoption of Generative AI is expected to lead to increased data usage and greater consumption of cloud resources.

Generative AI is one of the most disruptive technological innovations of recent times. Generative AI models possess the remarkable capability to generate fresh and original content across various forms, including text, images, videos, music, and software codes. Notably, the demand for generative AI has surged worldwide since the launch of ChatGPT and Stable Diffusion among other AI tools and key cloud hyperscalers are driving much of the growth in this space.

While the exploration of generative AI goes back to 2014, recent progress in this field owes much to the advancements in deep learning algorithms and hardware, such as graphics processing units (GPUs) and tensor processing units (TPUs). These breakthroughs have paved the way for the development of intricate generative models that cover a wide spectrum of applications. From chatbots, content generation, and summarization tools, to image and video generation, software coding, and biomolecular algorithms, these cutting-edge innovations present transformative possibilities for organizations spanning sectors. By employing natural language prompts and leveraging vast datasets, generative AI empowers companies to reimagine their applications, create unparalleled customer experiences, enhance productivity, and revolutionize their businesses.

The unique strength of generative AI lies in its ability to generate fresh content and solutions after learning from data. Large language models (LLMs) that support generative AI, rely heavily on extensive datasets and demand powerful and scalable computational infrastructure for real-time data processing. Developing a generative AI model entails the collection, processing, and storage of vast volumes of training data, particularly in the case of image and video datasets.

- Cloud computing provides indispensable storage and computational resources for processing and analyzing large datasets.

Unlike traditional machine learning models that rely on structured data, generative models thrive on unstructured data, which can be arduous to acquire and label, consuming valuable time and resources. Cloud emerges as the solution. Many cloud providers offer specialized tools and services for data labeling, as well as access to high-performance computing resources necessary for training large-scale models.

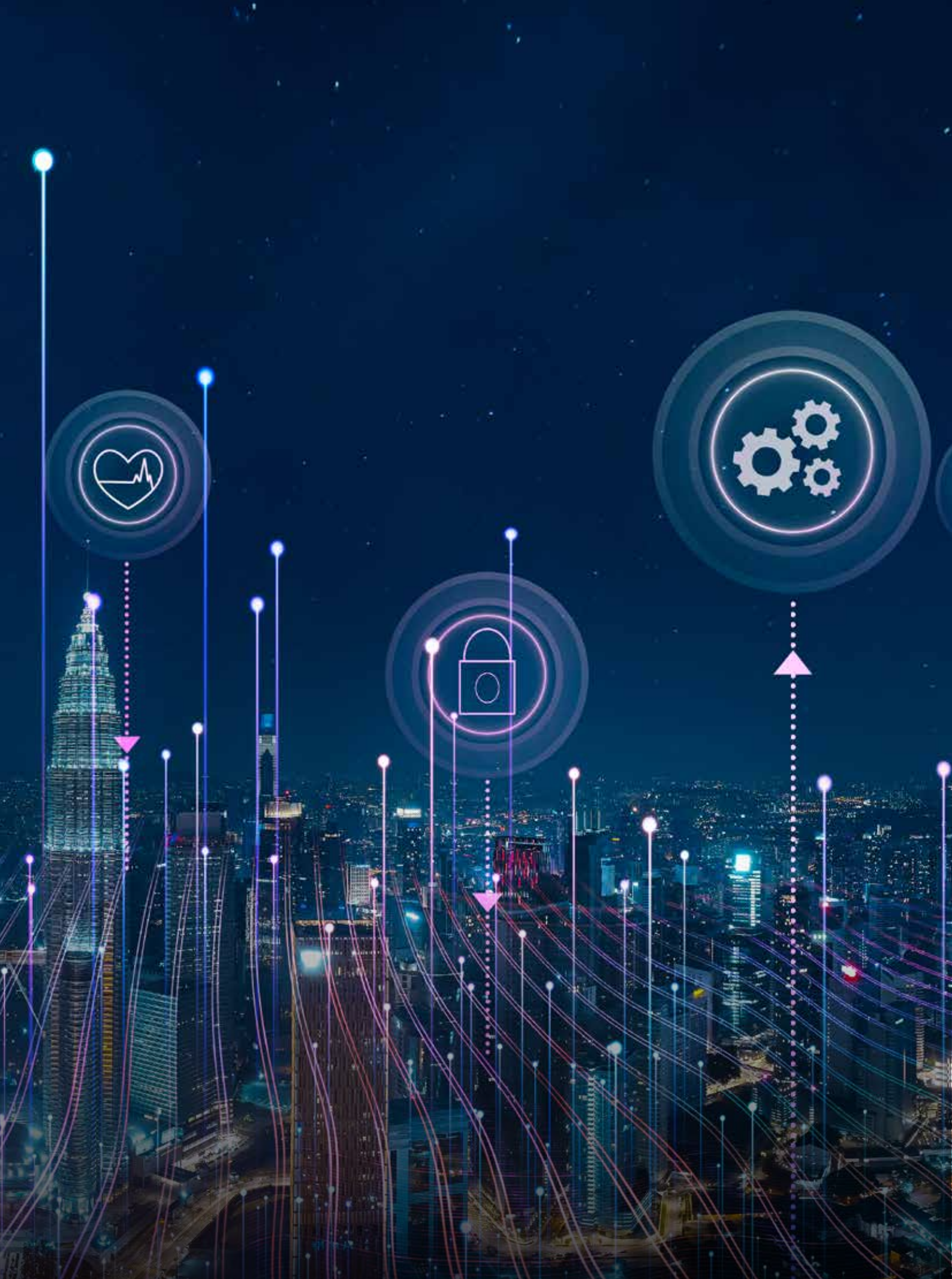
Leveraging data fabric

Enabling organization-specific AI experiences necessitates a consistent supply of clean data derived from a meticulously managed and tightly integrated analytics system. Amidst this complexity comes the challenge of dealing with numerous data storage locations. Hence, an organization's data requires logistics as robust as its learning capabilities. To achieve a comprehensive view of enterprise data, a resilient data access layer or architecture must be constructed. At present, most organizations' analytics systems are intricate webs of specialized and disconnected services.

Enter data fabric, an architecture that streamlines the end-to-end integration of diverse data pipelines and cloud environments through intelligent and automated systems. With this unified approach, organizations can leverage one product, providing a cohesive experience.

- The data fabric architecture equips organizations with all the essential capabilities to extract insights from data. This fosters holistic and data-centric decision-making.





The data is organized within an in-built data hub, automatically indexed for discovery, sharing, governance, and compliance. By intertwining data fabric with cloud computing platforms at each layer, organizations can unlock the full potential of their data. Developers can harness the power of generative AI in conjunction with their data, while business users can uncover valuable insights. Within the data fabric, generative AI tools enable users to employ conversational language to create dataflows and pipelines, generate code and functions, construct machine learning models, and visualize outcomes.

Organizations can even create personalized conversational language experiences, merging cloud, generative AI models, and their data, ultimately publishing them as plug-ins.

Furthermore, cloud-based ML platforms offer scalable and cost-effective resources for training generative AI models. These platforms provide pre-configured ML environments that can be conveniently scaled to meet project requirements. Once the model is trained, the subsequent steps of deployment and management arise. This is where Generative AI ModelOps plays a crucial role as it encompasses the management and operationalization of ML models.

Another advantage of leveraging cloud for generative AI is the access it provides to pre-trained models and cloud service providers' APIs. These pre-trained models serve as starting points, enabling developers and organizations to swiftly implement generative AI solutions without having to start from scratch. Cloud APIs also simplify the integration of generative AI functionalities into existing applications or workflows.

Striking the right balance

Many of the generative AI tools are currently at developmental stage and far from maturity. Therefore, it is essential to strike a responsible balance in employing these tools, considering their wide range of applications and potential impact on society.

When utilizing generative AI tools, organizations need to be mindful of several potential concerns like data leakage, inaccurate responses due to hallucination, risk of biased output due to skewed or biased training data, and so on. By acknowledging these considerations and addressing them proactively, organizations can harness the benefits of generative AI. This necessitates finding the right equilibrium between sector-agnostic baselines and sector-specific rulemaking, considering diverse needs and contexts.

In a data driven business world, generative AI is all set to transform the way companies innovate, operate, and work. Organizations that choose not to adopt cloud computing may face challenges in fully leveraging the benefits of generative AI because of limited computing resources, restricted data access, limited collaboration and integration, and slower innovation as well as deployment. By leveraging cloud-based resources, organizations can accelerate their innovation cycles and bring generative AI applications to market faster.



Call to action

Cloud adoption is no longer a technology initiative but a business imperative. Modern organizations can no longer afford to rely solely on on-premises infrastructure. The rapid emergence of transformative technologies, such as generative AI, cybersecurity, AR/VR, blockchain, IoT and many others, has prompted businesses across sectors to swiftly adopt these innovations to drive their organizations forward. To facilitate this transformation, accelerate their cloud journey, and derive maximum benefits out of cloud, companies should consider cloud as a foundational capability and thus build a Cloud Center of Excellence (CoE).

The significance of a company's cloud journey extends far beyond the purview of Chief Information Officers (CIOs) and Chief Technology Officers (CTOs). In fact, the list of critical stakeholders invested in this transition encompasses a broad spectrum of key decision makers within an organization. Thus, the CoE should function taking guidance from board members and CEOs while having members that include CTOs, Chief Operating Officers (COOs), Chief Financial Officers (CFOs), Chief Information Security Officers (CISOs), and talent officers, all of whom have a substantial stake in the success of the company's cloud journey. Recognizing the multifaceted benefits of cloud, these key people should actively be engaged in shaping their organization's cloud strategy.

The cloud enables enhanced scalability, flexibility, and cost-efficiency, empowering businesses to swiftly adapt to evolving market dynamics. CEOs, driven by a strategic vision, understand that cloud technology underpins innovation, operational agility, and competitive advantage. Meanwhile, board members ensure that the cloud journey aligns with the organization's long-term goals and yields sustainable growth.

CTOs and CIOs play a pivotal role in orchestrating a seamless migration to the cloud. Their expertise is indispensable in selecting the most suitable cloud providers, designing robust architectures, and

overseeing the integration of cloud-based services with existing systems. COOs and CFOs, on the other hand, appreciate the potential cost savings associated with cloud adoption, as well as the operational efficiencies it affords across various business functions.

In an era marked by increasing cybersecurity threats, CISOs are acutely aware of the enhanced security measures offered by reputable CSPs or in a private cloud environment. Their involvement in the cloud journey ensures that data protection, privacy, and compliance requirements are diligently addressed. Moreover, talent officers recognize that embracing the cloud attracts top-notch professionals who are well-versed in cutting-edge technologies, further strengthening the organization's competitive edge.

To facilitate a successful cloud migration, CoE can adopt some best practices.

These are:



Embrace hybrid cloud

The cloud has become a commodity, with similar features offered by all major hyperscalers. However, each hyperscaler also provides specialized services. Therefore, organizations should adopt a hybrid cloud approach to leverage the best capabilities available. This also safeguards against vendor lock-in.



Leverage open source

When building applications on the cloud, organizations should consider using open-source services. This enables seamless migration from one cloud platform to another or even to an on-premise infrastructure, providing flexibility.



Adopt cloud for new workloads

To gain a competitive edge, organizations should develop new workloads and applications exclusively on cloud. This approach facilitates faster time-to-market, allows for experimentation, and provides access to a wide range of innovative services.



Accelerate data platform migration to cloud

By doing so, organizations can unlock the potential of their data better and faster.



Establish appropriate guardrails

Organizations must establish the right guardrails to optimize cloud costs. This entails setting up governance frameworks and implementing cost management strategies to ensure efficient resource allocation and minimize unnecessary expenses.



Architect for reverse migration

After optimizing their cloud infrastructure, organizations may consider reverse migration to an on-premise environment, particularly if certain workloads exhibit predictable resource utilization. This evaluation should consider potential cost benefits.



Rethink talent strategy

To ensure long-term sustainability, organizations must re-evaluate their talent mix. Incorporating AI as part of the talent strategy is crucial, as it enables organizations to harness the power of machines and humans in a complementary manner. Striking the right balance between human expertise and machine capabilities is vital for organizational success in the era of AI.

Apart from these, each stakeholder plays a crucial role in driving and enhancing the organization’s cloud journey and thus has to undertake role appropriate calls of action.

Actions	CEO	CIO/CTO
 <p>Strategic</p>	<p>Establish Cloud Center of Excellence (CoE)</p> <p>Sponsor digital initiatives with emerging technologies such as Gen AI contributing to strategic agendas such as growth or cost containment, branding, talent acquisition</p> <p>Encourage businesses to adopt to product mindset using cloud capabilities</p> <p>Envision new line of businesses or revenue sources built on cloud-platforms</p> <p>Reimagine operating models to infuse agility, transparency, and resilience using digital technologies</p>	<p>Leverage combination of multi and hybrid cloud strategies to maximize benefits</p> <p>Strategize lift and shift, lift and modernize and cloud-native (SaaS or new development) based on velocity of change applicable to business and agility needed in support functions to operate the business</p> <p>Consider data-as-a-business strategy and accelerate migration of data platforms</p> <p>Strategize to build for differentiation and buying for agility</p> <p>Consider alliances and partnerships with niche SaaS providers in new age areas such as Web3, Gen AI etc., to build business specific IPs</p>
 <p>Operational</p>	<p>Reposition cloud as organizational capability instead of competency Sponsor standing-up of a specialized team to ensure financial health while promoting cloud consumption, such as Cloud FinOps</p> <p>Promote hyper automation using cloud-technologies and in sighting enabled by AI to reduce cost of back-office operations</p>	<p>Set up monitoring and observability framework</p> <p>Focus on establishing a cloud playbook comprising of good practices-based reference architectures, landing zones, etc.</p> <p>Consider open source technologies to build cloud- ready applications</p> <p>Reverse migrate to a friendly architecture for priority workloads</p>
 <p>Tactical</p>		<p>Build new work /application only on cloud</p> <p>Adopt cloud ready DevEx</p>

	CRO/CISO	COO	CFO	Chief Talent Officer
	<p>Build cloud control matrix to establish governance by design for cloud environments</p> <p>Recast security outlook specifically from a data, identity and availability standpoint</p>	<p>Establish Data Governance framework</p>	<p>Build a cloud finance capability center to monitor and analyze cloud cost</p> <p>Adopt a right combination of humans and machine as a part of talent and experience strategy</p>	<p>Recalibrate a fit for future talent strategy for cloud</p> <p>Adopt a right combination of humans and machine as a part of talent and experience strategy</p> <p>Nurture a culture that enables change and adoption</p>
	<p>Strengthen the identity management tools</p> <p>Consider extensive use of intelligent automation for data-led insights into cloud operations</p> <p>Plan for infusing systems enabling early warning signals to mitigate anticipated risks</p>		<p>Analyze current landscape and optimize cloud spend</p> <p>Implement FinOps tools and setup FinOps practices</p>	<p>Augment inhouse capabilities to build and place the right talent</p> <p>Refresh workforce models to meet the organization's need on cloud</p> <p>Align careers and rewards to skills</p>
	<p>Recast logical access procedures for cloud environments accessed by managed service providers, subcontractors or third parties</p>			<p>Set up training academies for cloud skills</p> <p>Continuous listening and engagement</p>



8

Conclusion

Cloud: A business imperative for future-ready enterprises

India's projected rise as a prominent economy in the mid-century, coupled with the steadfast transformation brought about by digitalization, sets the stage for a future enabled by the Digital India Stack. In the coming years, Indian enterprises are poised to amplify their digital services with unprecedented speed and scale. They will produce IPs, advanced technology centers of excellence, and industrial stacks empowered by the evolving cloud and data advancements.

Cloud computing, as the backbone of this digital transformation and innovation, will enable enterprises to innovate and scale rapidly. Companies will need to refactor, rearchitect, or rebuild their applications for the cloud, embracing a multi-cloud approach that matures and becomes prevalent across organizations. The next competitive frontier will be industry cloud solutions, customized offerings that align with specific sector requirements, business processes, and regulatory frameworks, often incorporating cutting-edge capabilities like AI.

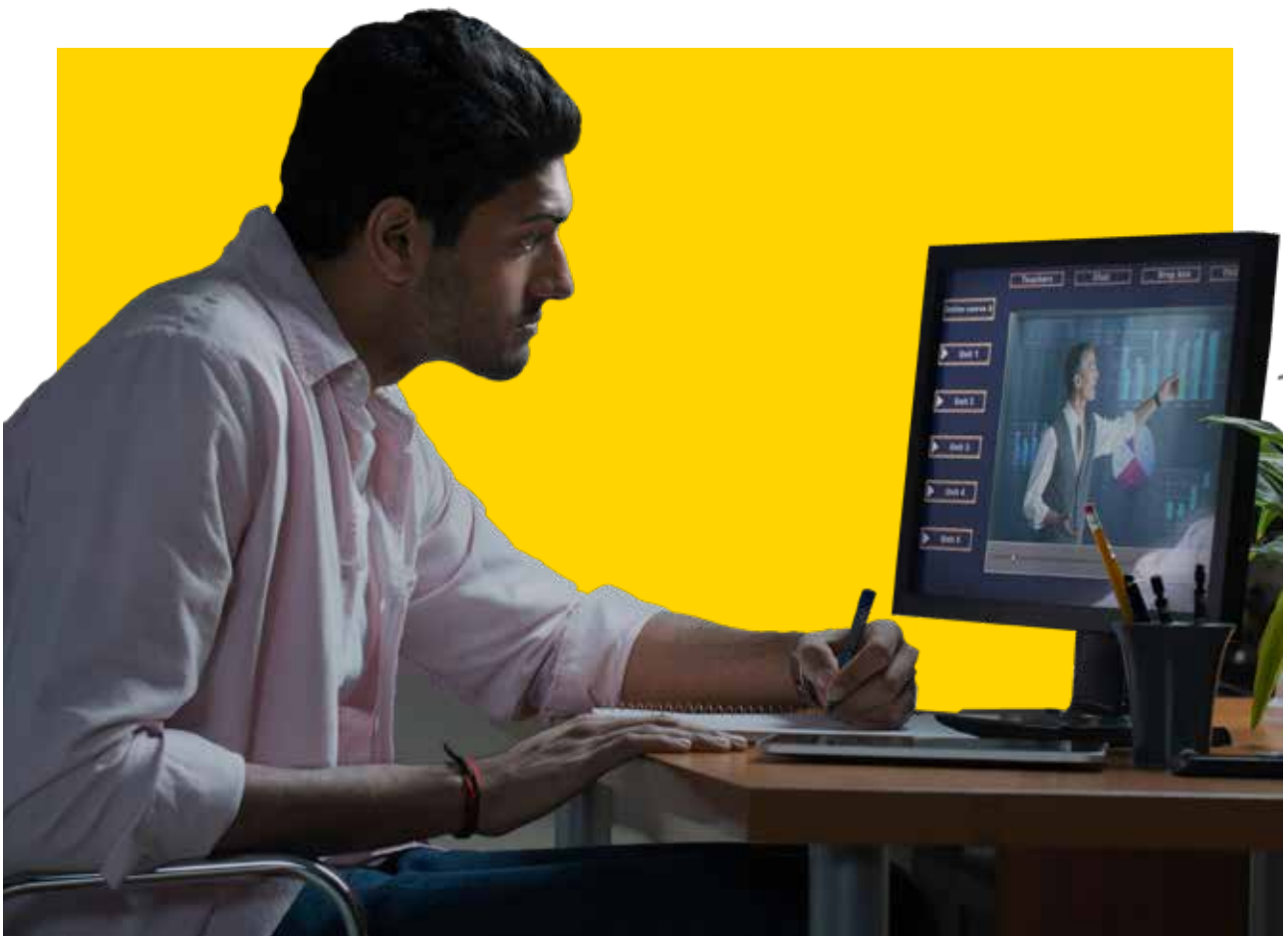
Leveraging data will serve as a key driver during this transformative phase. Organizations born in or migrated to the cloud will leverage data analytics to tap into new revenue streams and fuel growth, benefiting from their innate advantage of having access to vast internal and external data. What once started as a technological necessity, cloud computing has evolved into a business imperative.

Another critical aspect of this digital growth lies in reimagining the talent landscape. Future enterprises must adapt their talent pool to manage cloud services effectively and explore new possibilities. Furthermore, in a data-driven business environment, emerging technologies like generative AI will shape the way companies innovate, operate, and collaborate. Organizations that fail to adopt cloud computing may

struggle to fully leverage the potential of generative AI due to limited computing resources, restricted data access, inadequate integration, and slower innovation and deployment.

In the years to come, cloud computing is poised to assert its dominance as the de facto choice for building new applications, data and analytics workloads. Traditional workloads that are not adapted for cloud-native environments will become less common. Embracing the cloud will emerge as a core business decision for enterprises, underpinned by accelerated adoption and migration strategies.

Forward-thinking organizations will establish centers of excellence dedicated to transforming their businesses by adopting cloud and digital technologies, thereby harnessing the full extent of their transformative power. To ensure that organizations adopt the appropriate approach and utilize effective control and governance tools, a thorough understanding of business imperatives is necessary. We are optimistic that the Indian industry will seize this opportunity to embrace the cloud, unlocking its boundless potential and leveraging its benefits to innovate, create new revenue streams, gain a competitive advantage, and provide enhanced experiences for customers, employees, and other key stakeholders.



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