



The hybrid cloud survival kit

**Managing complexity through
orchestration and automation**

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Introduction

Hybrid cloud is inevitable for most large enterprises, but struggling with its complexity does not have to be.

Today, greater than 65 percent of companies use a hybrid cloud approach, according to Forrester Research,¹ and that is expected to climb. Many have found that by creating a hybrid cloud computing environment with a combination of on-premise, private, and third-party cloud services, they can tailor cloud delivery to fit varied needs within the organization.

Despite its benefits, hybrid cloud delivery presents a multitude of challenges to Chief Information Officers (CIOs).

Most companies have not had the luxury of planning and building a hybrid cloud delivery model from scratch. Rather, they started running applications on a single cloud platform and added internal or external cloud platforms to their delivery model for specific business reasons over time, creating an uncoordinated cloud patchwork.

Therefore, it is no surprise that 25 percent of IT professionals say that operational complexity is among the biggest challenges they encounter in trying to utilize hybrid cloud delivery models, according to a survey by Interop ITX/InformationWeek. Another 29 percent cite performance.²

Many organizations looking to reap the benefits of hybrid cloud have experienced mixed results and, often, unexpected consequences.

A company seeking innovation by leveraging the hybrid cloud is held back by application architectures and systems development processes that are not yet optimized for a hybrid environment. Instead, those processes are scattered across multiple teams and enabled by different tools.

Problem statement:

Hybrid cloud delivery models provide many benefits, but they also introduce complexity that must be managed to ensure those benefits are realized—and unintended consequences are mitigated.

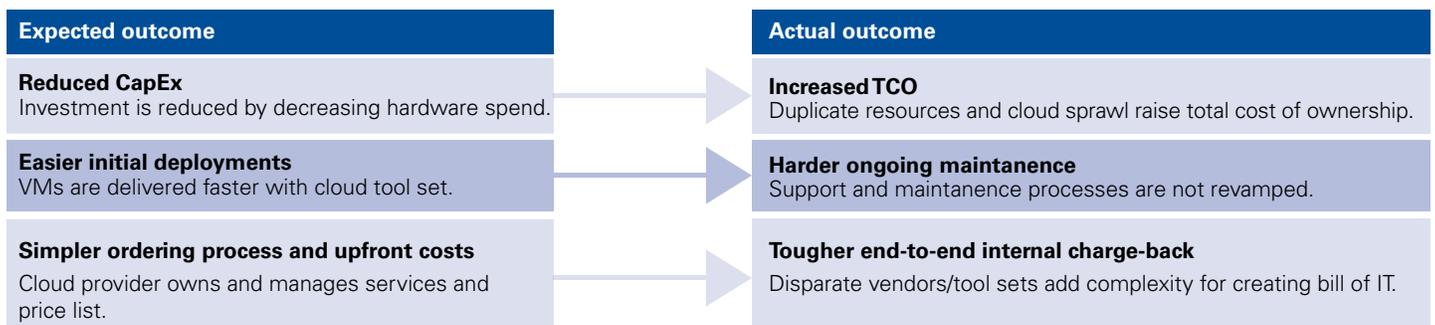
Further, with infrastructure running in different models and different venues, the lack of coordination leads to inefficiencies and could open organizations up for risk.

For example, an organization may introduce a new hybrid cloud tool set to make initial deployments easier, delivering virtual machines (VMs) faster. But, until IT revamps the underlying support processes, ongoing infrastructure maintenance is more difficult. Or, decreased hardware spend should help reduce overall capital expenditures, yet duplicate resources and cloud sprawl often increase total cost of ownership. Finally, public cloud providers offer more flexibility with increased access to prebuilt, modular services, but the user ends up with less control and less visibility into which services were purchased.

However, IT organizations can vastly improve hybrid cloud performance even before they must invest in the full transformation of their technology operations to support multiple cloud delivery models.

This paper addresses how to establish a near-term strategy for managing hybrid cloud delivery that allows organizations to better realize the benefits of hybrid cloud today while helping IT remain relevant through the technology and marketplace changes to come.

The paradox of cloud implementation



The CIO and hybrid cloud success

Forward-thinking CIO's use the cloud as a competitive advantage to allow their companies to push products to market faster and cheaper, manage costs, reduce risk, and provide a platform for application teams to deliver capabilities they did not even know were possible. Success in this area will not only address the CIO's everyday responsibilities for driving efficiencies but, at a higher level, will also help demonstrate the CIO's vision and value to company leadership and board directors.

The majority of CIOs believe they should be leading innovation across the business, according to the 2017 Harvey Nash/KPMG CIO survey, and strategic use of the cloud is one way CIOs are proving their value to the executive team. CIOs said they are leveraging the cloud to improve availability and resiliency (41 percent), increase agility and responsiveness (39 percent), and accelerate product innovation (34 percent), more than they are to simply cut costs (28 percent).

As IT's strategic value grows, more than 70 percent of IT leaders also expect the strategic influence of the CIO will increase, according to the survey. The proportion of CIOs serving on their executive committees ticked up significantly to 62 percent, the highest level in more than a decade of tracking. Three out of four CIOs attended a board meeting within the last year, with IT strategy and technology investment as two of the most popular topics of discussion with directors.

Indeed, survey authors said the CIO's role is evolving into one of "navigator" for their leaders through an unpredictable political, business, and economic environment, in part by creating more nimble technology platforms to respond quickly to change.

As IT organizations struggle to keep up with rapidly changing business models, CIOs are focused on evolving their capabilities to provide flexible, dynamic, and continuous support to their internal clients. Yet, while CIOs are growing their strategic value to their organizations, their top concerns remain delivering consistent and stable performance to the business and increasing operational efficiencies, according to the survey.

In this paper, we explain how to implement hybrid cloud automation and management while, at the same time, meeting the challenges inherent in the CIO's ever-changing role.

¹ The Forrester Wave: Hybrid Cloud Management Solutions, Q1 2016

² Interop ITX and InformationWeek 2016 State of Cloud Computing Survey, December 2016

Evolution of the hybrid cloud

In many ways, the origins of the hybrid cloud led to the challenges IT organizations face in managing it.

When hybrid cloud “just happens”

A hybrid approach is not always planned or organized. The easy portability and implementation of as-a-Service (aaS) offerings allow business owners to purchase and stand up capabilities in a short time with minimal IT involvement.

Indeed, individual business units can build a product on a public cloud that, if successful, generates significant revenue on a platform that the CIO and his or her team do not manage or control. Worse, the CIO may not know about this cloud use at all.

Today, more than 85 percent of companies use two or more cloud providers at once, according to the Interop ITX/InformationWeek survey,³ including approximately 15 percent that use six or more. These pockets of “shadow IT” and the web of multiple cloud services add another layer of complexity CIOs need to get their arms around in order to avoid duplication costs and ensure compliance with internal policies and industry regulations.

Hybrid cloud is happening, whether planned for or not, and it is up to the CIO to take control through a management framework.

As-a-service fuels hybrid cloud growth

Nearly half of organizations surveyed by Harvey Nash and KPMG⁴ plan to make a “significant” investment in software as a service (SaaS) in the next one to three years, up substantially from 27 percent in the current year. The number of organizations expecting to invest significantly in platform as a service (PaaS) will more than double to 33 percent, while another 38 percent expect to invest significantly in infrastructure as a service (IaaS), up from 23 percent.

Hybrid cloud usage has to grow in tandem to handle aaS workloads that proprietary data centers simply cannot. The demand for servers to test, host, and run aaS applications is taxing even the most substantial internal IT infrastructures with significant proprietary server capabilities. At a minimum, some of the load has to shift to the cloud—public, private, or both. Even businesses with regulatory, compliance, and other requirements to keep certain applications in proprietary data centers must consider offloading other workloads to the public cloud.

At the same time, design paradigms are evolving so quickly that the aaS applications in development today could require cloud capabilities tomorrow that companies are not yet prepared to manage. For many IT organizations, hybrid cloud is becoming more of a necessity than a choice.

³ Interop ITX and InformationWeek 2016 State of Cloud Computing Survey, December 2016

⁴ The 2017 Harvey Nash/KPMG CIO Survey is the largest IT leadership survey in the world in terms of number of respondents. The survey of 4,498 CIOs and technology leaders was conducted between December 19, 2016 and April 3, 2017 across 86 countries.

New applications, old solutions

Proper hybrid cloud management requires both the automation of tasks and the orchestration of workflows.

In addition to taking over repetitive tasks, automation leverages various configuration management solutions already used to accelerate time to value and help monitor configuration drift over time. Meanwhile, orchestration solutions provide workflow management capabilities, including support for user-defined, conditional, or scheduled actions; a graphical workflow editor; and versioning capabilities.

Yet, when it comes to automation and orchestration tools, IT organizations are often left using legacy solutions.

A company using private cloud for aaS may look to public cloud providers to handle periods of bursting or heavy traffic and tap rapid scaling capabilities. However, the application teams may not know how to easily use or truly leverage the public cloud. Similarly, predominantly public cloud users may have introduced a private cloud solution along the way to meet specific business requirements. But now, IT no longer has access to the turnkey solutions embedded in public cloud offerings and has to figure out how to manage the platform it just built.

Most organizations lack a complete set of capabilities and a cohesive approach. Moreover, they do not have the automation necessary for proper hybrid cloud management. Even for more mature cloud users who already follow a hybrid cloud delivery model to move their workloads to the most appropriate venue, portability is largely manual and uncoordinated.

Meeting the challenge

It is not that orchestration and automation tools do not exist; they do. The marketplace is littered with solutions, often with overlapping features. Some of the vendor tools were developed for private cloud and have been adapted to connect APIs on the public cloud. Others were used on the public cloud first, and vendors are trying to expand them for use on private cloud. Meanwhile, many companies are trying to build their own tools to manage hybrid cloud. Regardless, they generally do not coordinate across both, and the technology can fall behind in this rapidly changing environment.

The market has not yet matured enough to offer a comprehensive, out-of-the-box orchestration solution or platform for hybrid cloud delivery that will coordinate, take advantage of opportunities, manage risk, and fully support the business. However, there is a near-term solution that CIOs can pursue.

Manage complexity with light orchestration and integration



Cloud Capability Model



IT Architecture Standards and Compliance

IT Financial Management	Third-party Provider Relationship Management	Application and Technology Engineering	Solution Design
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Identity and Security

- Cyber Risk and Compliance Management
- Security Architecture
- Information and Privacy Protection
- Identity and Access Management
- Threat and Vulnerability Management
- Security Information and Event Management

Traditional Corporate Datacenters

Identity & Security	Software	Manual/Automation Operations
	Platform	
	Infrastructure	
Service Management Tooling		

IaaS

Identity & Security	Software	Manual/Automation Operations
	Platform	
	Infrastructure	
Service Management Tooling		

PaaS

Identity & Security	Software	Manual/Automation Operations
	Platform	
	Infrastructure	
Service Management Tooling		

SaaS

Identity & Security	Software	Manual/Automation Operations
	Platform	
	Infrastructure	
Service Management Tooling		

WAN/Internet

Operations Automation

- Orchestration and Integration
- Service Request Brokering
- Provisioning
- Operations



Service Management

Service Portfolio Management	Service Level Management	Availability Management	Change Management	Release and Deployment Management
Service Catalog Management	Capacity and Performance Management	IT Service Continuity Management	Configuration Management and Discovery	Incident Management

Enterprise Managed

Cloud Managed

The Cloud Capability Model is simply a framework for all of the tools and processes an organization needs (capabilities around the outside of the diagram) to manage its hybrid cloud operations (the center).

Three of the capabilities in the model—Strategy, Architecture, and Governance; Identity and Security; and Service Management—are important but typically managed effectively by IT and, therefore, outside the scope of this paper. The fourth capability, Operations Automation, is the “survival kit” where IT organizations should focus their initial efforts to help manage hybrid cloud complexity and stay relevant with business leaders.

By introducing automation and orchestration to hybrid cloud operations, IT organizations can broaden access to cloud service capabilities, better manage operations, and embed governance policies while staying flexible enough to take advantage of new technologies as they emerge.

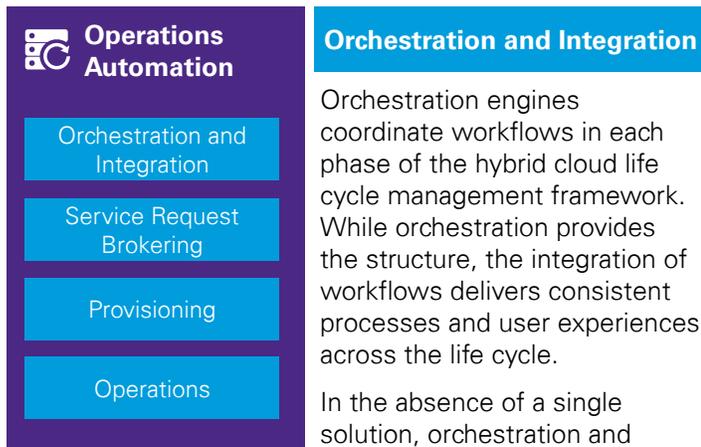
Operations Automation

- Orchestration and Integration
- Service Request Brokering
- Provisioning
- Operations

Within Operations Automation are the functions that manage the hybrid cloud life cycle—Orchestration and Integration, Service Request Brokering, Provisioning, and Operations—from the earliest stages of determining the best cloud resources for workload placement to ongoing application management and infrastructure updates, and the eventual teardown or decommissioning of resource consumption.

By focusing on these four functions and key considerations for each, IT organizations can simplify hybrid cloud operations.

Focus on operations automation



tools and processes that organizations need to manage their hybrid cloud operations, including the multiple data centers and public cloud services, aaS platforms, and all of the security and operations mechanisms necessary to run each application. For example, orchestration and integration capabilities manage financial approvals and support the charge-back of cloud service consumption. Without it, technologists are left to try to manage assorted scenarios, and users have different experiences, depending on how and what they access.

“ In the absence of a single solution, orchestration and integration will support all of the tools and processes that organizations need to manage their hybrid cloud operations. ”

Yet, both infrastructure teams and application teams today likely lack unified management capabilities across all of their cloud environments. A significant number of companies—more than a quarter of firms surveyed by Interop ITX/InformationWeek—do not automate or orchestrate their workloads at all.⁵ Another 23 percent say they use cloud management software, but relying on this software alone likely falls well short of the orchestration and integration required.

Orchestration tools are necessary to integrate different functions and enforce policies. Because the heavy lifting for hybrid service management is already done within the individual clouds, only “light” tools are needed. These tools include straightforward integration capabilities that enable consistent tool management and control, infrastructure management automation, security policy enforcement, and standard service management. They should also standardize the request management and self-service fulfillment experience that is automated.

The right orchestration tool set will lower onboarding effort and cost, increase agility consistency and efficiency, and, overall, provide greater flexibility for the hybrid delivery model.

Service Request Brokering

Light orchestration tools or hybrid less cloud management solutions should direct application teams to the “right” cloud in a multicloud environment through an automated service request brokering process.

To start, build a decision matrix that guides application teams to the right delivery model for their workloads. A questionnaire built into a self-service portal should lead application teams through a systematic review that includes security and compliance, technology, operational support, capacity, and latency requirements, as well as financial considerations, to automatically determine the best cloud delivery model for each workload. Without a decision matrix, system administrators and operations teams have to be engaged to provision cloud services, which leads to placement inconsistencies, suboptimal utilization of resources, and value leakage.

The initial setup of the decision matrix requires an analysis of the application portfolio in order to segment application profiles. These application profiles are then used to effectively direct workloads to appropriate cloud delivery models and providers.

⁵ Interop ITX and InformationWeek 2016 State of Cloud Computing Survey, December 2016

Application profiles to support service request brokering

Core – Defined use cases, preapproved deployment. Example: An organization identifies a large set of “core” applications with consistent architectures. Application teams access the self-service portal and are preapproved to deploy their applications on the appropriate cloud delivery model according to the core profile.

Common – Distinct design patterns, preapproved/ packaged offerings. Example: Applications with distinct design patterns fit the “common” profile, which requires application teams to provide more detail about technical requirements. However, application teams will still be directed to a cloud delivery model that provides preapproved, packaged offerings to address their requirements.

Distinct – Nonstandard architecture components, limited service catalog offerings. Example: For applications with a combination of standard and nonstandard architecture components, making them “distinct,” application teams must provide additional information. Once the information is provided, where possible, the application teams are directed to a cloud delivery model that includes a limited set of service catalog offerings meeting a subset of their requirements. However, to finalize their platform design, application teams still need to work with a support team.

“ Application teams can find the ‘right’ cloud in a multicloud environment through an automated service request brokering process. ”

Unique – Nonstandard architecture, assisted brokering. Example: For unique applications, application and support teams need to work together to determine the best cloud delivery model. IT organizations that partner with application teams throughout the software development life cycle can help design application architectures that reduce provisioning cycles and optimize costs.

IT’s communication to application teams about the “why and what” of segmentation during the service request brokering process is paramount. Not only does sharing the strategy behind segmentation and placement help cut down on disagreement between infrastructure and application teams, it can also prevent those teams from going around the infrastructure organization to place workloads where and when they want.

Provisioning

In a hybrid cloud environment, automated provisioning is critical.

After the right cloud platform is determined, cloud services should be automatically provisioned using predesigned templates offered in a service catalog. Application teams select the packages that contain capabilities and configurations that meet the requirements of their application. Many times, application teams can even provision their own infrastructure without additional inquiry or assistance.

“ Predesigned templates offered in a service catalog allow cloud services to be automatically provisioned— often without additional inquiry or assistance. ”

Once application teams choose the best template for their needs and obtain necessary financial approvals, the environment is automatically built. Over time, the environment automatically scales to meet changing consumption patterns, taking the guesswork away and allowing application teams to simply do their work in the most appropriate cloud environment.

Additionally, the dynamic provisioning of resources in a hybrid cloud delivery model can support “bursting,” which provides additional capacity across cloud service delivery models to support short-term business needs.

Operations

Once applications are running on the right cloud with the right support, public cloud service providers typically manage a significant portion of the operations.

However, there is still a lot left for internal teams to do. With no single tool capable of automating and orchestrating the operation of a hybrid cloud delivery model, application and infrastructure teams need a tool strategy to identify the right solutions. Each tool in the arsenal must be capable of executing a runbook of tasks as well as integrate with a common workflow to link together interdependent activities. Operational efficiency will depend on the quality of integration with the orchestration engine and the maturity of the runbook.



Keep in mind that the integration of new tools can disrupt an existing automation ecosystem, presenting a challenge to IT organizations that have already automated operations. For the best return on investment, organizations should rationalize tool sets with similar functionality before selecting new tools, and then focus on tools that enable frictionless orchestration workflow and improve operational efficiency. This requires a full analysis of the automation level (manual, partial, or full) that each tool delivers to the best investment strategy.

Infrastructure teams, in particular, need tools to manage the configuration of infrastructure as code (scaling, deployment validation, etc.). Application teams, on the other hand, need tools to package and deploy binaries, as well as other tools that automate testing functions to shorten the cycles for different phases of testing (regression, API, component, GUI, etc.). These tools are critical for the continuous integration and continuous deployment of workload, because they reduce the need to involve operations teams, thereby increasing delivery velocity.

While public cloud service providers typically manage a significant portion of the operations, internal teams still have a lot to do, and they need a tool strategy to identify the right solutions.

The tools strategy should also ensure that the hybrid cloud management solution is integrated with Service Management and Identity and Security layers of the Cloud Capability Model. IT service management capabilities must integrate with the APIs of the multiple cloud vendors, either directly or through a cloud management solution. Service Management tool integration with cloud vendors will enable organizations to use one system to support the hybrid cloud delivery model, reducing complexity.

Additionally, hybrid cloud management requires security capabilities to manage accounts, system configurations, and data protection. Security and compliance teams should be involved from the beginning of strategy discussions, all the way through the implementation of the solution and support operations. Monitoring tools can enforce corporate security policies that cloud providers cannot possibly cover due to variations in how applications are built and run.

What is your hybrid cloud scenario?

While companies reap benefits from using both public and private clouds to fit their varied needs, this hybrid approach also introduces a significant amount of complexity. Here are three common scenarios companies tend to fall into and areas of focus to help drive success.

Heavy user of one delivery model

Companies that use public and private cloud but tend to use one over the other may need a strategy refresh. The focus for this type of cloud enterprise user should be to understand their current cost model and create the ability to compare current costs against the usage of the other cloud type. This requires both configuration and inventory management tools, as well as tools for financial management. For example, private cloud users might compare current costs against the same level of public cloud usage, adding in migration costs as well. Meanwhile, public cloud users need to think about costs associated with public cloud consumption as well as other noneconomic factors, such as security.

Growing private on top of public

Private cloud adoption is on the rise, as public cloud users have added private cloud resources, according to RightScale.⁶ Those looking to build and/or increase their proprietary capabilities are similar to the “heavy users of one delivery model” described above in that configuration, and inventory management tools are essential. However, these enterprises will find that new considerations around performance parity between public and private cloud platforms are increasingly important. One centralized, workable dashboard that aggregates metrics from across the varied platforms will become increasingly important.

Growing public on top of private

Even while private cloud usage is on the rise, public cloud continues its explosive growth trajectory. As more enterprises extend their cloud usage to include public cloud, latency is a strong consideration. Planning which locations to place workloads will largely depend on the interconnected needs of existing applications and where those workloads reside today. The closer public workloads can be placed to interconnected private workloads, the better. New security considerations around APIs and permissions becomes a factor as well. Similar to the “growing private on top of public” scenario above, performance parity and one centralized, workable dashboard become important as public cloud workloads increase.

While different organizations require different approaches to orchestration, they do have four common requirements:

1. A sustainable operating model, regardless of business drivers
2. The ability to rapidly scale
3. Performance parity between internal and external cloud
4. Orchestrated and automated operations.

No matter where an organization is on its hybrid cloud journey, it will benefit from the fourth consideration and the focus of this paper—orchestration and automation.

⁶ Interop ITX and InformationWeek 2016 State of Cloud Computing Survey, December 2016

Key considerations for implementation

Launch a robust pilot program

Identify areas for improvement with a pilot program, focusing on the Operations Automation component of the light orchestration solution.

The pilot should incorporate API management and integration, end-to-end financial management, Quality of Service, (QoS) and performance management. Additionally, round out the pilot with a test of service request brokering and provisioning via self-service catalog offerings. If these aspects are smoothly incorporated as part of an initial pilot, it should provide the confidence that hybrid cloud management and automation can be expanded to handle additional delivery models.

The pilot also should test the integration of two cloud delivery platforms with similar offerings to evaluate performance and pricing between the two. Include use cases where components of an application are deployed on different cloud delivery platforms to ensure that the platforms are integrated effectively. For example, deploy the application database on one cloud platform and the middleware solution for the application on another. Be sure to test an already-deployed application in order to compare like-for-like with the current hybrid cloud setup.

As part of the pilot, ensure that application teams can use their tools effectively in the hybrid model. Look for training gaps during the pilot, conduct a skills inventory and change management survey, and be sure to document all lessons learned.

Last but not least, make sure the pilot addresses security policy enforcement. IT professionals believe security is their greatest challenge in managing hybrid cloud delivery models, according to the Interop ITX/InformationWeek survey.

Include organizational change management

The adoption of a new hybrid cloud model by an established enterprise technology organization can lead to significant disruption for employees and deep conflict with the culture. Failing to manage the disruption properly can introduce just as much risk to the cloud strategy—and maybe even more risk to the enterprise—as failing to execute effectively.

Preparation involves more than just getting everyone on board with a shared vision and common objectives. The cloud brings changes to all aspects of an IT organization, with new technologies, architectures, and sourcing models requiring new employee skills and capabilities, and sometimes, the elimination of job functions altogether. A current skills assessment weighed against future needs will identify shortfalls in talent and training. At the same time, continuous communication across all constituencies helps IT teams grow comfortable and even excited about the changes to come, prompting employees to invest in evolving their careers alongside the evolution of the organization.

Everyone must understand the magnitude of change triggered by cloud adoption and, just as importantly, recognize the opportunities created as a result. The need for systems administrator skills is on the decline, yet simultaneously, a new role of “infrastructure developer” has risen.

These infrastructure developers will work with APIs and “Infrastructure as Code,” rather than with the physical widgets in conventional data centers. Organizations can take a cue from Google’s newly created Site Reliability Engineering field of expertise and consider treating issues as software problems to improve utilization, availability, latency, and performance of their workloads that run on cloud platforms.



What's next?

A glimpse at how businesses might operate in a consolidated public cloud world

By deploying light orchestration to manage hybrid cloud delivery, companies maintain flexibility at a time when cloud computing continues to evolve at lightning speed. Based on the rapid evolution of cloud computing to date and our deep experience assisting numerous companies with their cloud strategy and implementation, we anticipate the following:

1) Enterprises will inevitably shift most workloads to the public cloud.

While private cloud use may be growing in the near term, CIOs expect to move nearly half of their company's applications to a public cloud by 2020, according to a survey by Morgan Stanley.⁷ Meanwhile, worldwide spending on public cloud services and infrastructure will grow more than 21 percent annually—nearly seven times the rate of overall IT spending growth—by 2020, according to estimates from International Data Corporation.⁸

Due to security and regulatory aspects, certain industries as well as companies operating within specific countries will continue to seek private cloud options. However, the vast majority will take full advantage of the public cloud and cloud-based services. This trend will drive operations to be more about the application and less about the infrastructure.

2) A handful of public cloud providers will dominate the marketplace.

The public cloud market is consolidating. Roughly 60 percent of enterprise cloud users run applications on Amazon Web Services, and approximately 40 percent have apps running on Microsoft's Azure. All of the other providers only account for some 10 percent.⁹

And the big names are just getting bigger. Amazon Web Services (AWS) dominates the market, generating \$12.2 billion in revenue in 2016, 55 percent more than in the previous year, and heading toward an expected \$17 billion in 2017. Microsoft's Azure more than doubled its revenue in 2016.¹⁰ In the shadow of these two behemoths, a number of known names have left the market already, including Dell, Hewlett Packard and Verizon.¹¹ Working with just one provider to get compute, storage and service needs will decrease complexity, but with a potential side effect: vendor lock-in may become a serious issue; time will tell.

3) The concentration of companies on a limited number of public cloud providers will change how and why companies develop and share applications.

As cloud providers condense, microservices technology evolves and networks converge, applications will no longer stay within company walls. This presents exciting new opportunities for collaboration across companies and institutions.

One company could develop an application that another company runs, or companies could share infrastructure and run-time platforms. Such simple, easy collaboration will open the door to IT creativity and innovation beyond what one company can do on its own today.

To participate in this future vision of application development, companies must first get their hybrid cloud operations in order; those who fail to do so will be left behind.

⁷ The Wall Street Journal, "Cloud Growth Pinched by Tighter Budgets: Survey," January 18, 2017

⁸ Worldwide Semiannual Public Cloud Services Spending Guide, International Data Corporation, February 2017

⁹ RightScale 2016 State of the Cloud Report

¹⁰ The Wall Street Journal, "Amazon Rivals Have Big Clouds to Fill," Feb. 17, 2017

¹¹ SearchCloudComputing.com, "Verizon Cloud joins casualty list amid public IaaS exodus," February 12, 2016

Hybrid cloud survival checklist

Exactly how each organization automates and integrates its hybrid cloud operations depends in part on how its cloud usage started, private or public first. That origin determines the level of automation already at hand, the organization's familiarity with automation to date, and what needs to be brought under one roof for effective management going forward.

However, organizations should generally focus on the following key actions to enable effective automation and management in the near term—the “survival kit”:

1. Select a “light” orchestration tool to integrate functions and enforce policies, leaving the heavy lifting to the cloud service providers.
2. Automate service request brokering to quickly direct application teams to the cloud platform most appropriate for their workloads.
3. Leverage self-service catalogs that include predesigned packages to automatically provision and build environments.
4. Introduce tools for both operations and application teams that improve management of applications and infrastructure once applications are deployed.
5. Rationalize current tool sets with similar functionality and automation levels before making an investment in new capabilities.
6. Integrate service management and security tools with multiple cloud vendors to reduce complexity.
7. Launch a pilot program to identify areas for improvement, with an initial focus on service request brokering, provisioning, and tools integration.
8. Institute an organizational change management program to address the disruption to job responsibilities and culture driven by cloud adoption.

Hybrid cloud management models should be built to handle these emerging technologies that, while helpful, add complexity:

Containers

As hybrid cloud usage increases, containers will likely prove to be more than just a replacement for virtual machines. Both VMs and containers allow organizations to run multiple applications on one server or host. But while each VM uses its own operating system, middleware, and applications, enabling multiple VMs to run concurrently on the same hardware, containers are operating system specific, sharing the system's libraries and kernel. As a result, containers use less memory and provide greater modularity and scalability. They can also be launched more rapidly and improve server utilization levels. While VMs can increase server utilization levels to 50 percent, containers can do much more. Most importantly, containers can be moved to any environment running their operating system.

Microservices

Because of their modularity and scalability, containers are often used in conjunction with small, independent processes—microservices—that together form complex applications and utilize language-agnostic APIs. Microservices are built around business capabilities and can be deployed independently. As such, a microservice can be dropped into a container capable of being moved between private and public cloud infrastructure.

How KPMG can help

KPMG helps clients manage the complexity that often plagues hybrid cloud usage by providing the structure, approach, and discipline required to define and implement an effective hybrid cloud delivery model.

We work with companies to develop a hybrid cloud infrastructure automation strategy to better realize the benefits of hybrid cloud while mitigating unintended consequences. We aim to make sure the strategy is aligned with business needs by conducting impact assessments, establishing target operating models based on our hybrid cloud life cycle management framework, building transformation road maps, and creating business cases that justify their plans.

Impact assessment

We leverage the integrated hybrid cloud capability framework to help our clients create or modify their hybrid cloud management strategies based on an assessment of the following:

- Existing tools used to orchestrate activities across disparate cloud delivery models and automate functions within each cloud delivery model
- Application profiles and policies that are used to broker the most appropriate cloud services based on workload types
- Self-service catalogs and templates used to provision cloud services
- Organization structures and delivery processes.

Target operating models

As an essential early step in the successful transformation to a hybrid cloud operating model, we work with organizations to create hybrid cloud delivery models that prepare them for the changes required to realize their cloud strategy. We help clients provide standard access to their services, identify a standard set of services, and establish metrics and scorecards that will serve as a baseline for improvement.

Additionally, we maintain a cloud ecosystem repository containing the marketplace solutions that support one or more of the functions in the hybrid cloud life cycle management framework. We then leverage both the

ecosystem knowledge and the framework to create target-state operating models that help our clients identify architecture components for the orchestration, brokering, provisioning, and operation of their hybrid cloud delivery model. We also help our clients determine how target-state solutions will work together to deliver the performance and stability that their customers expect.

Transformation road map

We help clients create a transformation road map for improving the management of hybrid cloud delivery models. The road map is drawn from a balance of business benefit targets and operational improvements that are realized through the orchestration and automation of management activities.

Business case

Ultimately, we help our clients build a scenario-based business case that supports their leadership's vision and provides them with transformation options. We tailor financial templates for our clients to capture the current cost of services, estimate the future cost of services, and consider transformation costs. The cost can then be compared to the expected benefits for the scenario considered.

Testing and implementation

We help clients put concept into practice. We work with them to develop and execute pilot programs, as well as to interpret the results and make adjustments. Following the conclusion of the pilot phase, we are there to guide our clients through the implementation of their hybrid cloud delivery model, helping enable that client outcome matches expectation.

Learn more

To learn more about effective cloud strategies that help CIOs realize value from cloud investments, please see our thought leadership, "[Journey to the cloud](#)".¹² For details about our services, including cloud services, visit www.kpmg.com/us/IT.

For the latest CIO insights from KPMG, visit www.kpmg.com/us/CIOinsights.

¹² <http://www.kpmg-institutes.com/institutes/advisory-institute/articles/2017/02/cio-agenda-journey-cloud.html>

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Pierre works closely with organizations to build infrastructure and cloud strategies that enable the business to rapidly deploy and scale new digital solutions and IT to rationalize the legacy environment. He is passionate about helping clients drive the greatest value from new technologies and manage associated risks throughout the migration and into operations. Over the last 25 years in IT consulting across multiple industries and regions, Pierre has managed an extensive range of assignments, including IT strategic planning, transformation management, design and implementation of IT infrastructure, and management solutions.

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