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Thought Leadership Paper
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and Intel

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Hybrid Cloud: A Smart Choice For AI And HPC

Drive Business Benefits While Solving For Top
Challenges



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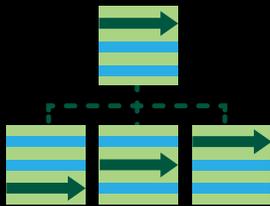
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AI and HPC use in the cloud will grow as firms attempt to improve infrastructure efficiency and scalability



Running these workloads in a hybrid environment leads to significant business benefits.

Executive Summary

High-performance computing (HPC), once the purview of academia, is going mainstream. Often used to train AI models, these systems are in increasingly high demand due to firms' needs for sophisticated data analysis and the data-intensive applications in AI and machine learning (ML).¹ As AI and HPC use increases, IT teams will need to make a slew of important decisions, including how to make the best use of another business technology-shaping force: cloud computing.

Dell Technologies and Intel commissioned Forrester Consulting to evaluate the use of cloud for HPC and AI workloads. To explore this topic, Forrester conducted an online survey with 732 global IT decision makers at government, higher education, manufacturing, financial services, healthcare, and oil and gas organizations. We found that to optimize performance and ensure success, firms are deploying HPC and AI on cloud, and they have no plans to stop anytime soon.

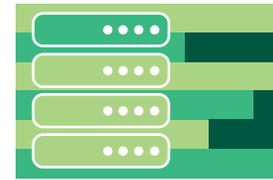
KEY FINDINGS

- › **Hybrid cloud is the new reality.** Firms are making increasingly more use of cloud — both public and private — especially when it comes to HPC and AI workloads. But this doesn't mean all deployments are moving off-premises. In reality, respondents say their firms expect cloud use to increase moving forward, but most are still working with environments that combine both cloud and non-cloud infrastructure.
- › **Firms must contend with security, latency, and application architecture issues while managing costs.** The majority of respondents report struggling with security issues, network delays, and necessary app rework that can derail projects and lead to increased costs. Though managing costs is a universal goal, firms need to put a heavier focus on cost optimization if they want to be successful.
- › **Hybrid cloud can be the cure for what ails firms.** Cloud migration will always be difficult. However, respondents in our study find that deploying HPC and AI workloads specifically in a hybrid environment results in business benefits that directly solve for some of their biggest challenges, most notably: improved performance, lower costs, and better security.
- › **Mature cloud use can transform your business.** Respondents say their firms are already reporting improvements to their bottom lines from their move to cloud. What's even more encouraging? Some mature organizations have instituted formalized processes, compiled sufficient resources, and maintain consistent management to help them use cloud as a way to fundamentally transform their business. As a result, these firms enjoy even larger gains from their efforts.

Expanded AI And HPC Use Necessitates A Move Towards Hybrid Cloud

As the need to glean insights from increasingly large datasets increases, today's firms find themselves in need of advanced data analysis, modeling, and simulations. This has led to increasing demand for ML, AI, and high-performance computing.² And this shift in compute and storage needs will necessarily reshape the business technology landscape moving forward as firms weigh the pros and cons of where to run these systems. In our study of 732 global decision makers of IT infrastructure cloud, HPC, or AI strategies, we found that:

- AI initiatives require a modern IT infrastructure.** Today's IT decision makers understand that to increase their use of AI workloads and scale across the organization, they must modernize everything from servers and storage to data warehouses and the cloud. This is especially true for HPC and cloud environments: Nearly 90% of respondents think that their AI initiatives increase the need to modernize high-performance computing power while 76% think they will need to modernize their hybrid cloud infrastructure.
- Though on-premises deployments dominate today, a move towards cloud is coming.** Forty-four percent of respondents say their firms currently run HPC services on-premises, while 40% choose on-prem for their AI and ML services (see Figure 1).

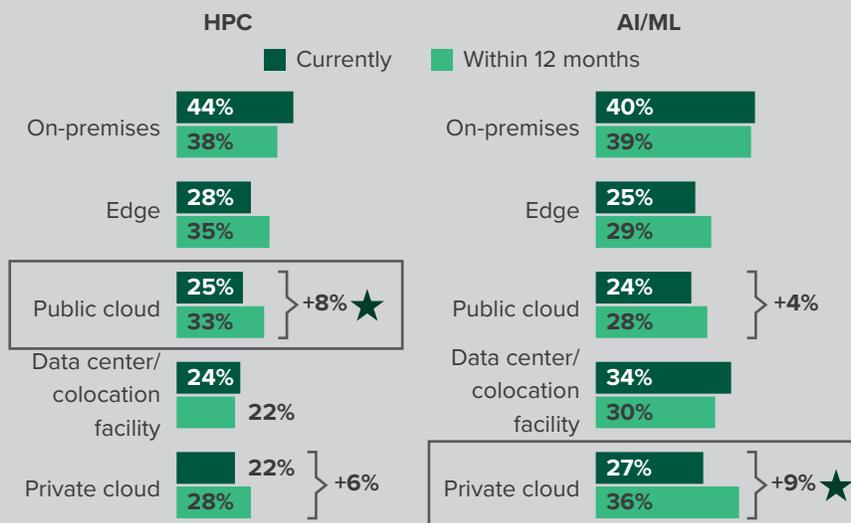


Forrester defines HPC as a platform where large clusters of computational nodes conjoin with high volumes of storage and bandwidth that allow for faster computing and complex problem solving.

Figure 1

“Where are you currently running each of the following services or supporting services?”

“Within the next 12 months, where are you planning to run each of the following services or supporting services?”



Base: 732 global decision maker on IT infrastructure cloud strategies, high-performance computing strategies, or AI strategies
 Source: A commissioned study conducted by Forrester Consulting on behalf of Dell Technologies and Intel, June 2020

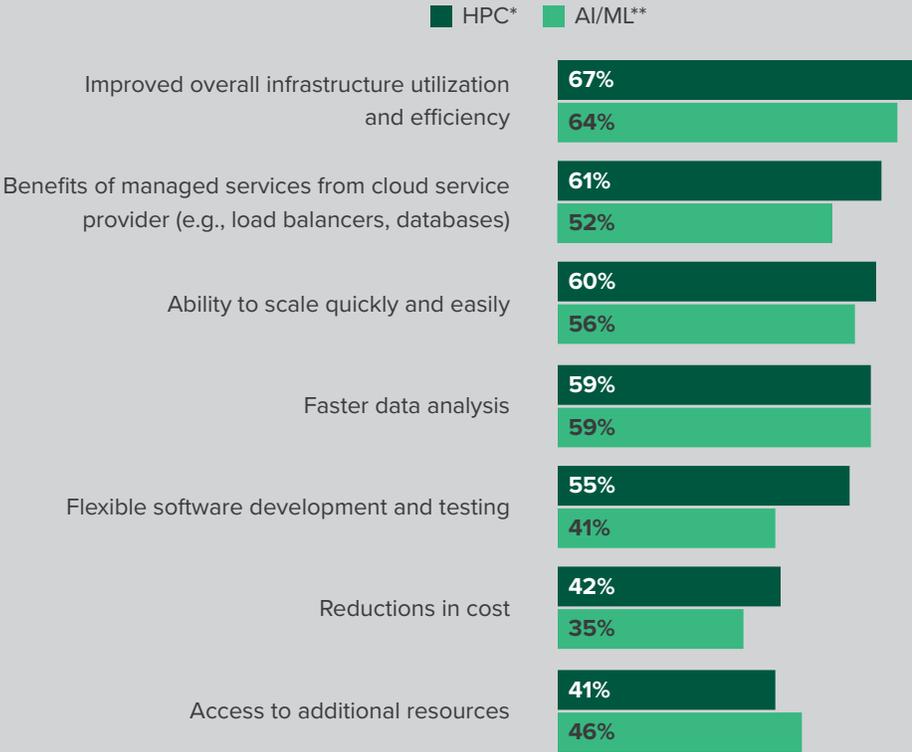
While on-premises deployment is the most popular for HPC and AI/ML today, there will be a clear shift toward adding cloud within 12 months.

Cloud deployments account for far less with only about a quarter of respondents utilizing public and private cloud environments for either HPC or AI workloads. However, within 12 months, there will be a clear shift toward cloud: 33% of respondents say their firms plan to run HPC services in public cloud (an 8% increase), and 28% plan to use private cloud (6% increase) in the coming year. While the biggest infrastructure move for HPC is a move to the public cloud, the biggest move for AI/ML is a move to the private cloud. Within 12 months, 36% of respondents say their firm plans to run AI/ML on private cloud (9% increase) and 25% say their firm plans to run AI/ML on public cloud (4% increase).

- Efficiency and scalability drive increasing cloud use.** Improved infrastructure utilization is the top reason firms are moving both HPC and AI services to the cloud (see Figure 2). The top drivers for moving to the cloud also include scalability, faster data analysis, and benefitting from the managed services that cloud providers offer. Improved infrastructure utilization and efficiency is the top factor impacting compute platforms for app development strategies, indicating the huge importance that firms place on optimizing the infrastructure options they have at their disposal.

Figure 2

“You said that you were planning to keep or move _____ to the cloud within the next 12 months. What are/were the main drivers of that decision?”



*Base: 338 global IT infrastructure cloud strategy decision makers planning to keep or move HPC to the cloud in the next 12 months
 **Base: 373 global IT infrastructure cloud strategy decision makers planning to keep or move AI/ML to the cloud in the next 12 months
 Source: A commissioned study conducted by Forrester Consulting on behalf of Dell Technologies and Intel, June 2020

THOUGH VARIOUS CLOUD STRATEGIES EXIST, HYBRID CLOUD ENVIRONMENTS ARE THE NEW REALITY FOR MOST FIRMS.

Forrester has declared that multicloud is here to stay, and respondents in this study agree.³ The truth is that most firms today pursue a hybrid cloud strategy or a mix of public and private cloud environments based on application and business requirements. In this study, we found:

- › **Hybrid environments prove popular for AI.** The move toward cloud does not necessarily mean a move entirely away from on-premises. Our study found that respondents' firms most often deploy their AI technologies in a hybrid environment during exploratory and development (28%), testing (31%), and production (26%). Furthermore, just under one-fifth of respondents say their firms deploy these workloads in multiple clouds. Altogether, nearly half of all respondents' firms use a combination of cloud and noncloud environment to best suit their needs throughout the AI technology lifecycle.
- › **Speed and flexibility make hybrid extension the most popular cloud strategy.** Hybrid extension — leaving an application and all its data in place but adding new modules and/or data in the cloud — is the most common cloud strategy for HPC, AI/ML, and research computing applications. For AI/ML, these cloud strategies are largely driven by a desire to optimize performance (65%), limit disruptions to operations and processes (65%), and decrease implementation time (63%). For HPC, fast implementation (64%) and a flexible architecture (62%) drive cloud strategies. To further boost portability, 84% of respondents say their firms use containers for app development, and nearly all those respondents consider them important.

Security, Latency, and Architecture Issues Cause Firms To Struggle

The move to cloud is not without its challenges. Cloud migration forces firms to reassess and update existing processes and applications, and it requires ample foresight to plan ahead for application growth and scale.⁴ IT decision makers struggle with issues of security, performance, and architecture, all while trying to balance the costs and benefits of moving workloads to the cloud.

In our study, we found that the key challenges to executing AI and HPC in the cloud fall into three major categories (see Figure 3):

- › **Security.** Concerns over security, privacy, and compliance are top of mind for respondents. Nearly 50% report grappling with security issues as they expand their use of cloud, making it the number one problem. Additionally, just over half of all respondents say their firm struggles with insufficient infrastructure security as they execute on AI strategies and security and compliance concerns while planning and implementing high-performance workloads in the cloud. Respondents also cite identity and security rework as the number one cost associated with moving workloads to the public cloud.
- › **Latency/data transmission.** Firms also struggle with their ability to move data efficiently and smoothly across the network. Latency issues are problematic for 33% of respondents' organizations as they expand their use of cloud. Over half find the inability to access or move data due to network constraints to be a challenging or very challenging obstacle to executing their organization's AI strategies. Data transmission latency and network performance is even more obstructive to planning and implementing high-performance workloads in the cloud as 63% of respondents find this challenging. Data transfer issues also result in increasing costs. Data transfer is tied with application reconfiguration as the third biggest cost associated with moving workloads to and from public cloud.
- › **Application architecture issues.** Without the right planning, cloud migration can hinder — rather than help them achieve — efficiency goals set at the onset. As firms expand their use of cloud, performance issues, learning new cloud-native architectures, and application architecture of existing apps each rank as large challenges. Additionally, 49% of respondents say their organizations find application performance difficult, impacting their ability to implement high-performance workloads in the cloud. Again, this all leads to increased costs for firms. Application reconfiguration and rework are some of the biggest costs associated with moving workloads to both public and private cloud. Application reconfiguration and modernization can be very resource-intensive before firms realize anticipated benefits. Organizations need to critically identify the best cloud strategy, considering how much they need to modernize their existing applications and how much they'll need to scale new applications to minimize performance challenges.⁵



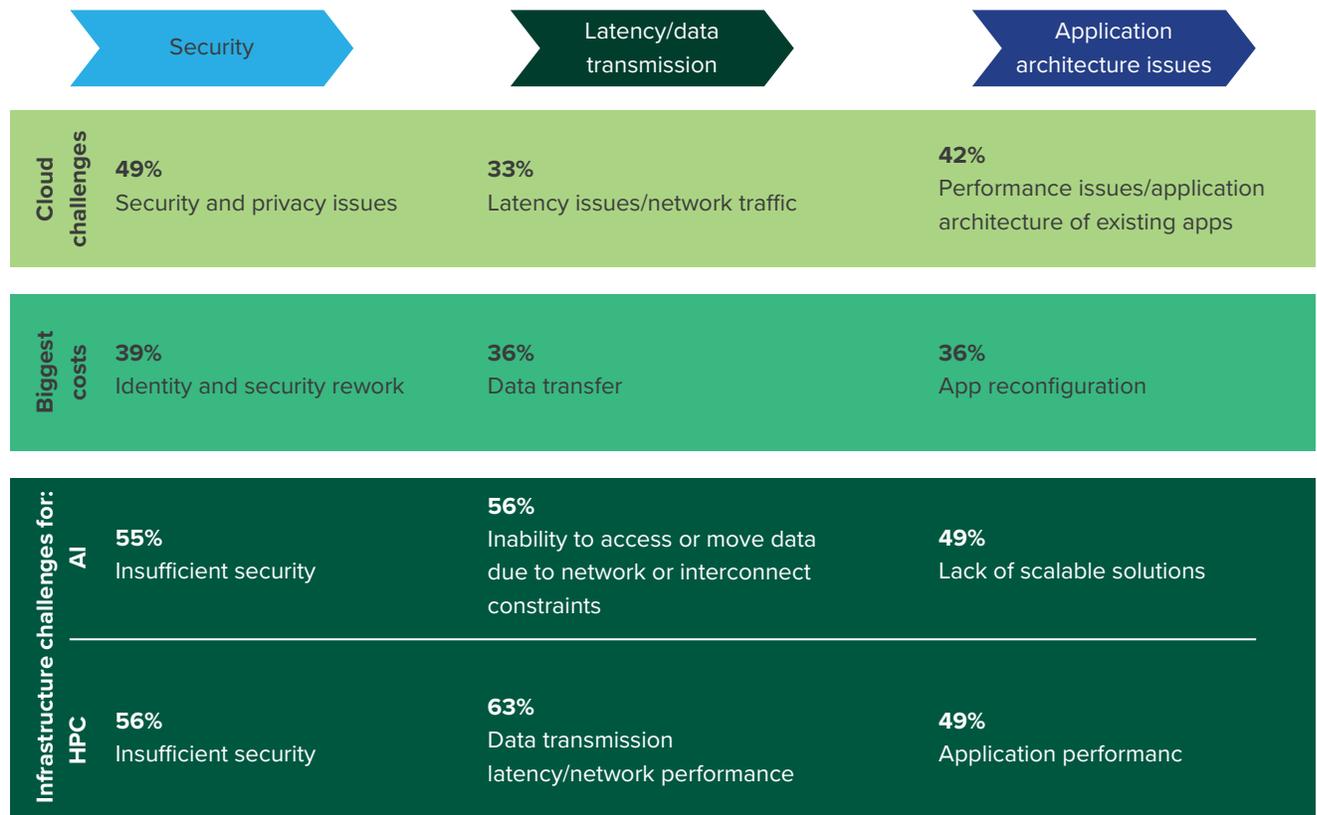
“A business disruption of just an hour can cost tens of thousands of dollars if the cloud platforms are not safe.”

VP in IT, Australian healthcare organization



In addition to the costs associated with all of the above, 53% of respondent decision makers find system cost to be a challenging infrastructure issue impacting AI strategy execution, 57% cite cost and cost transparency as a problem when implementing HPC in the cloud, and 39% find data uplink and downlink costs as an infrastructure challenge with HPC. Yet less than half of respondents say their firms consider cost optimization when determining cloud strategies for AI and HPC workloads. Firms must factor in the costs associated with cloud if they want to make the most of their considerable investments.

Figure 3
Key Challenges To Executing AI And HPC In The Cloud



Base: 732 global decision maker on IT infrastructure cloud strategies, high-performance computing strategies, or AI strategies
 Source: A commissioned study conducted by Forrester Consulting on behalf of Dell Technologies and Intel, June 2020

Adopt Hybrid Cloud To Accelerate Business Benefits From AI And HPC Initiatives

Despite their challenges, respondents in our study understand that putting in the work to overcome their issues is worth it. They say their firms are already seeing benefits to their bottom lines and other business benefits from moving workloads to the cloud generally, and specifically from running HPC and AI in a hybrid environment. But they can't do it alone. IT decision makers report needing the support and assistance that solution vendors offer. We found:

- Organizations need the help that cloud platforms can provide.** Firms are looking to cloud platforms to help solve some of their challenges. Specifically, as organizations expand their use of multiple on-premises and cloud compute platforms, they need the capability to help manage a multi-cloud environment. Forty-nine percent of respondents agree that multicloud flexibility to optimize IT resources for specific workloads would bring the most value to their organization. Storage management, security visibility, and cost optimization are also valuable offerings, helping them to tackle the current challenges at hand.
- Firms are already seeing the benefits of cloud.** The move to the cloud has paid off so far. Nearly two-thirds of respondents have seen a positive bottom line impact from their firm's migration of workloads to the cloud. These positive returns are likely a result of myriad business benefits firms have experienced to date. Moving workloads to the cloud frees up IT teams to work more strategically, allows for more flexible and high-performance infrastructure, and lowers both storage and compute costs (see Figure 4). Respondents say their firms anticipate these returns will only continue to grow: Within the next three years, more than three-quarters of firms expect a positive impact to their bottom line from their migration efforts (see Figure 5).

Figure 4

Top Benefits Of Public Cloud

-  Ability for our IT departments to focus on strategic projects rather than be data center managers
-  Lower storage costs overall
-  Improved app or infrastructure performance
-  Lower compute costs overall

Base: 732 global decision maker on IT infrastructure cloud strategies, high-performance computing strategies, or AI strategies

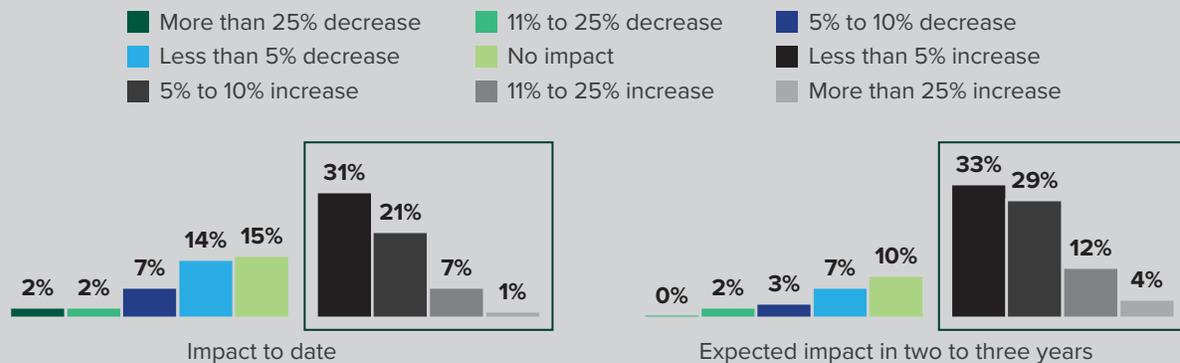
Source: A commissioned study conducted by Forrester Consulting on behalf of Dell Technologies and Intel, June 2020



45% of respondents expect a more than 5% increase to their firms' bottom line from their shift to the cloud.

Figure 5

“Roughly, what has been the financial impact of migrating workloads to the cloud on your organization's bottom line?”



Base: 732 global decision maker on IT infrastructure cloud strategies, high-performance computing strategies, or AI strategies
 Source: A commissioned study conducted by Forrester Consulting on behalf of Dell Technologies and Intel, June 2020

› **Hybrid cloud emerges as a potential solution to firms' top challenges.**

Respondents are seeing similar benefits from running AI and HPC workloads in a hybrid cloud environment. Recalling how important efficient infrastructure utilization is to firms, it is notable that the top benefit of hybrid cloud is improved IT infrastructure management and flexibility (see Figure 6). Additionally, benefits like improved performance, better overall cost management, and improved security solve for some of firms' top challenges. As a director of a higher education institution in the UK said, "We pursue a hybrid-cloud strategy because it has proved to be very effective for our business, especially in terms of optimizing cost and benefitting from research computing cloud strategies."

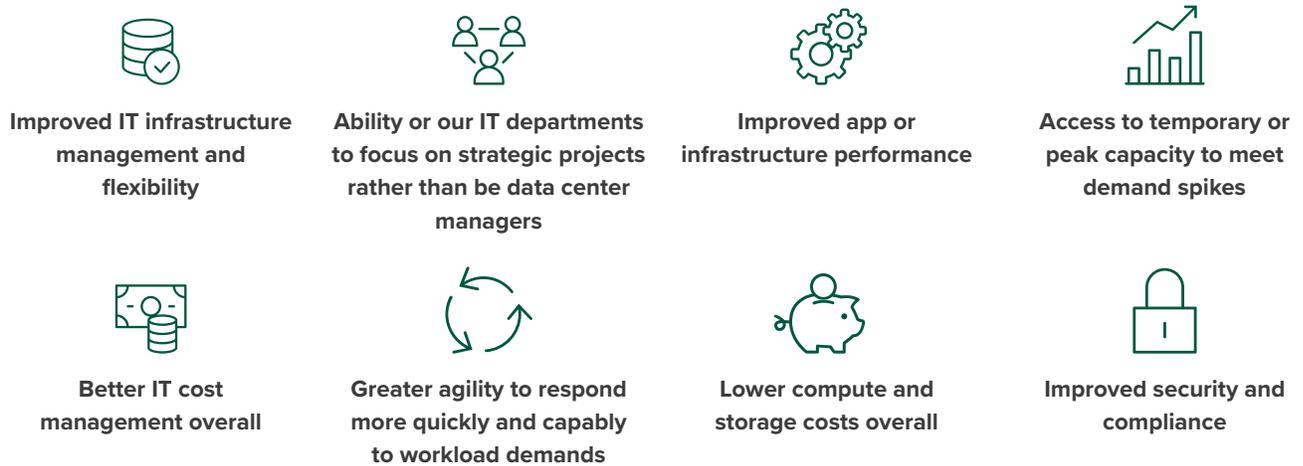
"A hybrid cloud environment that provides service integration has the potential to enable organizations to benefit from data in a fast, compliant, and secure manner, regardless of location."

VP in IT, French manufacturing firm



Figure 6

Top benefits from running AI and/or HPC workloads in a hybrid cloud environment



Base: 732 global decision maker on IT infrastructure cloud strategies, high-performance computing strategies, or AI strategies
 Source: A commissioned study conducted by Forrester Consulting on behalf of Dell Technologies and Intel, June 2020

Make The Most Of Cloud: A Lesson From Cloud Leaders

For this study, we assessed the maturity level of global decision makers of IT infrastructure, high-performance computing, or AI strategies on their strategic use of cloud and divided them among three groups. We labeled cloud leaders, roughly 30% of total respondents, as firms with high maturity, while cloud laggards (30%) fell under low maturity. Lastly, firms that straddled the lines between leaders and laggards (40% of respondents) fell into the bucket of medium maturity. For this paper, we will focus on the differentiation between high- and low-maturity groups to examine the extremes of how cloud can be used within a business. Those with medium maturity generally fell somewhere in between their high- and low-maturity peers.

Mature firms use cloud to transform their business. They have formalized processes, sufficient resources, and consistent management, which helps them leverage cloud to significantly alter their business model and operations. Overall, these leaders make more and better use of hybrid environments for HPC and AI by optimizing performance and limiting business disruptions. This sets them apart from low-maturity firms that lack the appropriate policies and guidance to create a formal cloud strategy and therefore tend to use cloud as a means of incremental tactical improvement rather than as a way to fundamentally change their business model or operations. These organizations are less likely to actively monitor their cloud use, aren't likely to offer consistent cloud management tools sets, and lack the internal skillsets to plan, design, configure, deliver, and maintain IT resources in the cloud. Nearly one-third of these low maturity firms have no formalized cloud strategy at all.

Leaders further distinguish themselves in the methods they use to migrate workloads and their use of hybrid cloud. Mature firms:

- › **Make more extensive use of hybrid cloud for AI and HPC workloads.** Given how instrumental cloud is to mature firms' overall business strategies, it's unsurprising that cloud is also a critical part of their AI and HPC strategies. More-mature firms currently run their AI and HPC services in cloud environments (both public and private) than low-maturity firms. They are also nearly seven percentage points more likely than less-mature firms to deploy AI technologies in a hybrid environment at all stages (development, testing, and production). This will continue to be the case moving forward: Mature firms plan to move more AI and HPC services to the public and private cloud within the next 12 months, again placing them ahead of their lower-maturity peers.
- › **Better understand the need for IT infrastructure modernization that AI initiatives create.** There is, in general, a greater urgency among mature firms to modernize all aspects of their IT infrastructure. Respondents from ninety-four percent of mature firms (versus 85% of less-mature firms) find that AI initiatives increase their firm's need to modernize servers and HPC abilities, and 89% of respondents from mature firms (vs. 75% from less-mature firms) find that they need to modernize server accelerators for deep learning. The difference is particularly noticeable when it comes to hybrid cloud: 87% of respondents from mature firms say their organization needs to modernize their hybrid cloud infrastructure compared to just 69% of respondents from less-mature firms.



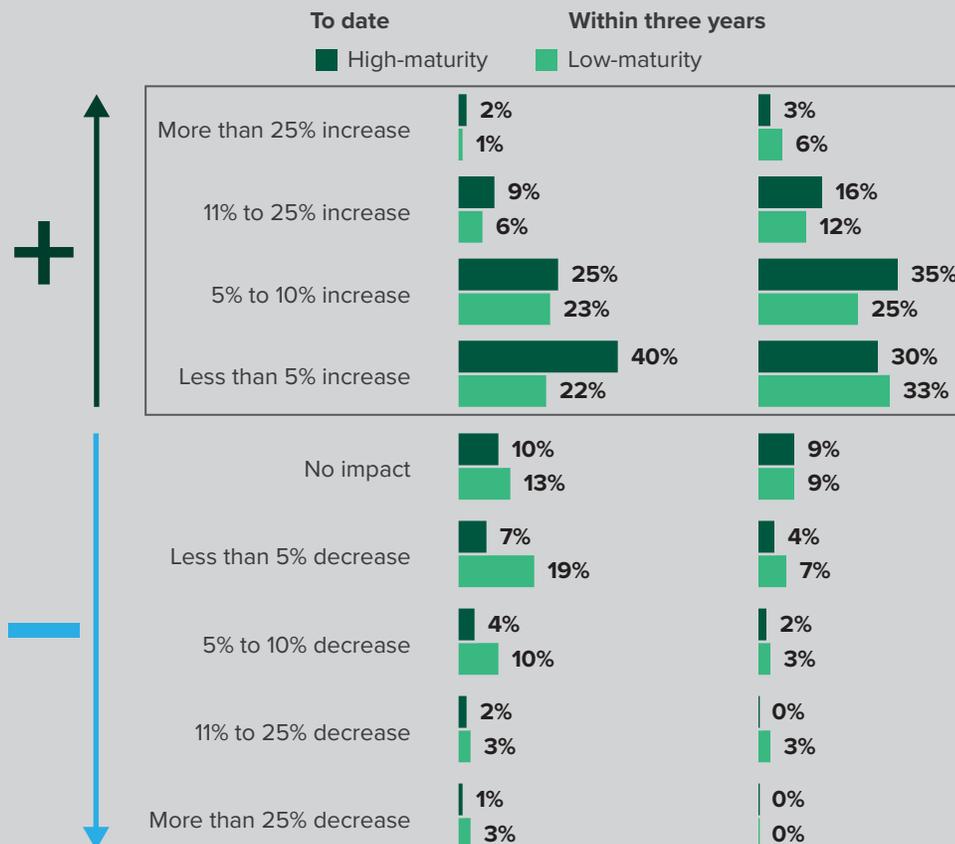
All geographies and company sizes have similar cloud maturity distributions though the highest percentage of high maturity firms tends to be within the government sector.

- Avoid full replacement strategies to balance performance and speed.**

Mature firms, armed with their advanced cloud posture and more modern infrastructure, most often opt for a lift-and-extend or lift-and-shift migration for their AI workloads. Their approach to HPC workloads is more varied, but one thing remains constant: Full replacement is a last resort. Less-mature firms, on the other hand, are more likely to attempt a full replacement for both AI and HPC applications. This method of replacing a system with one or more custom-built apps in the cloud gives these firms more architectural flexibility, but it is much more time- and work-intensive. This difference in approach is because mature firms are trying to leverage the existing cloud architecture to optimize performance, limit disruptions to their operations, and achieve the quickest time-to-implementation. Low maturity firms are, in essence, starting from scratch.
- Enjoy larger returns on their cloud investments.**

Mature firms are more likely to see positive financial impact from cloud migration. In fact, 76% of respondents from mature firms say their organization has seen a positive return to date, while respondents from nearly half of low-maturity firms say their organization has either experienced no impact either way or — even worse — lost money on the endeavor. Respondents from mature firms also expect to see even larger gains within three years: 85% expect to see positive gains overall, while over half (55%) expect to see at least a 5% increase (see Figure 7).

Figure 7
Mature firms see far more positive returns than less-mature firms



Base: 436 global decision maker on IT infrastructure cloud strategies, high-performance computing strategies, or AI strategies
 Source: A commissioned study conducted by Forrester Consulting on behalf of Dell Technologies and Intel, June 2020

Key Recommendations

Traditionally, setting up high-performance computing infrastructure has been capital intensive, and it was reserved for large enterprises, government agencies, or research organizations. In recent years, with the cost benefits brought on by Moore's Law, as well as the advanced services that public cloud vendors now offer, HPC in the cloud is not only a viable option for organizations of any size, but it can offer significant advantages that includes freeing up IT support resources to focus on innovation.⁶ However, the right approach will require a systematic approach from planning to operations. With the advent of robust cloud options and services, important but fewer reasons remain for AI and HPC applications to be all on-premises.

Forrester's in-depth survey yielded the following important recommendations:



Consider cost, latency, and data gravity as the core deciding factors.⁷

HPC and AI workloads are resource-intensive. They require specialized infrastructure including support from graphic processing units and high-speed storage as well as innovative software approaches. Whether you are experimenting with AI workloads or you already have an HPC environment and are expanding further, establish a clear framework centered around data gravity and internal cloud readiness for assessing the right approach for cloud usage. Unlike regular workloads, HPC and AI workloads attract associated applications and large amounts of analytical data quickly towards itself, eventually making any further migration efforts cost-prohibitive.



Adapt your architecture to the hybrid cloud. Data from this survey emphasized that a hybrid cloud approach not only addresses the top concerns of organizations with regards to HPC on the cloud, but it also forces digital transformation through a cloud first approach in application development. An all-cloud strategy for AI and HPC workloads can significantly skew the economic benefits in the long term unless justified by a lack of scalability requirements or network access. With the advent of mature HPC virtual machine orchestration engines and reliable data center interconnection networks, a hybrid approach offers the best of both worlds.

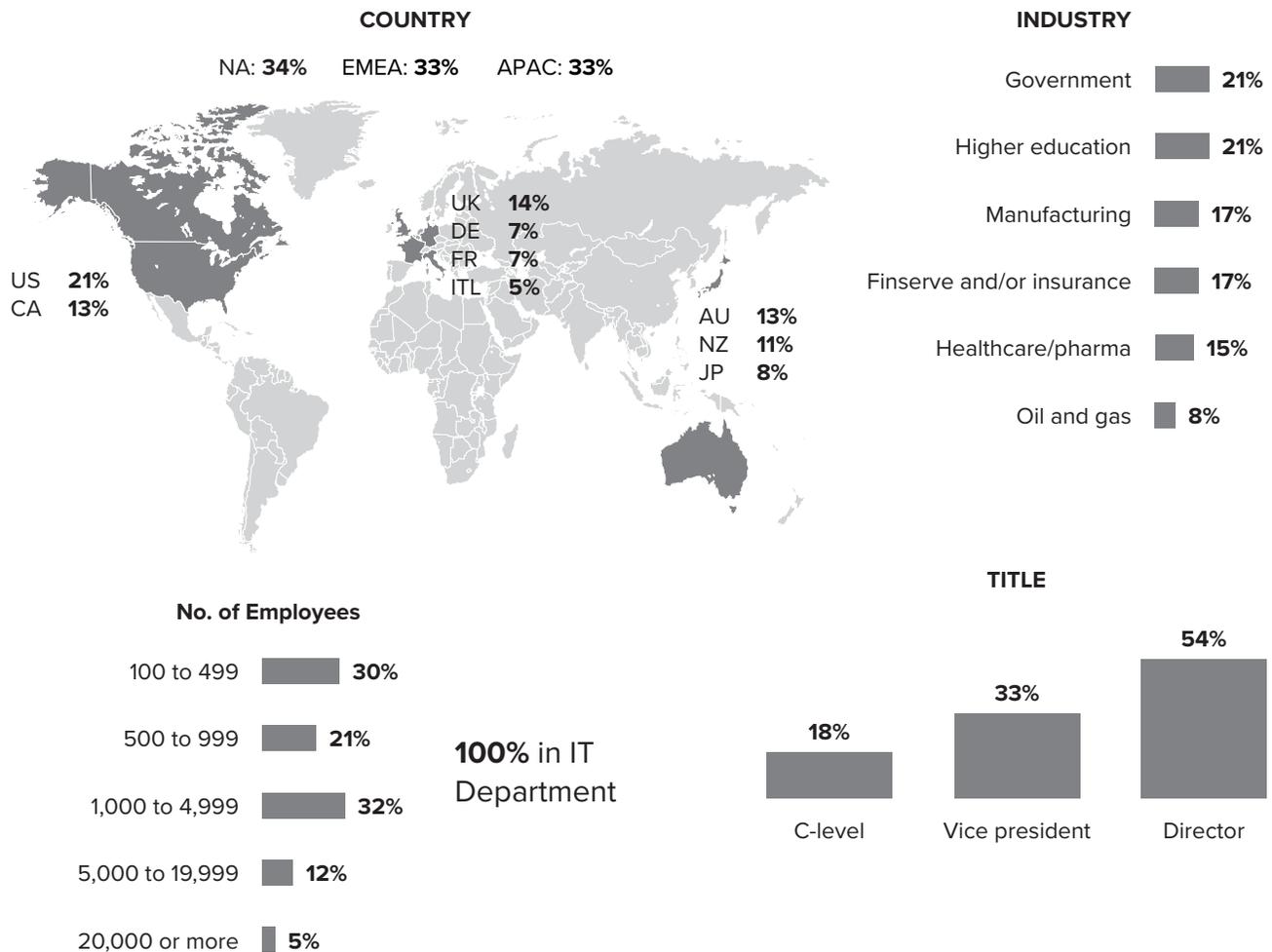


Empower HPC teams with the right tools and guidelines. Infrastructure and operations leaders must empower HPC teams with guidance on how to use cloud platforms safely, sustainably, and cost-effectively. To do this, develop governance guidelines and training that prepare IT staff to leverage the cloud responsibly and productively. Pay special attention to security needs of sensitive analytical workloads. Be prepared to supplement the cloud services that public cloud providers offer with cloud monitoring tools, orchestration tools, an efficient cloud release management process, and cloud access guidelines for your teams.

Appendix A: Methodology

In this study, Forrester conducted an online survey of 732 decision makers on IT infrastructure cloud, high-performance computing, or AI strategies in the US, Canada, the UK, Germany, France, Italy, Australia, New Zealand, and Japan. Survey participants came from government, higher education, manufacturing, financial services, healthcare, and oil and gas organizations of all sizes. Respondents were offered an incentive as a thank you for time spent on the survey. The study began in May 2020 and was completed in June 2020.

Appendix B: Demographics/Data



Base: 732 global decision maker on IT infrastructure cloud strategies, high-performance computing strategies, or AI strategies
 Note: Percentages may not total 100 because of rounding.
 Source: A commissioned study conducted by Forrester Consulting on behalf of Dell Technologies and Intel, June 2020

Appendix C: Supplemental Material

RELATED FORRESTER RESEARCH

“Predictions 2020: Cloud Computing,” Forrester Research, Inc., November 4, 2019.

“The Forrester Tech Tide™: Compute Platforms, Q4 2019,” Forrester Research, Inc., October 19, 2019.

“Top 10 Ways To Master Performance For Your Cloud Migration,” Forrester Research, Inc., April 13, 2020.

Appendix D: Endnotes

¹ Source: “The Forrester Tech Tide™: Compute Platforms, Q4 2019,” Forrester Research, Inc., October 10, 2019.

² Ibid

³ Source: “Adoption Profile: Hosted Private Cloud In North America, Q3 2020,” Forrester Research, Inc., July 6, 2020.

⁴ Source: “Top 10 Facts Tech Leaders Should Know About Cloud Migration,” Forrester Research, Inc., March 14, 2019.

⁵ Source: “Top 10 Ways To Master Performance For Your Cloud Migration,” Forrester Research, Inc., April 13, 2020.

⁶ First observed by Intel co-founder Gordon E. Moore, Moore’s Law essentially states that the number of transistors in a given unit of space will roughly double every two years, thereby doubling computing power but halving cost.

⁷ Data gravity is defined as the ability of bodies of data to attract applications, services, and other data. The larger the amount of data, the more applications, services, and other data will be attracted to it.