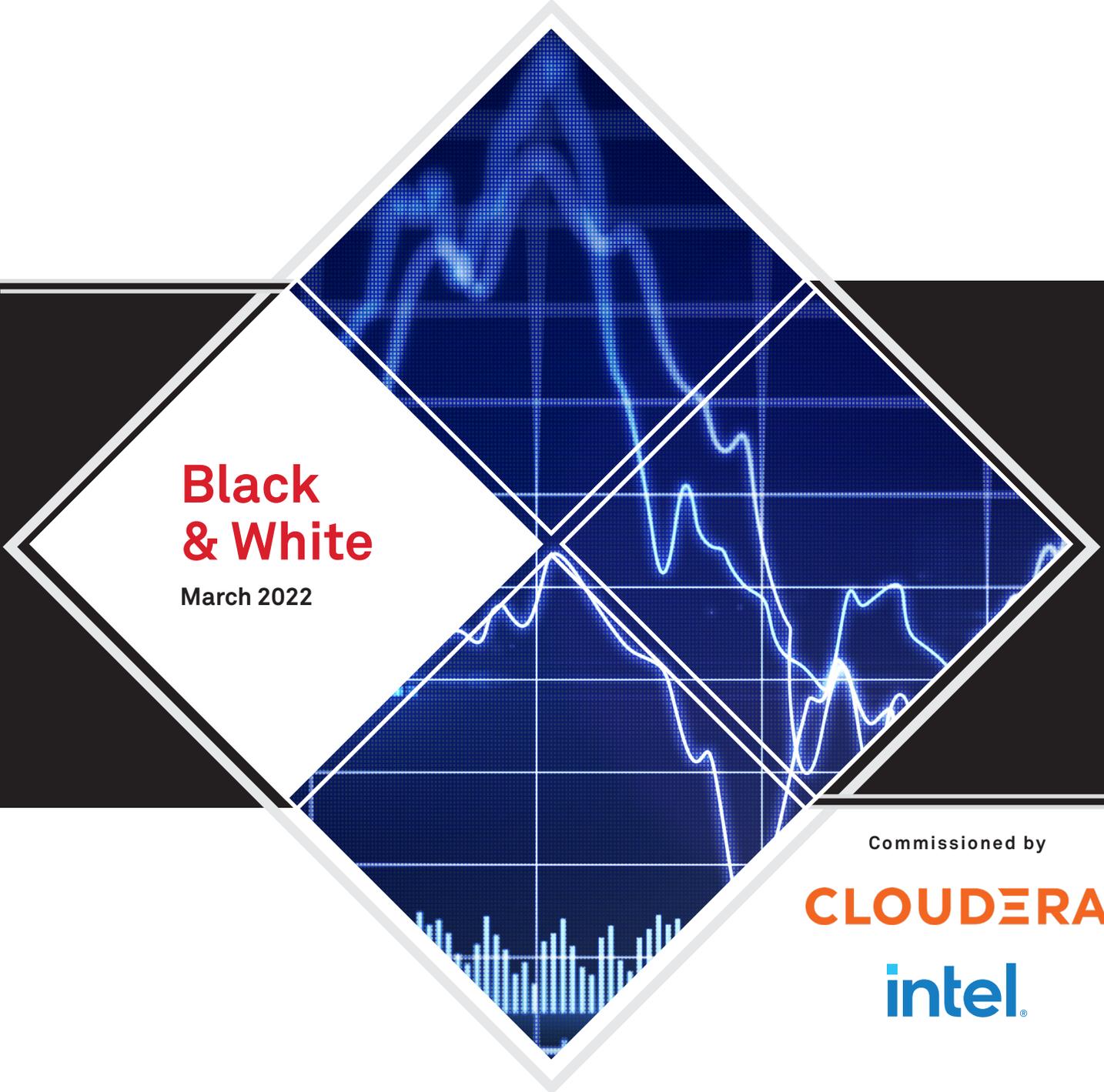


# Hybrid Data Architectures

Powering Enterprise Digital Transformation



**Black  
& White**

March 2022

Commissioned by

**CLOUDERA**

**intel**<sup>®</sup>

451 Research

**S&P Global**  
Market Intelligence

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## About this paper

A Black & White paper is a study based on primary research survey data that assesses the market dynamics of a key enterprise technology segment through the lens of the “on the ground” experience and opinions of real practitioners — what they are doing, and why they are doing it.

## About the Author



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Melanie Posey is the Research Director for the Cloud & Managed Services Transformation at 451 Research, a part of S&P Global Market Intelligence. In addition to managing the research team, she focuses on analyzing the evolution of enterprise IT through the lens of cloud and the associated transformation of IT consumption and delivery models. Melanie also manages 451 Research’s Voice of the Enterprise: Cloud, Hosting & Managed Services offering.

Prior to joining 451 Research, Melanie spent more than 15 years at IDC in a variety of roles, providing analysis, forecasting and insight for the cloud, hosting, datacenter, managed services and telecommunications markets. At IDC, Melanie received numerous awards for research, collaboration, sales support and client service, including being named runner-up for the prestigious James Peacock Memorial Award.

During her more than 20-year career in the technology research and consulting arena, Melanie has been quoted extensively in the business and technology trade press, and is a frequent speaker at industry and client events.

Melanie holds an MA in international relations/international economics from the Paul H. Nitze School of Advanced International Studies (SAIS), a division of Johns Hopkins University, an MA in political science from the University of Michigan, Ann Arbor, and a B.A. in French from Amherst College.

# Introduction

Data-driven decision-making is one of the key business imperatives of the digital economy, providing enterprises with the insight needed to create and deliver business value, rapidly capitalize on new opportunities, improve operational efficiency, respond to market disruption and sustain competitive advantage. Multiple technologies converge to facilitate digital transformation. Cloud provides the infrastructure, serving as the chassis that supports scalable digital operating models. Cloud-native frameworks enable agile deployment, management and orchestration of applications (the engine of digital business). Data – and the ability to process, manage, analyze and act upon it – takes pride of place as the fuel that powers digital business processes.

Cloud infrastructure, cloud-native applications and data collectively serve as the platform that takes individual companies and entire industries to their destination: digital transformation. But the vehicles can't get to where they're going without fuel, and the fuel needs an optimized path to the vehicles. That path is the data pipeline. Cloud is now a mainstream feature of enterprise IT, and cloud native is emerging as the default approach for new application development. But heterogeneous IT estates featuring both public and private cloud infrastructures are also standard operating practice in enterprise IT. As organizations seek to build, operate, manage and secure digital workloads 'here, there and everywhere' with public, private and edge clouds, the data pipeline must operate seamlessly across diverse IT environments, delivering the fuel to meet the escalating 'anywhere/anytime' expectations of data practitioners, line-of-business stakeholders and the C-suite for data-driven business intelligence and insights.

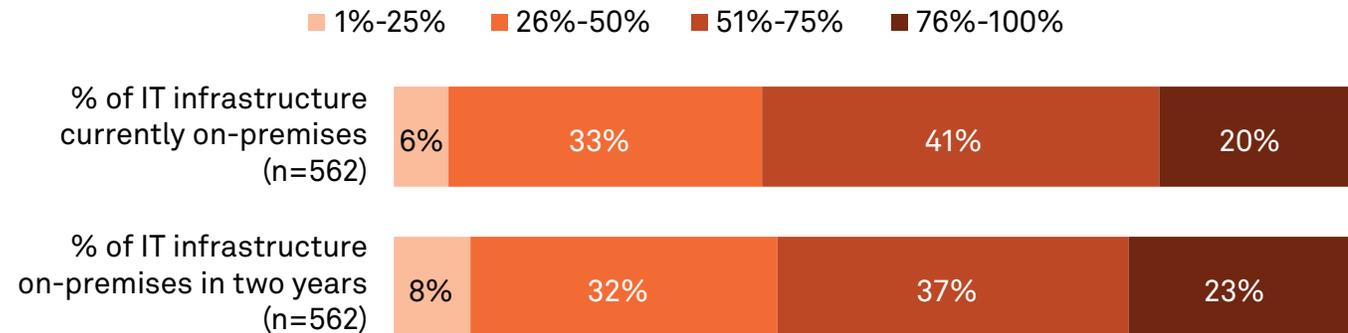
Digital strategy begins with data strategy, which in turn informs IT infrastructure requirements and application development and deployment practices.

# The Future of IT is Hybrid, Multicloud and Complex

Today’s enterprises face an overwhelming array of options for deploying and running their data and analytics workloads, including datacenters and data platform frameworks, and they must make decisions about on-premises versus off-premises and private cloud versus public cloud. However, as the cloud operating model takes hold, enterprises have choices about where workload execution takes place, and a consensus is emerging in favor of infrastructure-agnostic approaches to key business processes, which provide flexibility by enabling enterprises to run workloads in multiple environments, such as public clouds and private clouds housed in on-premises datacenters or third-party colocation facilities.

While public cloud continues to gain traction as a workload execution venue, there does not appear to be a significant short-term impact on the enterprise use of on-premises datacenters and infrastructure. In a 451 Research survey commissioned by Cloudera, 61% of enterprises reported that their organization’s IT infrastructure currently operates primarily (i.e., more than half) in on-premises/colocation datacenter environments, and 60% of enterprises anticipate that this will still be the case two years from now. The proportion of enterprises reporting that more than three-quarters of their IT infrastructure operates on-premises increases from 20% today to a projected 23% two years from now (see Figure 1) – indicating on-premises datacenters and infrastructure will remain part of the enterprise IT mix.

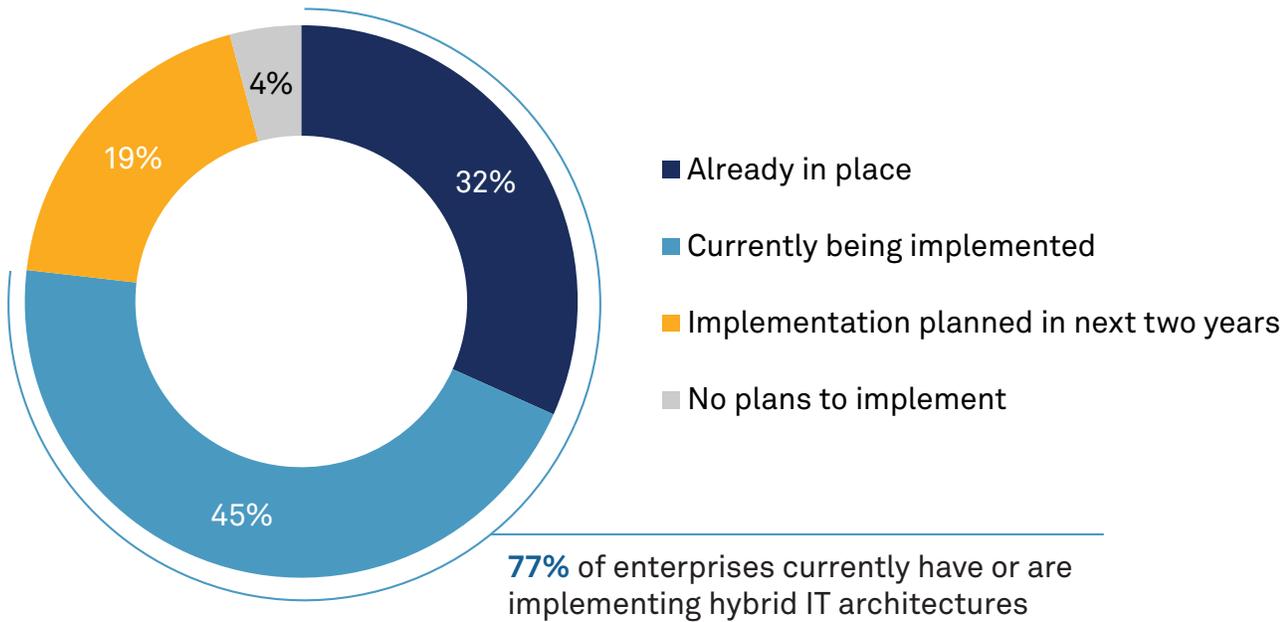
**Figure 1: Proportion of Enterprise IT Infrastructure in On-Premises Datacenter/Colocation Environments**



(Note: Discrepancies in totals are due to rounding)  
 Q: What proportion of your organization’s IT infrastructure would you estimate is in an on-premises/hosted datacenter, as opposed to public cloud?  
 Q: Two years from now what proportion of your organization’s IT infrastructure would you estimate will be in an on-premises/hosted datacenter, as opposed to public cloud?  
 Base: All respondents (n=562)  
 Source: 451 Research custom survey commissioned by Cloudera, Q4 2021

Hybrid IT environments that leverage both on-premises and off-premises cloud resources in an integrated fashion provide a way to move beyond ‘either/or’ IT infrastructure decisions. Nearly one-third of surveyed organizations have already implemented hybrid IT architectures, while an additional 45% plan to do so within the next two years (see Figure 2). Key capabilities and use cases driving hybrid adoption include workload migration, consolidation of different IT environments under a single management framework, cost efficiency and enablement of centralized data repositories.

Figure 2: Current State of Hybrid IT Implementation



Q: A hybrid IT environment leverages both on-premises systems and off-premises cloud/hosted resources in an integrated fashion. Which of the following best describes the current state of your organization's IT environment?

Base: Respondents with at least some IT infrastructure in public cloud environments (n=554)

Source: 451 Research custom survey commissioned by Cloudera, Q4 2021

Enterprise workloads have different resource, performance, security and compliance requirements, and one size may not fit all when it comes to IT infrastructure environments. The operational complexity of heterogeneous IT estates requires a data- and application-centric approach that allows for consistent management across the IT estate and facilitates seamless and secure movement of data and workloads in line with technology and business requirements. As hybrid (and multicloud) establishes itself as the organizing principle of enterprise IT, cloud-native architectures can help organizations with the management challenge by abstracting data processing and analytics functions from the underlying infrastructure – allowing enterprises to take a ‘best execution venue’ approach to both data management and application deployment.

# Data and Analytics Workloads: Infrastructure, Application Modernization and the Role of Cloud Native

Data/analytics functionality feeds into mission-critical business operations and strategic decision-making. However, data processing is one part of a larger data lifecycle management process spanning point-of-origin data collection/ingestion to data usage (analytics) to data storage and retention. As a result, data/analytics workloads are complex, with multiple moving parts that are difficult to manage and safeguard in the absence of well-defined governance and operating architectures. Therefore, workload placement decisions need to be made carefully, taking into account the requirements of multiple stakeholders including data analysts/data scientists, line-of-business users, the CIO, the CISO, the legal/compliance department and corporate management.

Although data/analytics workloads are shifting to public cloud environments (particularly net-new data platforms and analytics workloads), the situation is not a zero-sum game. 451 Research's [Voice of the Enterprise: Data & Analytics, Data Platforms 2021](#) survey found that enterprises anticipate deploying data platforms and services in both public cloud and on-premises environments (as well as in third-party colocation datacenters). Cloud-native technologies play an important role in IT infrastructure decisions, application modernization and overall data/analytics evolution. On the applications front, cloud-native frameworks bring greater agility to the application development lifecycle. On the workload-deployment-venue front, cloud native enables application portability. When combined with hybrid IT environments that integrate on-premises and public cloud infrastructure, that portability offers enterprises flexibility around where data/analytics workloads run and the ability to make those decisions based on specific requirements such as time-to-insight demands, data sovereignty and governance, and the locations/distribution patterns of data sources, data-driven business operations and key stakeholders.

When it comes to existing data/analytics workloads currently running on-premises, a slim majority of enterprises are opting to keep things as they are – at least for the time being – but with a view toward updating both the infrastructure and data platform/services stacks (see Figure 3).

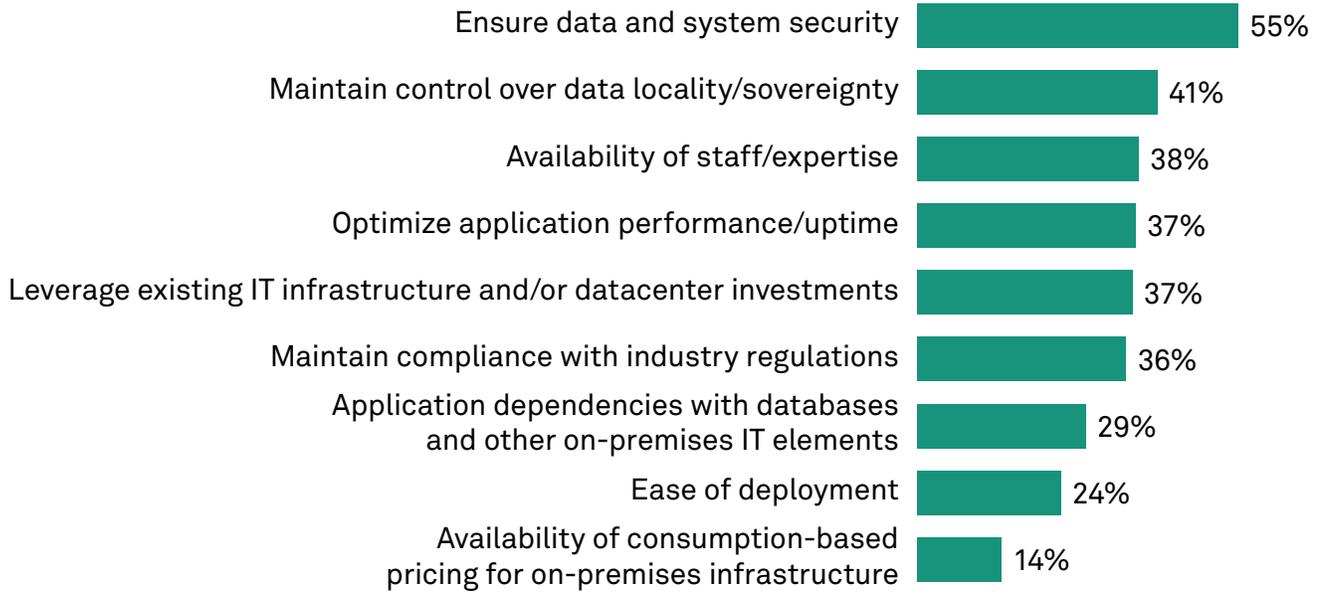
**Figure 3: Primary IT Infrastructure Strategy for On-Premises Data/Analytics Workloads; On-Premises Modernization Drivers**

**Primary IT infrastructure strategy for on-premises data/analytics workloads**

- Lift and shift to public cloud
- Repurchase/replace and shift to public cloud
- Refactor to cloud native then shift to public cloud
- Modernize to cloud native and continue to deploy on-premises
- Retain unchanged on-premises



**Factors fueling on-premises modernization/retention of data/analytics workloads**



(Note: Discrepancies in totals are due to rounding)

Q: Which of the following best describes your organization's overall IT infrastructure approach to existing on-premises data/analytics workloads going forward?

Q: You've indicated that your organization plans to retain or modernize existing data/analytics workloads on-premises. What are the most important reasons for this choice? Which of the following best describes your organization's overall IT infrastructure approach to existing on-premises data/analytics workloads going forward?

Base: All respondents (n=562) and organizations modernizing/retaining data/analytics workloads on-premises (n=188)

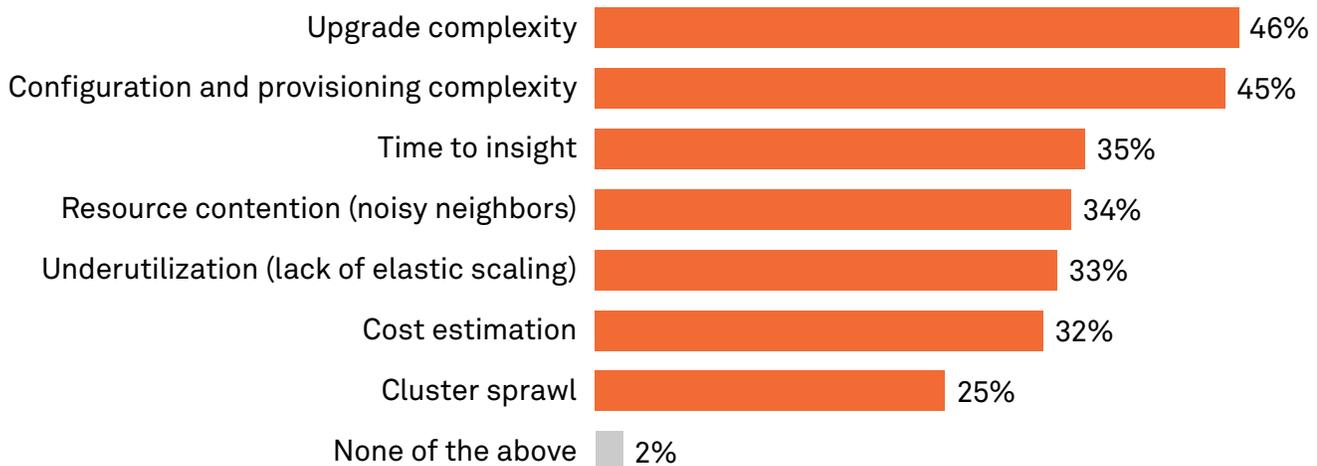
Source: 451 Research custom survey commissioned by Cloudera, Q4 2021

Fifty-three percent of enterprises show at least some inclination toward keeping their existing data platforms and analytics stacks on-premises. For a quarter of enterprises, the ‘modernization in-place’ approach represents the preferred path forward, while only 8% plan to stay in retention mode, keeping their current data platforms and application stacks on-premises and unchanged. The predominant factor driving the choice of path revolves around security concerns (protecting both the data and the infrastructure on which it is stored and processed). The refactor-and-shift contingent that plans to rearchitect or ‘cloud-nativize’ existing data/analytics platforms and workloads before redeploying to public cloud environments may be a wild card for continued on-premises operations. These organizations have prioritized modernization of the data/analytics stack; subsequent decisions about the infrastructure approach lean toward public cloud but could potentially land upon on-premises or hybrid as the eventual deployment strategy.

# Finding the Right Balance: Data & Analytics and Repatriation

Data/analytics workloads are complex and difficult to maintain and manage regardless of the IT environment(s) in which they operate. Enterprise perspectives converge on the challenges of running data/analytics workloads in public clouds, private clouds or traditional server architectures (see Figure 4).

**Figure 4: Data/Analytics Workloads: Key Infrastructure Challenges**



Q: What are the most significant challenges faced by your organization in relation to public cloud/private cloud/traditional server architecture for data/analytics workloads?

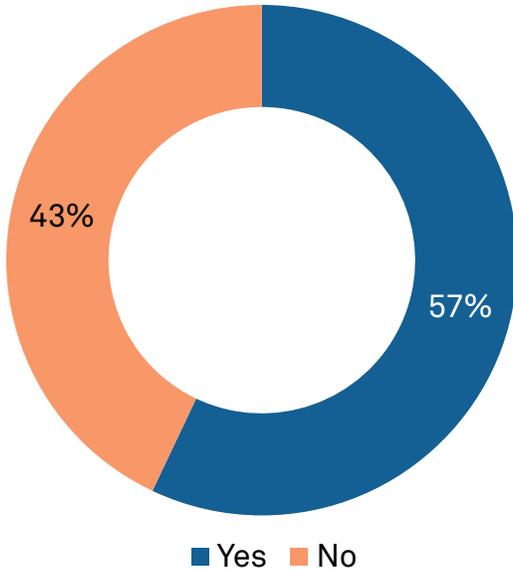
Base: All respondents (n=562)

Source: 451 Research custom survey commissioned by Cloudera, Q4 2021

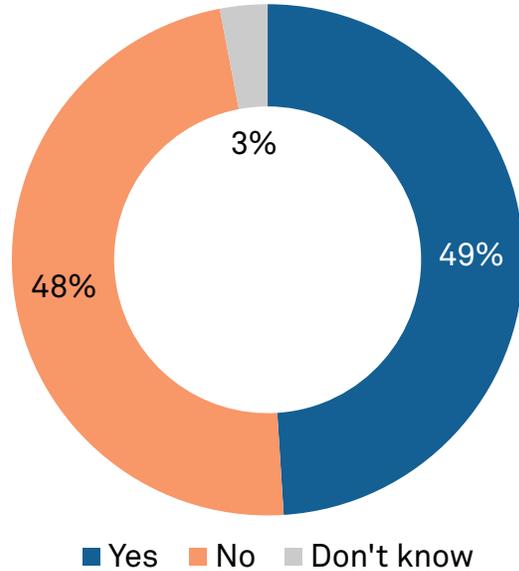
Nevertheless, because data/analytics workloads support strategic ‘run the business’ functions, it is important that enterprises do their due diligence in determining the best execution venue for these workloads. Data platforms do not operate in a vacuum; the end-to-end workflow (from data capture/storage to business insight) must be incorporated into the decision-making process. That being said, enterprises often have difficulty choosing the best execution venue for data/analytics workloads. As a result, repatriation happens (see Figure 5).

Figure 5: Data/Analytics Workloads Repatriation From Public Cloud to On-Premises/Colocation IT

Repatriation from public cloud to on-premises/colocation IT: this year



Repatriation from public cloud to on-premises/colocation IT: next year



Q: Has your organization migrated ['repatriated'] data/analytics workloads from an IaaS/PaaS public cloud environment to an on-premises/hosted datacenter in the past 12 months; does it plan to in the next 12 months?  
Base: All respondents (n=562)  
Source: 451 Research custom survey commissioned by Cloudera, Q4 2021

Nearly 60% of enterprise respondents reported having repatriated data/analytics workloads from public cloud environments to on-premises/colocation datacenter environments during the past 12 months, while nearly half indicated plans to do so during the next 12 months. Multiple factors (both tactical and strategic) are behind enterprise decisions to migrate workloads to on-premises/colocation datacenters from public cloud environments, but these factors don't necessarily constitute an indictment of the suitability of public cloud for these workloads (see Figure 6).

Figure 6: Factors Driving Data/Analytics Workload Migration From Public Clouds



Q: What factors drove or are driving the decision to bring these workloads/applications back on-premises from IaaS/PaaS public cloud environments?

Base: Respondents who have repatriated or plan to repatriate data/analytics workloads from public clouds to on-premises/colocation datacenter environments

Source: 451 Research custom survey commissioned by Cloudera, 4Q 2021

Data-sovereignty considerations top the list of repatriation drivers, followed by skills shortages that make it difficult for enterprises to leverage and manage workloads in public cloud environments, and improved (i.e., more cloud-like) options available from on-premises private cloud offerings. Interestingly, actual experience with a security breach in the public cloud is not a particularly significant repatriation driver, although security concerns do play a key role in keeping existing data/analytics workloads on-premises. This suggests that larger considerations come into play with regard to repatriation, hinting at the complexity and potential difficulty of data governance, regulatory compliance and application performance assurance in distributed and scalable/on-demand public cloud infrastructure environments. When it comes to data/analytics workloads, enterprises may not always be willing or able to navigate the on-premises/public cloud trade-offs: agility vs. control; flexibility vs. security; choice vs. complexity; and price vs. performance.

# Data/Analytics Workloads: Journey to Private Cloud

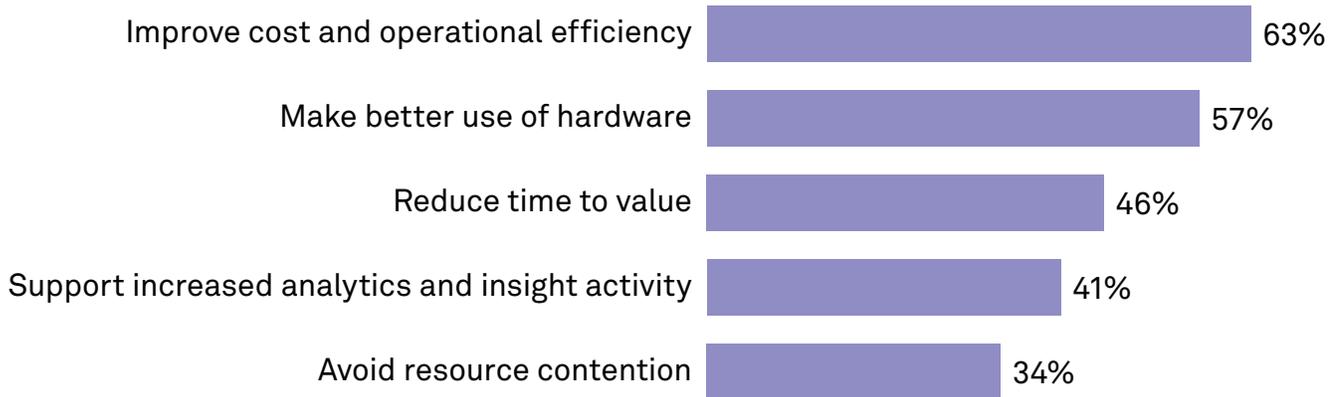
Although keeping data/analytics workloads on-premises is a desired approach for approximately one-third of survey respondents (and is still on the table for an additional 20% of enterprises), the infrastructure stacks supporting these workloads will nevertheless need to evolve. A key part of the data/analytics workload modernization process involves re-architecting the applications using cloud-native tools and frameworks, which will require the capabilities enabled by private clouds. Ongoing enhancements to private cloud infrastructure offer many of the same capabilities as a public cloud – self-service infrastructure provisioning, automated/elastic scalability, resource sharing across departments/workloads, automated monitoring/management of the IT estate, network-based access to compute resources – without the security and performance issues that can come along for the ride with public cloud or the effort that comes with upgrading traditional server architectures.

However, modernization of IT infrastructure in on-premises/colocation datacenters does not happen overnight. On average, enterprises reported that 53% of their organizations' IT environment deployed in on-premises/colocation datacenters currently operates as private cloud today, increasing only slightly to a projected 56% two years from now.

Yet, the rate of change is more pronounced among the most active users/adopters of on-premises private cloud (those already running more than half of their on-premises/colocation IT as private clouds). Among this group, private cloud as a proportion of the total on-premises/colocation IT estate is expected to grow rapidly from 22% of enterprises with more than three-quarters of IT estates running in private cloud mode today to 34% two years from now. One key takeaway of this shift is that enterprises will need to prioritize people and process investments to reap the benefits of running data/analytics workloads in private cloud environments (and, by implication, avoid the setbacks and disappointments that drive public cloud repatriation).

The shift to private cloud is being fueled by multiple factors (see Figure 7), led by the need for improved cost and operational efficiency (63%), followed by better leverage of IT infrastructure (57%), and reduction of overall time to value (46%). Each of these drivers supports a primary private cloud use case (data/analytics and insight).

Figure 7: Private Cloud Implementation Drivers



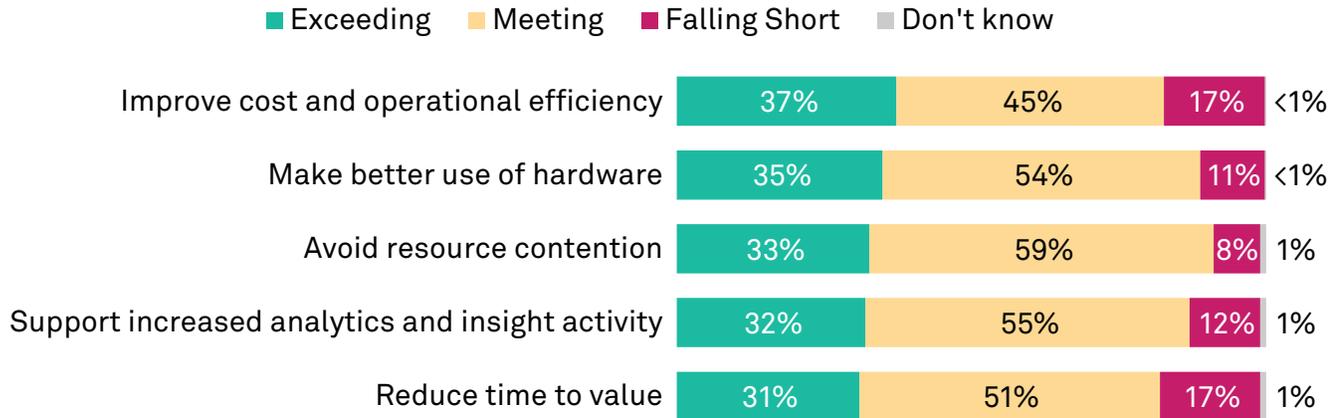
Q: Which of the following use cases are driving your organization's implementation (or planned implementation) of private cloud?

Base: All respondents (n=562)

Source: 451 Research custom survey commissioned by Cloudera, Q4 2021

The survey also explored enterprises' perception of whether private cloud delivered on the expected outcomes. The relatively high level of overall satisfaction with private cloud indicates that enterprises are deriving benefits from the shift away from traditional, siloed server infrastructure (see Figure 8).

Figure 8: Private Cloud Satisfaction



Q: For each of the following intended outcomes, please indicate whether your private cloud environment is exceeding, meeting or falling short of your expectations?

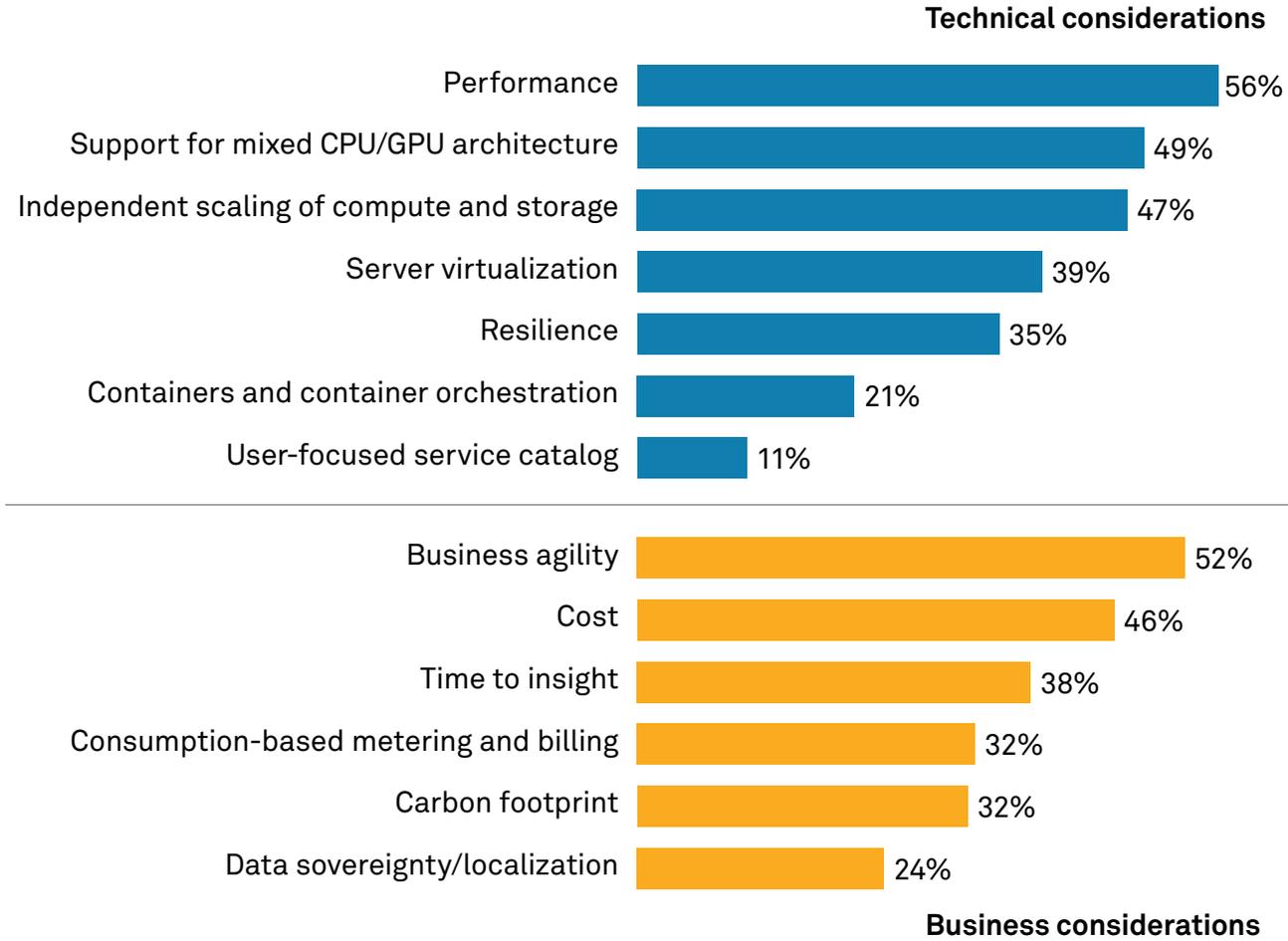
Base: Respondents with on-premises/hosted datacenter environments operated as a private cloud (n=557)

Source: 451 Research custom survey commissioned by Cloudera, Q4 2021

Private cloud deployment most substantially exceeds respondents' expectations for improved cost and operational efficiency (37%). However, the substantial proportion of enterprises indicating that private cloud meets overall expectations suggests that the bar may not be set particularly high. In general, the return on expectations for private cloud is directly proportional to the extent of private cloud adoption in the on-premises/colocated datacenter estate. The takeaway seems clear: Halfway measures on the road to internal private cloud architectures may result in enterprises leaving performance improvements and business value on the table.

On-premises private clouds may well be the best execution environment for enterprises whose mission-critical data/analytics workloads are currently in traditional server architecture environments and for those that have repatriated workloads from public cloud environments or plan to do so in the coming year. Private cloud checks all the technology and business boxes for enterprises looking to move forward with on-premises IT infrastructure: performance, speed and scale, as well as business agility and overall cost (see Figure 9).

**Figure 9: Data/Analytics Workloads: Key Selection Criteria for On-Premises/Colocation Infrastructure**



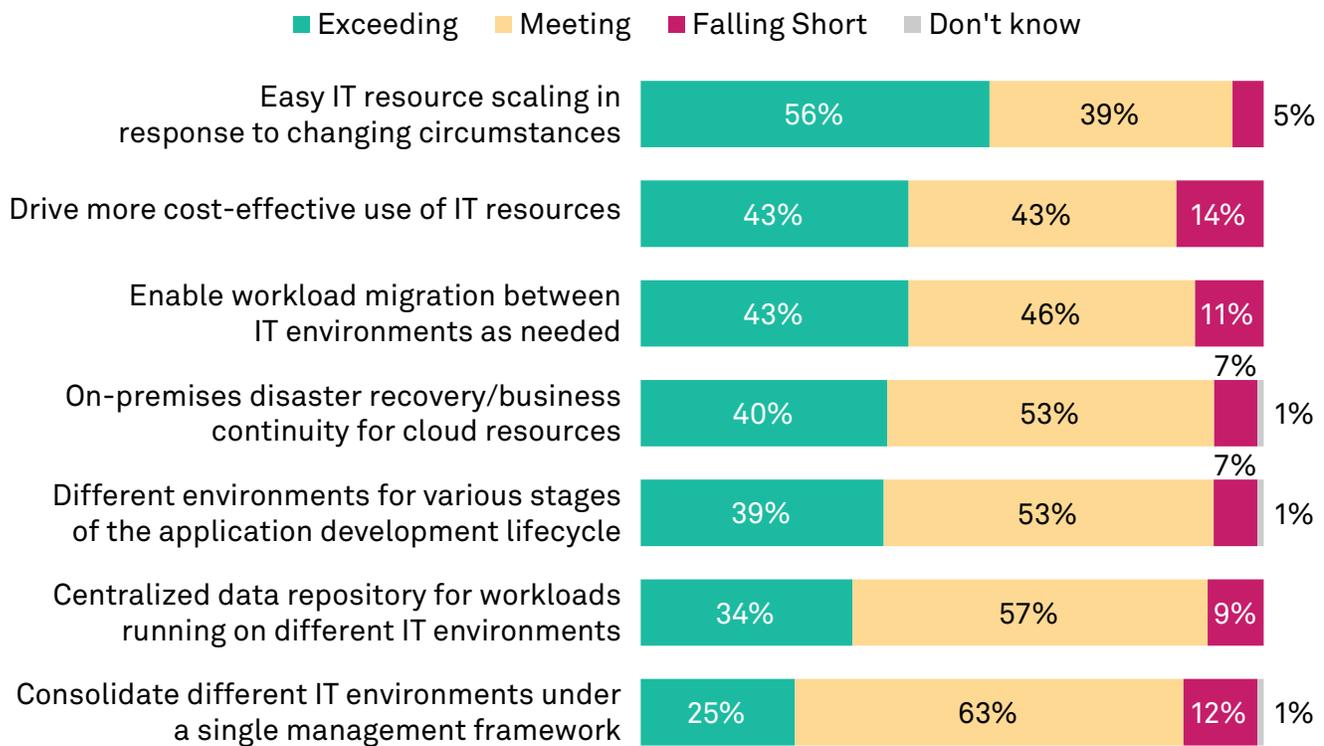
Q: Which of the following are important considerations when selecting on-premises/hosted datacenter infrastructure for your organization's data/analytics workloads?  
 Base: All respondents (n=562)  
 Source: 451 Research custom survey commissioned by Cloudera, Q4 2021

## Hybrid Cloud for Data Brings It All Together: Data/Analytics and Business Insights Flexibility

Despite widespread adoption of public cloud in enterprise IT estates, there has not been a significant decline in the use of on-premises and colocation datacenters. In fact, the expectation is that most enterprises will eventually operate hybrid IT architectures. Nearly 95% of enterprises surveyed agreed that adoption of private cloud would facilitate transformation of IT architecture to the hybrid model, which will in turn enable workload mobility between on-premises and off-site cloud environments. This infrastructure convergence sets the stage for broader flexibility around where to execute strategically important data processing and analytics functions. An infrastructure-agnostic data layer also supports a range of options for data movement, management and federation.

Hybrid IT architectures offer numerous capabilities that (ultimately) help to simplify the operation and management of enterprise IT estates, but delivering on the expectations of hybrid IT may be easier said than done. Hybrid IT has delivered the goods for faster application scaling: 56% of enterprises with hybrid IT architectures in place reported that results have exceeded expectations on this front (see Figure 10). However, consolidating disparate IT environments under a single management framework (one of the top use cases) remains a work in progress, with only 25% of enterprises reporting that their experience has exceeded expectations.

**Figure 10: Hybrid IT Expectations and Outcomes**



Q: For each of the following intended outcomes, please indicate whether your hybrid IT environment is exceeding, meeting or falling short of your expectations?

Base: Respondents with hybrid IT architecture currently implemented (n=175)

Source: 451 Research custom survey commissioned by Cloudera, Q4 2021

Hybrid cloud architectures for data/analytics enable enterprises to tap into the distributed scalability of public cloud infrastructure while adding private cloud functionality to existing on-premises IT estates. But upgrading on-premises infrastructure is just one piece of the puzzle – having clear processes that dictate where to deploy workloads across hybrid IT environments is key to maximizing operational efficiency for data/analytics workloads. However, only 47% of enterprises surveyed have such processes in place. Hybrid cloud can provide a foundation for systems of insight that serve the needs of both enterprise IT and line-of-business stakeholders, but the approach must be holistic. Combining data/analytics workload placement processes, well-defined data strategies, and cloud-native technologies for management and orchestration between and across IT venues lays the foundation for hybrid cloud to be an enabler of business transformation.

# Embarking on the Modernization Journey

Regardless of the exact approach, modernizing the underlying IT infrastructure estate is necessary for enterprises looking to fully leverage data and analytics capabilities as part of their digital transformations. However, a flexible and scalable IT environment is necessary, but not sufficient for success in the data-driven digital economy.

Issues to consider include the following:

- **Put data and the associated workloads at the center of your strategy.** The notion of ‘data-first, workload-centric’ should be the top-of-mind organizing principle of the transformation journey. Take stock of your organization’s application/workload portfolio through an operational lens, looking at factors such as processing, storage and latency requirements; business process dependencies; overall operational complexity; and data protection/compliance considerations. Other aspects key to determining the appropriate modernization path include API-enabling certain legacy assets to the more cloud-ready parts of the application estate.
- **Make sure the IT architecture aligns with both IT and business imperatives.** Once you’ve mapped and documented the technical aspects of your data/analytics workloads and applications, the next step is layering on the business considerations. What are the cost, security, regulatory/compliance and business criticality/data sensitivity factors that may shift workload deployment decisions toward (or away from) certain IT deployment venues?
- **Ensure ongoing IT operations and management.** Ongoing modernization requires a unified management approach involving intelligent mapping of data and workloads to (and between) workload execution venues, as well as processes for automation, scaling, runtime execution, performance management and security.

# Conclusions

## The Importance of a Holistic Approach

Enterprise IT is evolving away from set-in-stone either/or propositions involving public vs. private infrastructure; on-premises vs. off-premises implementation; and dedicated vs. shared resources. All of these options can be part of a modernized IT environment. Dedicated IT environments (either in enterprise datacenters or colocation facilities) will remain part of the mix, but on-premises IT estates must migrate from the traditional server silo approach to the scalable, automated pool-of-resources architecture of cloud. Private clouds then become the on-ramp to an agile and responsive hybrid data cloud environment that allows enterprise stakeholders to capture and act on business insights. Modern data architectures play a starring role in enterprises' pursuit of competitive advantage in a distributed, data-driven digital economy in which insights contribute to innovation, operational efficiency improvements, accelerated product development and reimagined customer experiences.

## Methodology

The survey data used in this report was collected by 451 Research, part of S&P Global Market Intelligence, and commissioned by Cloudera. The survey was fielded in the third quarter of 2021 and is based on a sample of 562 respondents.

content provided by: Cloudera & Intel

## CLLOUDERA

Data combined with analytics is a uniquely valuable asset for any business. When harnessed correctly, it can grow revenue, reduce costs and even transform the business, opening up new market opportunities. Cloud is the obvious technology of choice to unlock the value of data. But the discussion is no longer about cloud, but rather hybrid cloud.

The reality is that hybrid cloud is the new normal. Nearly all IT decision makers (89%) believe hybrid cloud is an optimal choice. And more so, they believe that businesses implementing a hybrid architecture as part of its data strategy will gain a competitive advantage.

But how do you use a hybrid cloud to unlock the value from your data? You need more than a heterogeneous resource landscape with disparate data and fragmented applications across all to bring things to a good end; you need a Hybrid Data Cloud. A Hybrid Data Cloud combines the data management, analytics, transactional and data science services of public and private clouds. That “and” is important because with “and” businesses can be sure they are able to unlock value from all their data, no matter where it is. A Hybrid Data Cloud enables businesses to industrialize the development, production and operationalization of AI powered data applications. It allows businesses to extend AI powered data applications across their business, faster and more reliably. This is the magic that drives digital transformation.

Cloudera Data Platform is the industry’s leading Hybrid Data Cloud. It provides the critical platform that lets organizations capitalize on hybrid cloud as well as deliver the fundamental capabilities to industrialize the development and production of data applications to get ever faster at turning ever more data into insight and value.



Cloudera is partnering with Intel to drive AI and analytics on hybrid data cloud. A hybrid data cloud operates across all infrastructures, including private, multi-, and edge clouds with common and consistent management, security, and governance. Cloudera hybrid cloud is optimized to run on Intel®-based technologies to deliver the power and speed necessary for faster insights to digital transformation.

To learn more about how Intel accelerates Cloudera hybrid cloud performance, please visit [www.intel.com/cloudera](http://www.intel.com/cloudera).

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