Designing and Building a Hybrid Cloud

Deliver Automation, Visibility, and Management Consistency in a Multi-Cloud World
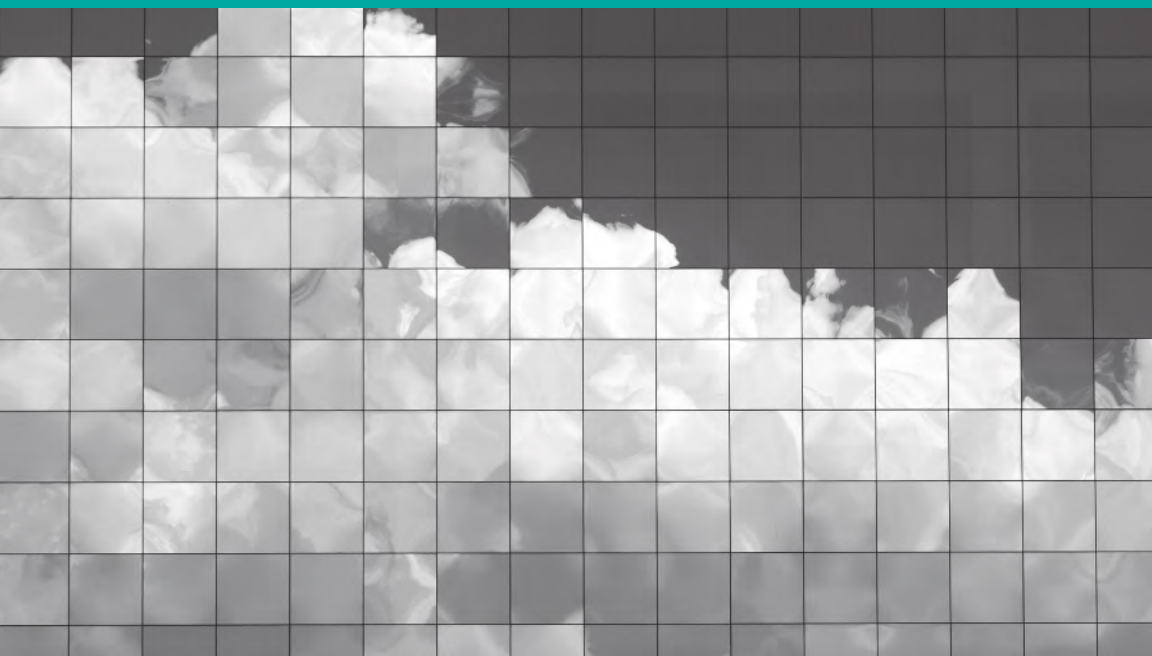
Philip Trautman

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Philip A. Trautman

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Is It Time to Embrace Hybrid Cloud?

Enterprises are turning to hybrid cloud to modernize IT for the digital era. But, given the significant complexity that still exists today in cross-cloud management and integration, many enterprises are struggling to create an effective hybrid cloud strategy.

What This Report Covers

This report recommends a three-step approach that will help you build a more functional and more mature hybrid cloud environment:

- Choose a single framework—a "cloud operating system"—to manage workloads on-premises and in the cloud
- Modernize datacenters and other on-premises infrastructure to utilize that framework
- Choose public clouds and cloud service providers compatible with the same framework

This approach will provide a higher level of automation, visibility, and consistency across all environments, private and public, ensuring your enterprise operates at the highest level and achieves the benefits of hybrid cloud.

Designed for IT leaders and business decision makers, this report will help you assess, plan, and implement this hybrid cloud strategy to achieve greater control over all IT services, regardless of where they are running.

The Cloud Is Reshaping Enterprise IT

Over the last 10 years, the increasing capabilities of the public cloud have dramatically reshaped the enterprise IT landscape. Many enterprises initially announced they were adopting a "cloud-first" strategy or that they were "all in"

on the public cloud. That early euphoria has now been tempered by reality, as enterprises have learned—often the hard way—that not every application is suited to public cloud. Many were shocked at how quickly the bills for public cloud services added up. When you factor in all the costs—getting the performance you need, data protection costs, and other variables—it can be twice as much to run predictable workloads in the cloud versus on-premises.

By 2016, a study by IDG Research noted that, "nearly 40% of organizations with public cloud experience report having moved public cloud workloads back to on-premises, mostly due to security and cost concerns." This doesn't mean that enterprises have been abandoning the cloud. They're simply taking a "hybrid" approach and working to strike a smarter balance between workloads in the cloud and workloads that run on-premises, whether on traditional infrastructure or in a private cloud.

According to IDC,[1] by 2015 more than 80% of companies had already adopted a hybrid cloud IT strategy. A combination of on-premises IT services and cloud-based services deliver substantial business benefits and give your company a competitive edge over less nimble rivals.

What Is a Hybrid Cloud?

In the loosest definition, a hybrid cloud combines on-premises IT (traditional infrastructure and private cloud) with off-premises resources or services from a public cloud—such as Google Cloud Platform (GCP), Amazon Web Services (AWS), or Microsoft Azure—or at a cloud service provider (CSP) or software-as-a-service (SaaS) provider, as illustrated in Figure 1-1.

> **NOTE**
>
> **Public Cloud versus Cloud Service Provider**
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> In this report I take pains to distinguish between the big public clouds and smaller cloud service providers. As you'll learn, each may have a role to play in your hybrid cloud strategy.

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1 IDC Cloud Predictions for 2015, December 2014.
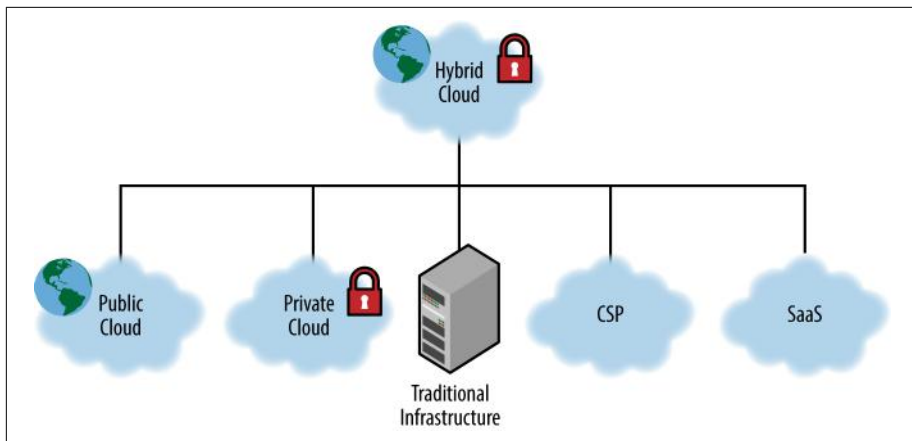
Figure 1-1. A hybrid cloud can be composed of both on-premises (IT infrastructure, private cloud) and off-premises (public cloud, CSP, SaaS) elements.

In a stricter definition of hybrid cloud, a service is built from a combination of different clouds that could include both private and public clouds as well as CSPs. In a three-tier application stack, the presentation service might be on a public cloud, the application service might reside on a managed private cloud, and the database service might reside on-premises.

Another term that is becoming common is "multi-cloud." Just as it sounds, multi-cloud is the strategy of using multiple different clouds that could include a variety of private, public, and hybrid cloud deployments to satisfy your IT needs.

What About Enterprise Cloud?

Another recent entry to the cloud lexicon is "enterprise cloud." An enterprise cloud is designed specifically to address enterprise needs and tailored to meet requirements for:

- **Traditional applications.** Cloud environments are often a bad fit for traditional business applications, which may require significant refactoring.
- **Next-generation applications.** Often referred to as "cloud-native" applications, these have been designed to run in cloud environments.
- **End-user computing.** Many companies have discovered that virtual desktop infrastructure (VDI) is a good way to increase the security of customer data while also increasing IT efficiency.

Enterprise clouds incorporate the elements of many other cloud types, delivering the benefits of private, hybrid, and multi-cloud models in a way that may more closely match your business needs and the capabilities of your IT team.

Applications and the Hybrid Cloud

For many of us in IT, infrastructure has such a prominent place in our thinking that it's sometimes easy to forget that it's not an end in itself. It's important to keep in mind that hybrid cloud is simply a means to deliver the applications and services your business needs to succeed. This includes the traditional business applications that you've relied on for years, and the next-generation, cloud-native applications that will propel your business into the future. In this report, these are referred to as mode 1 and mode 2 applications:

- **Mode 1 applications.** Traditional and well-understood enterprise applications such as email, relational databases, and business applications such as ERP, CRM, etc.
- **Mode 2 applications.** Next-generation, cloud-native applications, possibly developed using an agile or continuous development approach. These applications are often close to the customer, such as mobile applications.

You probably already know that some applications are ideally suited for public cloud, some are better on-premises, and some can move back and forth—or span the two. Chapter 3 discusses assessing your needs and planning for different application types.

> **NOTE**
>
> **A Single Infrastructure or Bimodal IT?**
>
> Supporting mode 1 and mode 2 applications with separate infrastructure (and possibly separate teams) is sometimes referred to as bimodal IT. Although it may be tempting to run mode 1 and mode 2 applications in this fashion, this approach will limit agility in the long run. Your hybrid cloud needs to seamlessly encompass both. After conducting interviews with IT leaders from a variety of industries, Bain & Company reported, "Companies are finding that the two-speed IT model is fraught with practical issues that make it unsustainable".

The State of Hybrid Cloud

As enterprises in all industries pursue digital transformation and embrace new technologies like artificial intelligence and the Internet of Things (IoT), hybrid cloud adoption is poised to accelerate. As part of this process, many enterprises are also pursuing datacenter modernization. IDC predicts that, "by 2020, the heavy workload demands of next-generation applications and new IT architec-

tures in critical business facilities will have forced 55% of enterprises to modernize their datacenter assets through updates to existing facilities and/or the deployment of new facilities."

For many enterprises, the hybrid cloud up to this point has been an organic outgrowth of accelerating business needs as much as it has been planned. You may already be operating in a hybrid model and progressing to a multi-cloud approach. However, numerous pain points exist. Global management and the necessary integrations between on-premises and cloud environments are still lacking.

For your business to compete and succeed in the long run, your IT team will need to figure out how to overcome its current IT challenges—both on-premises and in the cloud—to efficiently deliver the applications and services your business needs. This report is intended to help guide you with these important decisions.

Summary

The cloud is dramatically reshaping the enterprise IT landscape. After an early rush to the public cloud, the majority of companies are settling on a hybrid cloud strategy that can utilize resources from traditional enterprise IT, private clouds, public cloud providers, and CSPs.

Key takeaways:

- A hybrid cloud combining on-premises IT services and cloud-based services can deliver substantial business benefits and give your company a competitive edge over less nimble rivals.
- Bimodal IT, in which separate infrastructure is used to support traditional enterprise applications versus cloud-native applications, is best avoided.

Understanding the Hybrid Cloud

While many have suggested that hybrid cloud is only a waypoint on the road to full public cloud adoption, hybrid cloud is fast becoming the dominant enterprise IT operating model; hybrid cloud adoption grew 3X from 2016 to 2017. This chapter explores hybrid cloud benefits and explains why it is the preferred model. It also provides a prescription for creating a mature hybrid cloud.

What Are the Benefits of Hybrid Cloud?

If the hybrid cloud is going to be such an important part of your future, what should your business hope to gain? The hybrid model offers many potential benefits:

- **Flexibility and agility.** By far the most important benefit of a properly architected hybrid cloud is increased business agility. You have ready access to resources to support new applications, accommodate development and testing projects, or to quickly address unanticipated needs. In an ideal world, workloads can be moved quickly between on-premises and cloud locations, and leverage resources from multiple locations. (Unfortunately, API and architectural differences between different cloud providers make this challenging.)
- **Elasticity.** Many industries experience big variations in resource demand. One clear example is retail, where activity spikes before the December holidays. The hybrid cloud model gives you the ability to respond elastically to resource demands. In a similar vein, many individual applications have big fluctuations in resource demand. Such applications need to run in an environment where they can grab resources when they are needed and release them when they are not, reducing overall expenses.

- **Self-service.** A well-designed hybrid cloud can allow IT users—such as developers and line-of-business managers—to gain access to IT infrastructure and services through a self-service portal. This not only gives them immediate access to services, it reduces the burden on IT since it no longer has to serve as the middleman.
- **Faster delivery of new products and services.** Hybrid cloud can help you deliver new products and services more quickly by eliminating barriers that slow your business and development teams down. New digital services become easier to create and deploy, and developers and test engineers can better access the resources they need when they need them.
- **Cost control.** A hybrid cloud model lets you run every application as efficiently as possible, while adopting a pay-as-you-go model that reduces your capital investments in infrastructure and datacenters. Designing datacenters to accommodate peak loads only to have infrastructure sitting idle much of the time is a poor choice versus adding cloud resources when needed to accommodate peak periods.
- **Avoidance of lock-in.** If you adopt a cloud-only model, it's almost impossible to avoid getting locked into one or two cloud vendors. It can be cost prohibitive to get your data *out* of the cloud, so you need to exercise caution before you move data from datacenters into the cloud.
- **Access to the latest technology.** In today's competitive business environment, enterprises cannot afford to find themselves in a situation where they are unable to gain immediate access to technologies that could provide a business advantage. One example of this is AI. The large public clouds are innovating rapidly and offering competing services. A hybrid cloud model gives you the flexibility to use the best technology to seize opportunities.

Whether or not you actually achieve these benefits depends on the choices you make, including your private and public cloud, cloud service provider, and SaaS choices. Reliance on legacy datacenter architectures—whether you own the equipment and software or not—or getting locked into a specific infrastructure stack can add to technical debt, increase operating costs, and limit future flexibility. You need to keep your options open, so you can choose the best destination for each workload. The results you ultimately achieve depend on how mature your hybrid cloud operations are.

Why Is Hybrid Cloud the Preferred Enterprise Model?

A variety of evidence points to hybrid cloud as the preferred model for the enterprise. According to the RightScale 2017 "State of the Cloud" report, hybrid cloud is the preferred enterprise strategy; 85 percent of enterprises have a multi-cloud strategy in place, up from 82 percent in 2016.

Recognized Public Cloud Limitations

More than one established enterprise has rushed to the public cloud over the last several years with mixed results. The current trend towards moving some workloads back on-premises is a clear sign that initial expectations and reality were not aligned.

In many cases, the public cloud remains a better fit for mode 2 or cloud-native apps than for more traditional mode 1 apps. The benefits of porting mode 1 applications to the cloud may simply not be worth the effort. Most organizations have hundreds of such applications that they will continue to need far into the future.

If that prediction seems unrealistic to you, just consider the continuing niche occupied by the mainframe computer. It's been more than 30 years since its fall from grace, but mainframes—and the applications they run—are still with us.

There are a variety of challenges that may result when running enterprise workloads in the public cloud, including:

- **Cost.** Much of the initial enthusiasm for public cloud was based on expectations of reduced costs, but this has rarely been the result. Applications with predictable resource requirements—whether mode 1 or mode 2—may be more cost effective to run on-premises than in the cloud.
- **Availability.** It seems like there's a significant public cloud outage almost every year that makes enterprises reexamine their cloud plans. You may not want the availability of critical applications that your company relies on to be in someone else's hands.
- **Control.** For some applications and data, your company may not be willing to give up the level of control (including control over availability) that you get by running on-premises.
- **Performance.** It may seem counter-intuitive, but the public cloud may not deliver the necessary application performance. This is especially true for mode 1 applications that are designed to scale up rather than scale out.
- **Compliance and data sovereignty.** Depending on your industry (and the countries you're operating in), you may be subject to stringent regulatory requirements that make public cloud unattractive. This has been the case in financial services and healthcare in particular, although things are starting to change.
- **Security.** Managing security in the cloud is substantially different from managing security on-premises. A number of recent and well-publicized cases where data was accidentally left publicly accessible underscore this difference. Enterprises that end up repatriating applications from the cloud most often cite security or cost as the reason.

This isn't to say that public clouds—or CSPs—are a bad choice. They have an important role to play. Successful enterprises simply need to be smart about choosing the best location for each application or service in their portfolios, while retaining the flexibility to make adjustments as requirements change.

Are You Ready for GDPR?

Data sovereignty and compliance regulations continue to evolve. The European Union (EU) is in the process of putting a framework in place to protect the personal data of its citizens. The General Data Protection Regulation (GDPR) is intended to strengthen and unify data protection. At the time this report was written, GDPR was scheduled to take effect May 25, 2018, so it will likely be in effect by the time you read this.

This is a positive step for individuals residing in the EU, giving them more control over their data, including sensitive personal data and unique identifiers, genetic and biometric data, and pseudonymous data.

GDPR will change the way all companies do business. It applies not only to companies based in the EU, but every company that handles data belonging to EU residents. If your IT team has not prepared to address GDPR, this primer is a good place to get oriented.

Increasing Importance of Distributed and Edge Environments

In the last few years, enterprises have begun to recognize the extent to which data and applications are being dispersed, not just across private and public clouds, but also distributed remote office/branch office (ROBO) and disaster recovery (DR) environments and many other edge locations like retail stores, distribution centers, and production facilities.

The Internet of Things (IoT) is accelerating this trend as the number and variety of sensors increases to satisfy a variety of needs. The sheer amount of datacoming from sensors, and the need to process and respond to the data immediately, often requires local processing. A recent article on edge computing in *The Economist*, aptly titled "The Era of the Cloud's Total Dominance Is Drawing to a Close", notes the significant financial and other challenges associated with moving all data to the cloud for processing.

Your organization needs to factor the needs of edge and IoT deployments into your end-to-end cloud design. Some locations will likely need increasing amounts of computing and storage to process data locally and take action.

Cloud-Native Companies Leaving the Cloud

You might think that companies born in the cloud era—so-called "cloud-native" companies that lack the legacy applications and technical debt of longer-established enterprises—would naturally stick with an IT model based on the public cloud. But, even these companies may be gravitating toward hybrid cloud.

The best-known example is Dropbox. While Dropbox retains a footprint in AWS, over the last several years it built its own datacenters and moved 500 PB of data out of AWS. This was a huge undertaking for a company that had only about 1,500 employees at the time. Why? *Control, performance, and cost.*

Public Clouds Expand Hybrid Cloud Offerings

If you need any further evidence that hybrid cloud is going to be around a while, all the major public clouds—most of whom resisted the idea of hybrid cloud for reasons that should be obvious—have begun making concessions to accommodate the hybrid cloud needs of enterprise customers:

- **AWS** now offers a variety of services to address hybrid cloud needs including data, networking, identity management, and others. VMware Cloud on AWS began to roll out in 2017. AWS has also begun offering services to address on-premises, edge, and IoT requirements, such as AWS Greengrass and Amazon Linux 2.
- **Google Cloud Platform** is forging alliances with major IT vendors, including a partnership with Nutanix, and another with Cisco. GCP seems focused on support for next-generation cloud-native applications.
- **Microsoft Azure** has been less averse to the idea of hybrid cloud than its competitors. With the release of Azure Stack in mid-2017, Microsoft enables applications to run on-premises on a stack identical to the one in the Azure cloud, facilitating movement of workloads between your on-premises datacenters and Azure.

While the public clouds provide software to integrate with your datacenters, tools and strategies to integrate among the different public clouds are still sadly lacking.

A Strategy for Hybrid Cloud Success

The major public cloud vendors expect you to use their tools to integrate with your datacenters, and at this point there is very limited interoperability between clouds or integration across clouds. If you want to use more than one public cloud, you'll either have to live with the fact that the interfaces and tools are different for each cloud you use (which may require separate teams for each cloud) or find a higher-level framework that abstracts the differences. (See Figure 2-1.)
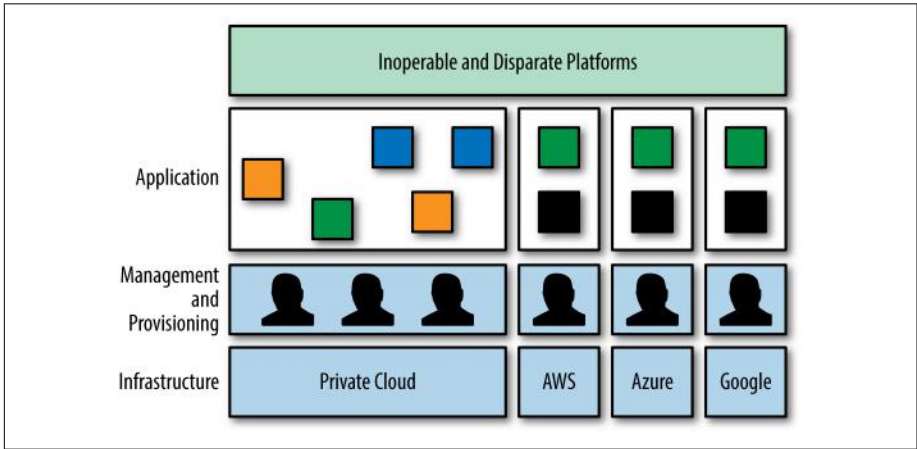
Figure 2-1. *The biggest challenge in creating a hybrid cloud is that the tools are different for every cloud environment today. A single, over-arching set of tools is needed to manage everything.*

You could choose a single public cloud provider and accept the vendor lock-in that results. (As a practical matter, many enterprises have probably tacitly adopted this approach already.) But, even with a single cloud provider, you probably won't be able to manage everything—on-premises and in the cloud— using a single set of tools.

All the guidelines that exist for assessing the maturity of hybrid cloud operations have one thing in common: at the highest level of maturity, they stress the need for automation, visibility, and consistency across all environments, private and public.

Most approaches to hybrid cloud are based on a strategy of trying to determine the best way to make all the disparate pieces—legacy infrastructure in your datacenters, public clouds, and cloud service providers—somehow work together. Based on the realities of the current cloud environment, this report proposes an alternative approach that has a higher likelihood of success:

1. Choose a single framework—a "cloud operating system"—that will allow you to manage workloads on-premises and in the cloud.
2. Modernize your on-premises environments in accordance with that framework.
3. Choose only public clouds and CSPs compatible with that framework.

Your enterprise needs a cloud operating system that gives you the ability to monitor, manage, and orchestrate across all environments using a single set of tools. This is the only way to ensure you operate at the highest level to achieve the full benefits of hybrid cloud.

Summary

The hybrid cloud offers many potential benefits, including greater agility, elasticity, self-service, and cost control. Enterprises now prefer the hybrid cloud for these reasons.

Key takeaways:

- Public clouds can create significant challenges for some enterprise workloads in terms of total cost, lack of control, performance, and compliance.
- Distributed and edge environments are growing in importance and aren't easily incorporated in a public-cloud-only model.
- Consider adopting a single cloud operating system in combination with datacenter modernization and careful selection of public cloud and CSP partners.

Assessing Your Hybrid Cloud Needs

Before you can begin architecting your hybrid cloud, it is first necessary to assess your current situation and your future needs. The better you do at this, the better the eventual outcome is likely to be.

Do your best to assess the economics of all your IT operations—both on-premises and in the cloud. This will allow you to take the best advantage of public clouds and CSPs to satisfy your needs—even as those needs continue to evolve. This chapter will help you answer the following questions:

- Which public clouds and CSPs is your business using? Which should you be using?
- Which of your applications and services are best suited for the cloud? Which applications should be on-premises?
- What new business initiatives are on your priority list, and how are those likely to translate into infrastructure, application, and service needs?
- What guidelines will you use to make hybrid cloud decisions?
- What are your primary hybrid cloud goals?

If you're reading this report, it's likely that your company today is not the company you want to be in the future. The whole purpose of digital transformation is to better prepare your business for success in the digital era. Because IT will play a crucial role in your success (or failure), you will need to figure out how to sustain the critical aspects of your current IT operations in a way that frees up resources to empower your business teams and enables your company to deliver new digital services to increase customer engagement, reduce business friction, and open new markets.

Assess the Current State of Your Operations

For most enterprises, assessing the entirety of your IT operations is, in itself, a daunting task. There are almost certainly activities taking place that you know little or nothing about. A regional sales team may have moved corporate data into AWS to run analytics, a skunkworks project may be using Information as a Service (IaaS) from a CSP, or your marketing team may have added new applications from multiple SaaS providers.

In some cases, the temptation not to care or get involved may be strong, but at a minimum you need to assess whether each unauthorized activity is putting important data at risk and violating regulatory requirements or corporate policies. You must also assess how much duplication and overlap exists. An obvious example is the hard-to-control spread of corporate files across services like Dropbox, Box, Google Drive, iCloud Drive, Microsoft OneDrive, and so on.

The first step is identifying all the locations where you have IT infrastructure, services, and data. This may include:

- Primary and secondary datacenters
- DR facilities
- Remote offices and branch offices
- Distribution centers, production facilities, and other edge locations
- Colocation facilities
- Major public clouds
- Smaller service providers including managed services
- SaaS providers

For each location where you own the infrastructure, you should ask:

- What resources (infrastructure and staff) do you have in the location?
- How current is the infrastructure?
- What percentage of the infrastructure is traditional/siloed? Virtualized? Private cloud?
- What's the utilization rate of all infrastructure?
- Is physical space limited?
- How important is this location to the business?
- What part(s) of the business rely on this location?
- What does this location cost in terms of capital and operating expenses?
- How much staff time does it take to sustain this location?

For cloud providers, ask yourself a similar set of questions:

- Why are we using this provider?
- Do the services from this provider duplicate services running elsewhere?
- How important is this provider to the overall business?

- What part(s) of the business rely on this provider?
- What does this location cost in terms of operating expenses?
- How much staff time does it take to sustain this location?

With a complete list of locations in hand the next step is to identify and prioritize the important workloads running at each location. Sample questions include:

- What is the workload?
- Why is the workload running in this location?
- What resources is it consuming (computing, storage, network bandwidth)?
- How important is the workload to the business?
- Who depends on this workload?
- Who manages this workload and does it have any special or unique management or monitoring requirements?
- What other applications/services is this workload associated with/connected to?
- How is the workload protected? Is the associated data in multiple locations?
- What are the workload's regulatory and security requirements?
- What's the total IT budget commitment to this workload, including management costs?

Identifying and prioritizing all your important IT workloads will allow you to make smarter decisions, including any necessary trade-offs, as you plot your path forward.

NOTE | **Don't Overlook Development and Test Resources**

Be sure to include all IT resources dedicated to development work, including tools, repositories, build servers, and so on.

Assess Your Future Workload Needs

With a completed assessment of your current IT operations in hand, it's time to polish up your crystal ball and start looking into the future. Your hybrid cloud strategy should address your foreseeable needs for the next three to five years, not just the applications and services that you're already running.

Start with the low-hanging fruit:

- What new applications and services are due to come online over the next year?
- Are you planning to update, change, or expand any important business applications (ERP, CRM, SCM, and so on)?

- What's your projected company headcount growth and how will you accommodate those new users (traditional desktops, virtual desktops, and applications)?
- Are there any seasonal workforce requirements?
- What's happening with IT operations and development?
  — Are there any changes planned to major infrastructure software like hypervisors?
  — Are there any new management or security software coming online such as security information and event management (SIEM) software?
  — Are there any changes/additions to development teams and tools?

Next, what new business initiatives or technology initiatives is your company engaged in or planning? It's harder to be prescriptive here, but some likely technology initiatives include:

- Big data analytics
- Internet of Things
- Artificial intelligence
- DevOps (see Chapter 6)

For each potential new workload, do your best to forecast:

- Is it mode 1 (traditional) or mode 2 (next-gen/cloud-native)?
- What IT resources will it require (infrastructure and staff)?
- What data and services will it depend on?
- Is it going to be on-premises, in the cloud, or a combination?

For example, for industrial IoT initiatives, sensors are likely to be on-premises (or at least not in the cloud). You may need to process the data near the point of collection, with some data transmitted to a corporate datacenter or the cloud for further analysis.

Creating a Workload Decision Matrix

With the information from your assessment in hand, you'll begin to get a pretty good picture of what resources you have and where gaps and opportunities exist. This information all feeds into the process of architecting your hybrid cloud, as discussed in the next two chapters.

At this point in the assessment process, you have everything you need to create a well-informed decision matrix to help you determine where to locate each workload going forward and how to assess anticipated costs. Some sample questions to ask for each application include:

- Who uses this application? Is it customer-facing or used by company employees?

- Does the application depend on an ecosystem of other applications?
- Does the application have stringent compliance requirements?
- What is the impact to your business if the application is down or unreachable?
- What level of data protection and disaster recovery does it require?
- Does the application consume and release resources as needed, or is it persistent?
- Does the application consume more and more resources over time in a way that you can't control or limit?
- Is the same or a similar service available in a SaaS model?
- Does the application scale vertically or horizontally?
- Can the application be containerized?
- What's the I/O pattern? Steady or fluctuating? High or low?
- These factors tend to be interrelated. High I/O requirements or the need to run as part of an ecosystem will affect the cost of running an application.

Once you have the right cloud decision matrix for your organization, you can evaluate individual workloads and applications against it. Some applications will rank as prime candidates to move to the cloud if they aren't there already; some applications will clearly not be well-suited to the cloud and should be sited on-premises; others may require a little work to make them cloud ready.

As you plan, keep in mind that on-premises and private cloud environments tend to be a better choice for the most critical and performance-sensitive applications, while the public cloud and cloud service providers are a good choice to meet the needs of cloud-native applications that scale elastically. (See Figure 3-1.)

Ultimately, your goal is to optimize application placement so you can focus time and financial resources on delivering the best application stack for each application or service to ensure the best customer experience.

Two Classes of Applications That Belong in the Public Cloud

As a rule, very few existing enterprise applications were engineered to be well-suited to the public cloud. It may be years before legacy applications evolve to be public cloud–ready, if they ever do. If you move an application that isn't ready to the public cloud, you'll likely find you're burning money and not meeting your business needs.

The applications that do belong in the cloud often fall into two categories:

- Highly elastic applications
- New applications where you don't know the resource demand

Applications that have a low ecosystem requirement and are very elastic (have highly variable resource requirements) are often perfect for the public cloud.

They can get all the resources they need when they need them and release them when they don't. Hosting a highly elastic application on-premises might mean having to provision a large amount of expensive infrastructure to accommodate occasional activity spikes.

When you deploy a new application, it can be hard to predict what the demand or the resource requirements are upfront. It often makes sense to put these applications in the cloud initially, so they can get the resources they need. Once resource needs are understood, applications can be moved on-premises if that makes practical sense based on resource demands and application design.

Many companies are initiating large numbers of development projects to create new applications and services as part of their digital transformation efforts. Only a handful of such projects are likely to succeed and deliver a high return on the initial investment. By developing and deploying those applications in the cloud, you can minimize upfront capital outlays. Applications that succeed may eventually be reevaluated to determine where they fit best; applications that don't do well can simply fade away.
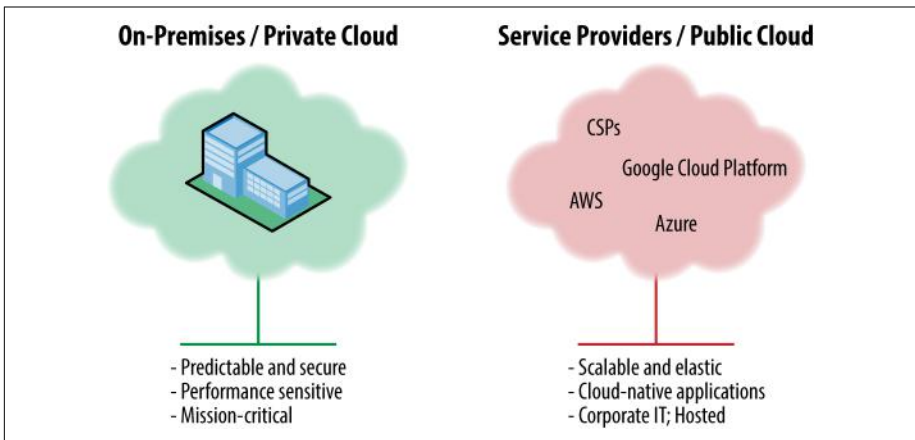
Figure 3-1. This figure shows some simple guidelines that often help when deciding whether a workload runs on-premises or in the cloud. Creating a decision matrix will help you make the best decisions about what to run on-premises and what to run in the cloud.

Seek Buy-In

When assessing your current and future needs, it's imperative to involve all internal IT customers and stakeholders. Your goal in bringing IT and business teams together is to get greater visibility and buy-in so you can move forward to create a hybrid cloud that meets the broadest range of foreseeable needs, while provid-

ing the flexibility to adapt quickly to changing market demands and unforeseen events.

Establish Your High-Level Hybrid Cloud Goals

As part of your assessment process, consider establishing three to five high-level, quantifiable objectives that you want your hybrid cloud to meet. These can help guide your planning process. Some examples might include:

- Consolidate less important mode 1 applications and reduce operating costs by 20%.
- Reduce provisioning time for virtual machines below 1 hour.
- Decrease time to market for new applications by 40%.
- Establish online disaster recovery for 95% of tier 2 applications.
- Containerize 50% of mode 2 applications.

It will be harder to determine if your hybrid cloud is a success if you don't start with a clear set of objectives you want to achieve.

Summary

This chapter provides detailed guidelines and suggestions for assessing your current and future needs and explains the benefits of creating a decision matrix to guide the process of siting applications going forward.

Key takeaways

Your assessment process should enable you to:

- Identify how much on-premises infrastructure you need.
- Determine which datacenters and other facilities are targets for modernization.
- Identify target applications and services for public clouds, CSPs, and SaaS providers.

Designing Your Hybrid Cloud: On-Premises and Private Cloud

Once you've completed the assessment of your current operations and future needs, you will be well prepared to start making decisions about the elements that will make up your hybrid cloud. The assessment has probably already sparked some ideas about environments you need to add—and existing environments that you need to transform or discard. As you architect your hybrid cloud, you'll need to make decisions regarding each of the following:

- Cloud operating framework
- On-premises infrastructure
- Public cloud
- Cloud service providers
- SaaS providers

The workflow is illustrated in Figure 4-1. Plan to define all the IT environments you will need to support both current workloads and future workloads (to the extent you can anticipate your needs).
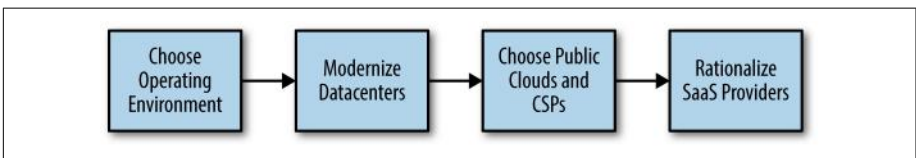

Figure 4-1. Process flow for designing a hybrid cloud.

Don't Choose Cloud Providers Too Soon

It can be a mistake to begin making decisions about particular cloud providers before you have outlined the complete list of environments you will need. Once you decide what you're doing on-premises (a decision that once made you likely have to live with for three to five years at a minimum), you'll be in a better position to choose providers that complement that choice.

In addition to the various environments that will make up your hybrid cloud architecture, you must also consider how you'll handle data protection and disaster recovery for each environment and each workload. Completion of the design should result in:

- The operating framework—cloud OS—you will use
- Modernization plans for on-premises facilities
- Which if any public clouds you will use
- What types of CSPs will work best
- A shortlist of SaaS providers

This chapter provides advice on choosing a cloud operating framework and guidelines for modernizing existing datacenters. Chapter 5 discusses the process of choosing cloud environments, including public clouds, CSPs, and SaaS providers.

Iterate to Success

As you begin to design and build your hybrid cloud, you will likely find that an iterative approach works best. For example, if your organization is large and spans multiple geographies, you may find that it's simply impossible to tackle everything at once. It may be better to focus on a single geography, or even a single part of a single geography. That way you can learn from the successes and failures along the way.

Your enterprise may have different IT teams that focus on satisfying the needs of specific user groups, like your product design teams. If you're organized that way, you might focus on the hybrid cloud needs of only one or two groups as a starting point.

Choosing a Cloud Operating System

The first and most critical decision you must make is selection of the cloud operating framework you'll rely on for your hybrid cloud. Unfortunately, many organizations back into this decision rather than make it up front. Often, this is an attempt to bring order to the chaos of a company's existing cloud efforts. Cre-

ating a coherent, top-down plan will result in a much more unified and efficient hybrid cloud environment.

> **NOTE**
>
> **Reconciling IT Ideals and Reality**
>
> The reality of enterprise IT rarely achieves perfection. This chapter discusses an ideal approach, with full recognition of the fact that you'll likely also need to make tactical cloud management decisions along the way just to keep the lights on as you work toward rationalizing your hybrid cloud.

As I described at the end of Chapter 2, your enterprise needs a cloud operating system that gives you the ability to monitor, manage, and orchestrate across all environments using a single set of tools, while enabling your users to work transparently in any environment. This will deliver the greatest simplicity for your IT organization and the greatest flexibility for your user community.

The first step is to determine what elements your cloud OS must encompass:

- Support for on-premises (private cloud) environments, public cloud, and/or CSPs?
- Mode 1 (traditional) applications, mode 2 (cloud-native) applications, or both?
- VMs or containers, or both?

Based on your requirements, here are some possible options to consider as your cloud operating framework:

- **OpenStack.** OpenStack gained early popularity as a platform for on-premises private clouds. While it had a promising start, it seems to have lost momentum in recent years. Rackspace is likely the largest cloud provider that supports OpenStack. You may be able to run OpenStack on AWS or GCP, but it won't be easy.
- **VMware Cloud.** VMware has the virtue of being extremely popular in enterprise datacenters. You are likely already using it in some parts of your operations. It supports both VMs and containers, although not equally well. VMware Cloud runs on AWS. VMware has a reputation for being expensive and automation can be cumbersome.
- **Nutanix Enterprise Cloud and Nutanix Calm.** Nutanix supports a wide variety of hardware options for on-premises deployment and supports both VMs and containers. Nutanix Calm provides application automation and lifecycle management for private and public clouds, including AWS and GCP. A rapidly growing number of cloud service providers have deployed Nutanix infrastructure.

- **Hybrid Cloud Management Software.** A wide variety of third-party hybrid cloud management solutions have emerged in recent years. This article does a good job of summarizing the pros and cons of more than ten different tools, including offerings from well-known companies such as IBM, HPE, Red Hat, and BMC.
- **Kubernetes.** Kubernetes is a platform for automating and managing the execution of containerized applications. You will likely want the framework you choose to be able to incorporate Kubernetes, but by itself it may not be the solution you are looking for.
- **Configuration Management and Orchestration Tools.** Like Kubernetes, tools like Chef, Puppet, Ansible, and SaltStack may be an important part of your infrastructure stack now and in the future as you embrace DevOps. However, at the moment these tools may not offer the necessary level of cross-cloud integration.
- **Platform as a Service (PaaS).** PaaS allows you to develop, run, and manage applications in a way that is abstracted from underlying infrastructure. Because some PaaS solutions are able to run both on-premises and in the cloud, PaaS potentially provides a hybrid cloud framework when used in conjunction with automation tools. This may be an option if you are only concerned with mode 2 (cloud-native) applications. If you need to accommodate both mode 1 and mode 2, you will again need a solution that abstracts resources at a higher level, possibly with the ability to incorporate PaaS beneath it.

Your decision should take into account the specific elements you need as determined by your detailed assessment (Chapter 3). Most enterprises are likely to be best served by an option that not only encompasses on-premises and cloud providers but also provides an ability to incorporate both the old (mode 1 applications and VMs) and the new (mode 2 applications and containers) in a single framework. However, there are certainly circumstances where you only need to focus on mode 1 or mode 2 applications in isolation.

Hybrid cloud management options are rapidly evolving, so making this decision may be difficult. Once you've identified a few candidates, the final decision may depend in part on which solution offers the most compelling roadmap and vision for the future.

Modernizing Datacenters

Having decided on a cloud operating system, the next major decision is to determine how you will modernize your datacenters and other infrastructure. Recent

data from IDC[1] suggests that the typical enterprise runs about 60% of IT on-premises today with 40% in the cloud. By 2021, this is expected to reach a 50/50 split. Therefore, it remains just as important to focus on what you will do on-premises as what you will do in the cloud.

The traditional infrastructure in your datacenters and other locations may be too complex, too expensive to operate, and too inflexible to satisfy your needs going forward. Unless you can remove the friction from your on-premises operations, your digital transformation will never be complete, and your business objectives will remain at risk. Adopting a hybrid cloud model changes on-premises needs. Datacenter modernization reduces technical debt and frees up resources (budget and personnel) to fuel your hybrid cloud plan and transform your IT operations and your business.

What capabilities must your datacenter infrastructure have to address your needs in the cloud era? Public cloud services are by and large built using web-scale building blocks that combine computing and storage in one. As you transform your datacenters, choosing a web-scale, hyperconverged architecture can simplify management and help ensure commonality across all elements of your hybrid cloud. In a 2017 research report, Wikibon analyst David Floyer supported this recommendation:

> Wikibon concludes that Senior IT executives should consider adopting an aggressive strategy for moving to a hyperconverged Server SAN environment. Previous Wikibon research found that gateways between different on-premises and service providers are expensive, and are an impediment to hybrid cloud functionality. Wikibon recommends Senior IT executives adopt a True Hybrid Cloud strategy, and ensure where possible that the same hyperconverged Server SAN infrastructure solution can be run on-premises and in the cloud, using the same hyperconverged technology and orchestration/automation software.

The following elements should be carefully evaluated for your critical-capabilities list:

- **Software-defined.** Dedicated silos of infrastructure as well as servers, storage, and networking components that must be physically configured are a thing of the past.
- **Hyperconverged.** Hyperconverged infrastructure (HCI) based on a web-scale architecture that combines servers, storage, and networking is supplanting traditional datacenter infrastructure in many enterprises. The right HCI implementation can handle any type of workload an organization is required to support.

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1 IDC Quarterly Cloud Infrastructure Tracker, April 2017.

- **Easy to manage.** Management complexity is a major impediment to IT success. A single management interface should control everything from infrastructure through application deployment.
- **Easy to automate.** Automation is the best way to ensure operational consistency, free up staff time, and eliminate the costly errors that result from manual configuration mistakes.
- **Self-service capable.** Having development teams and lines of business satisfy IT needs through self-service using a private cloud model can make them more productive, decrease time to market, and save IT staff time.
- **Application and VM-centric.** Data operations such as snapshots, replication, and cloning should operate at the same level of granularity as your applications: VMs or containers.
- **Protection built in.** Data protection and disaster recovery (DR) should be services provided by your infrastructure, not something you have to layer on and manage separately.
- **Distributed and edge capable.** Organizations increasingly need infrastructure in secondary and edge locations close to the point of business to collect and process data locally.
- **Inherently multi-cloud.** As you already learned, enterprises are combining on-premises operations with applications and services running at multiple cloud providers. Your datacenter infrastructure must facilitate your hybrid cloud operating model.

Expectations for enterprise IT services in the cloud era have been fundamentally reset. Development teams as well as other internal and external consumers of IT services now demand the agility and scalability found in public clouds. To complete your hybrid cloud strategy, you must look beyond legacy IT architectures to create datacenters that rival the cloud, while avoiding vendor lock-in and decoupling the layers of the stack from each other to the greatest extent possible.

Infrastructure Selection for Mode 1 and Mode 2 Applications

Mode 1 applications are the traditional enterprise applications you've been running for years. Mode 2 applications are the next-generation, cloud-native applications that your company has begun adding over the last few years.

Because the two application types are different, it may be tempting to choose separate infrastructure solutions—and maybe even separate datacenters—to address each requirement. There are several problems with this approach:

- Your infrastructure becomes more complex.
- When you get the mix wrong—too much for one, too little for the other—you can't easily rebalance resources, creating inefficiencies and lowering utilization.

- Mode 2 will likely grow at a faster, but yet to be determined, pace.

It's far preferable to choose infrastructure for your datacenter with the flexibility to accommodate both types of applications, even if you intend to dedicate infrastructure for each type for now. This approach will simplify procurement, streamline management, and give you the most flexibility to make future allocation adjustments to adapt to unforeseen requirements.

In the cloud, on the other hand, you may want to take the opposite approach. For example, you might choose CSPs that can offload many of your mode 1 applications economically, while putting some of your mode 2 applications in a public cloud that best delivers the elasticity and scale the applications require.

Availability, Data Protection, and Compliance

Ensuring data protection remains a critical IT function. As you modernize your datacenters and choose providers, you'll need to make certain that the choices you make can support your needs in these areas. Just because an application or service resides in the cloud (including services provided by SaaS providers), don't assume that you no longer have to worry about data protection.

An important aspect of your hybrid cloud may be to deliver more cost-effective data protection and disaster recovery for existing applications. Some of your public cloud and CSP selections may be primarily to satisfy these requirements.

Summary

The two most important decisions you must make as you undertake your hybrid cloud design are:

- Deciding on the cloud management framework—the Cloud OS—you will utilize
- Determining the best approach to modernize your on-premises infrastructure

Key takeaways

- Choosing the right cloud operating system for your organization provides the glue that allows your hybrid cloud to operate as a single, cohesive unit.
- Your decision must take into account the specific cloud elements you require as determined by your detailed assessment (Chapter 3).
- Most enterprises will be best served by a cloud operating system that supports both mode 1 and mode 2 applications.
- A modern datacenter architecture is essential to provide increased agility and flexibility and to reduce technical debt.

Designing Your Hybrid Cloud: Public Clouds, CSPs, and SaaS

Once you've chosen your cloud operating system and on-premises infrastructure strategy, it's time to choose the specific cloud environments that will be a part of your hybrid cloud. The goal is to select cloud providers that complement the decisions you've already made:

- Choose public clouds and CSPs compatible with your cloud operating system.
- Compatibility is less important for SaaS providers where you will simply consume the software service.

Choosing providers based on compatibility provides a common operating environment and more seamless integration between environments, enabling developers to use resources across your hybrid cloud as necessary without extensive retooling, and allowing on-premises applications to more easily take advantage of cloudbursting during periods of peak load.

This chapter provides additional guidance on choosing cloud partners. In some cases, you may want to establish relationships even though your needs are not immediate. This will allow you to move more quickly if a timetable needs to be accelerated, or you need to respond swiftly to a new opportunity or competitive threat.

Choosing Public Clouds and CSPs

To choose the best providers for your needs, you'll need to carefully navigate the evolving cloud landscape. As described in Chapter 3, this requires mature processes for deciding which applications and services to run where.

Beyond integration with your chosen cloud operating environment, the decision to choose a particular public cloud or CSP—and the subsequent decisions about which workloads to place there—depends on a range of factors such as:

- **Price.** Your goal is always to get the best return on your investment. The cheapest provider isn't always the best value in the long run. You may want to treat a particular service as an operating expense (OpEx) and run it in the cloud, a capital expense (CapEx) and run it on-premises, or some combination of the two.
- **Elasticity.** Many applications need the ability to scale up or down based on usage. Scaling can be predictable, such as handling end-of-quarter processing, or unpredictable, such as handling a surge of new transactions due to unforeseen circumstances. You'll need cloud providers that can address your needs for both types. Once again, it may not be the same provider.
- **Security, compliance, and data sovereignty.** No matter the exact nature of your business or the geographies in which you operate, your business is subject to numerous regulations, which may include data sovereignty laws that dictate where data can be stored. Cloud decisions must factor in these concerns.
- **Unique application needs.** If you're developing cloud-native applications designed to leverage NoSQL databases, containers, and microservices, you need infrastructure that can support those needs. If your datacenters are not well equipped to support those requirements today, you will need to identify a cloud provider that can deliver them.
- **Development needs.** To accelerate innovation, enterprises are turning to new agile models for software development, where self-service and automated deployment are the norm. Even if you're developing primarily on-premises, it's a good idea to include cloud providers in your plan that can meet your agile development needs.

Weigh these factors carefully before making your final decisions.

Public Clouds

The short list of public clouds includes just three: AWS, GCP, and Microsoft Azure. The next tier of providers, according to a 2017 Gartner survey, includes IBM, Oracle, and Alibaba. These major public cloud providers offer a compelling range of infrastructure and service choices.

Many enterprises make use of public clouds for specific workloads. As you evaluate public clouds, the key is to choose the ones that work best with your chosen cloud operating environment and complement your application environment. For example, Microsoft Azure makes more sense for enterprises heavily invested in Microsoft than enterprises running Linux. The major public clouds are also starting to offer services for specific industries.

Cloud Service Providers

CSPs often provide a level of customization, service, and support that makes them attractive choices for enterprise IT. Stay open to the possibility that CSPs may be a better fit for many needs than public clouds. Many CSPs focus primarily or entirely on particular industries, putting them in a better position to understand and satisfy unique regulations and other industry-specific requirements.

Another potential advantage of CSPs is that you can choose providers that are running the same infrastructure hardware and/or software you're running (or planning to run) on-premises, creating natural synergy, simplifying integration, and allowing you to take advantage of optimized tools for data protection and data management tasks. For example, if you're running VMware on-premises, then a CSP running VMware is an obvious fit. Similarly, if you have storage with built-in data protection (snapshots and replication), it can be advantageous to work with a CSP who has the same storage, enabling efficient data protection and DR without third-party solutions.

Many CSPs also provide managed services, allowing you to offload some or all of the responsibility for managing on-premises infrastructure and/or applications. This can be a good way to focus more time and attention on your strategic needs.

Should You Choose Managed Services?

The managed services world has transformed over the past decade, growing from basic datacenter co-location services to ubiquitous cloud services, including private, hosted, and hybrid cloud solutions. If you haven't given much thought to managed services for a while, it may be time to take a second look. Enterprises choose managed services to free up existing IT staff for more important projects.

Working with SaaS Providers

Your company may already use many SaaS providers, probably more than you realize. While SaaS may be a lower priority than datacenter modernization or selection of public clouds and CSPs, there are several things worth considering. First, standardize the set of SaaS providers your company will utilize to the greatest extent possible. Try to avoid having duplicate services from multiple providers, especially in the same geography. *Does your company really need Slack, Jabber, Jive, and Microsoft Teams?*

It goes without saying that the more providers you use (and the more locations you store potentially sensitive data), the greater the risks. However, you shouldn't overlook potential opportunities to outsource some applications you're running on-premises today to SaaS providers. Outsourcing can free up staff and infra-

structure to address higher priorities. It may also allow you to recover valuable datacenter space and reduce both your capital and operating budgets.

Finally, don't neglect the corporate data being stored by SaaS providers. At a minimum, you'll need to make sure that regulatory and data protection requirements are being met. You may want to maintain a separate copy of the data to ensure it is protected to your corporate standard, or in case the relationship with the SaaS provider ends at some point in the future.

Summary

This chapter provides specific recommendations for choosing public clouds, CSPs, and SaaS providers.

Key takeaways

- Public clouds and CSPs compatible with your chosen cloud operating system are strongly preferred.
- Look for CSPs that can offer a high level of industry-specific knowledge.
- Eliminate SaaS providers that duplicate services but be open to opportunities to outsource specific applications.
- Data protection and compliance remains your team's responsibility regardless of where your data is.

Getting Serious About DevOps

Established enterprise companies must work hard to keep up with competitors—including startups threatening to disrupt mature markets. Enterprises across a range of industries are turning to agile development and DevOps as a solution to these challenges.

For example, the financial services industry has given rise to a large number of new financial technology or *fintech* companies. This unprecedented level of business change is driving established financial services companies to move to a DevOps model. As one industry observer noted:

> Executives in this conservative sector see DevOps as a way to roll out value to the market faster, more efficiently, and more safely. DevOps enables financial services to increase the cadence and quality of application releases while also addressing governance, risk, security, and compliance strategies.
>
> –Steve Brodie, CEO, Electric Cloud

Once your hybrid cloud transition is complete—or at least well under way—you will have an infrastructure stack in place that is well equipped to support the automation, agile development practices, and continuous integration and continuous delivery (CI/CD) required by DevOps.

This chapter explains some of the concepts behind DevOps and looks at the challenges to achieving DevOps success.

NOTE

New to DevOps?

If DevOps is unfamiliar to you, be sure to read The Phoenix Project. This short book is now considered a DevOps classic and a must-read for IT professionals.

What Is DevOps?

DevOps is a combination of changes to IT culture and technology that aims to close the gap between development and operations teams (Figure 6-1), removing the friction between the two to accelerate the delivery of new capabilities and services.
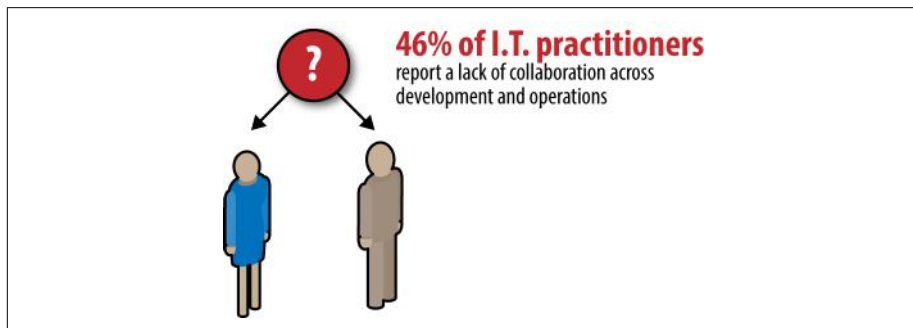

Figure 6-1. Friction between Dev and Ops can be a big impediment to the delivery of new software and features.

Traditional engineering teams operate in silos that allow counterproductive practices to persist. Long release cycles, missed release deadlines, and low product quality are signs that it may be time for DevOps.

DevOps bridges organizational gaps to deliver greater value for both internal and external customers. It removes strict division of responsibility and enables collaboration and automation, resulting in benefits that include:

- **Rapid release.** Automated testing and release of software covering everything from source code check-in to customer release and use.
- **Fail fast and fix fast.** Automated deployment (and reversion) strategies reduce risk while increasing release tempo.
- **Closed-loop design and testing.** Every change is an opportunity to learn and experiment, every gap or mistake an opportunity to improve testing, instrumentation, and automation. Automated operations allow monitoring systems to trigger healing.
- **Democratized access and self-service.** Development and test environments can be created ad hoc by developers, testers, and operations.

DevOps replaces the traditional waterfall method of application development with agile development methodologies with a high degree of iteration. In the past, the interval between software releases was often measured in months or years. Through coordinated effort between Dev and Ops, teams are now delivering code multiple times per day in many cases.

With fast and simple provisioning, integrated self-service, and easy access to infrastructure as needed, an agile hybrid cloud environment can give you a big step up when it comes to getting DevOps off the ground.

The Importance of Infrastructure to DevOps

Infrastructure agility is essential to the DevOps process. If you follow the guidelines presented in earlier chapters of this report, the resulting hybrid cloud should make it much easier to achieve your DevOps goals. Trying to build DevOps on conventional infrastructure will slow your progress and diminish the results. DevOps built from multiple platforms, with fragile integrations and multiple management tools, results in silos of infrastructure, greater friction in DevOps processes, and significant waste in terms of time and money spent because it is:

- **Hard to automate.** A simple policy change may end up being a massive undertaking.
- **Complex to monitor and troubleshoot.** Network, server, storage, virtualization, and application experts may be needed.
- **Difficult to protect and secure.** The availability of your dev environment is on the critical path and your company's data could be exposed.
- **Difficult to maintain and upgrade.** How can you do DevOps if software upgrades take six months and require downtime?
- **Slow and inefficient to provision.** DevOps depends on the ability to set up and tear down development and test environments rapidly using automated processes.

An efficient hybrid cloud streamlines DevOps by avoiding these complications.

Infrastructure Automation for DevOps

As important as culture is to DevOps success, it also relies on optimized tools for continuous integration and continuous delivery (Jenkins is the best known CI/CD tool), configuration management (Puppet, Chef, Ansible, and so on), and infrastructure automation. As you move to hybrid cloud, your development practices may have to expand to encompass the broadened scope as well.

Infrastructure automation is critical to DevOps success in a hybrid cloud. While numerous solutions exist today for solving various parts of the DevOps automation problem, most solutions focus on a slice of the puzzle and make simplifying assumptions about the overall state of the datacenter. What's needed is a solution that addresses the challenges created by the emerging IT landscape and helps development and operations teams navigate from their current state to their desired state, enabling convergence of automation across private and public clouds and CSPs.

A complete DevOps automation solution must provide:

- **Model-based automation.** A model is an abstract definition of an application or service that accounts for its various dependencies and can be easily understood by anyone no matter their skillset. A policy-based approach naturally complements model-based automation. Models abstract service configurations while policies decouple management concerns from concrete configurations.
- **Workflow-driven orchestration.** Today, DevOps is often forced to fall back on brittle scripts and cumbersome manual processes. In workflow-driven orchestration, all orchestration is the result of predefined workflows, enabling tasks to be coordinated centrally.
- **Workflow-driven lifecycle management.** The lifecycle of a service can be thought of as the set of activities that make up its entire "deploy to destroy" lifetime. The right DevOps solution provides the platform to manage and maintain each application throughout its lifecycle. This enables automation of complex functions, such as upgrade, migrate, and retire, while accounting for the dependency chain within a distributed service.
- **Reuse of existing automation.** IT organizations have already invested heavily in automation, if not in tooling then at least in personnel and in custom scripting and coding. Any DevOps automation solution must work with existing solutions and leverage them for the tasks they're best suited to, as illustrated in Figure 6-2.
- **A single interface.** DevOps needs a central location where all workflow can be defined, maintained, monitored, and shared. Today, so many different environments and tools are involved in the automation workflow that DevOps personnel are rarely able to share a holistic view across the IT landscape. The ideal DevOps automation solution delivers a unified view, enabling collaboration and a common perspective on all applications and services being managed.

Naturally, when you choose your DevOps environment, you'll want to look for model-based, workflow-driven automation tools that integrate well with your chosen cloud management framework.
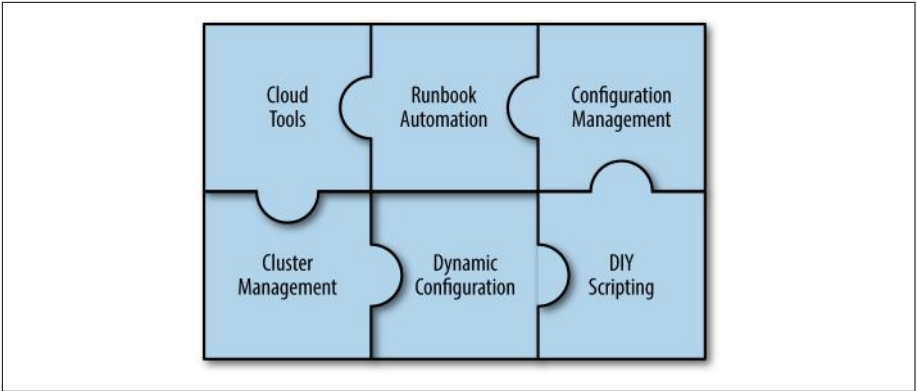
Figure 6-2. The ideal DevOps automation solution is able to incorporate the tools you already have in place.

For companies trying to create an effective DevOps practice, the hybrid cloud strategy in this report creates a solid foundation to build on. Modernizing IT infrastructure, reducing complexity and heterogeneity, and establishing relationships with the right CSPs and public cloud vendors will make automation of DevOps processes much simpler.

Summary

DevOps is a natural extension of the hybrid cloud environment described in previous chapters of this report. The right infrastructure is easier to automate, easier to provision, and easier to maintain, allowing your DevOps team to focus more attention on delivering new applications and services rather than dealing with the idiosyncrasies of complex infrastructure.

Key takeaways

- Mature solutions exist for source control, configuration management, continuous integration and continuous delivery.
- DevOps automation remains the biggest challenge.
- Look for automation solutions that are model-based to simplify definition of dependencies.
- Workflow-driven orchestration and lifecycle management can help you avoid too great a dependency on brittle and difficult-to-maintain scripts.

Adapting Your Organization to Hybrid Cloud

As you adopt a hybrid cloud strategy, you should anticipate the need to make changes to your IT organization. Where traditional, siloed infrastructure stacks rely heavily on IT specialists with deep knowledge of a particular discipline such as networking, storage, and virtualization, your hybrid cloud operations may depend much more on IT generalists.

The move to automation and self-service eliminates much of the time spent satisfying user requests and trouble tickets, allowing your team to shift focus from infrastructure and day-to-day tasks to the applications and services your company relies on.

This chapter explains why organizational changes are necessary, outlines opportunities to take advantage of resulting IT changes, and looks at organizational strategies for DevOps success.

Why Organizational Change Is Necessary

As important as technology has become to the modern enterprise, a successful digital transformation also requires significant changes to both company culture and management structure. For example, Dutch banking giant ING developed an agile approach to organization modeled on the success of companies such as Google, Netflix, and Spotify. In the process, ING discovered that significant changes to the company culture were also needed.

The recent report, Digital Transformation in Financial Services: The Need to Rewire Organizational DNA, discusses the need for firms to adopt a "digital DNA" across the company, a specific set of characteristics that enables them to succeed with digital transformation.

While transforming the culture and organizational structure of your entire company is beyond the scope of this report, I want to say a few things about the impacts and opportunities for the organization and culture of your IT and development teams. These teams can serve as a catalyst for the rest of the company.

The preceding chapters emphasize how thoughtful cloud adoption combined with datacenter transformation are essential to delivering the new applications and services necessary to maintain your company's competitive footing and enhance customer experience. As you work to accelerate the delivery of new digital applications and services, agile development methods will replace the traditional waterfall approach. The balance of power between developers and IT operations has to evolve to deal with this new reality.

Transforming your datacenters combined with prudent adoption of services from CSPs and public cloud providers has significant impacts on your organization:

- Frees up budget and personnel
- Reduces reliance on IT specialists
- Increases your ability to focus on applications and the application stack
- Facilitates a transition to DevOps

In order to take full advantage of these changes you may need to reorganize or flatten your organizational structure.

Reprioritize IT Resources

Traditional IT infrastructure is simply not flexible or scalable enough to adapt to digital needs. IT teams spend far too much time and effort on mundane management tasks that keep the lights on but don't move the business forward.

A high percentage of the IT budget is dedicated to day-to-day operations, which often consume up to 80% of your IT budget, leaving only 20% for innovation. The goal of datacenter transformation and hybrid cloud is to bring that split closer to 50/50, freeing up both budget and staff time that can be reallocated to new projects.

Reduce Reliance on IT Specialists

Fragmented infrastructure is difficult to automate and also creates a need for infrastructure specialists—individuals with specialized storage, networking, virtualization, and other skills who can troubleshoot the issues that inevitably arise. Hiring these individuals is both difficult and expensive. As your operation grows, it becomes impossible to continue hiring enough experts, making a dependence on superstars an unsustainable practice. In extreme cases, you may have just a

few engineers who understand the impact of infrastructure changes or who can implement complex changes.

Datacenter transformation and a correctly designed hybrid cloud strategy with extensive automation reduces your reliance on these specialists, allowing infrastructure tasks to be handled by IT generalists and breaking down barriers that exist in your IT operations. You may find that you no longer have a need—and indeed that it's counter-productive—to continue to be organized into separate server, virtualization, storage, and networking teams. With less time and attention on infrastructure, your teams focus instead on the application stack, application development, and new service delivery.

The resulting infrastructure is also much more comprehensible and amenable to your Dev team. Software-defined infrastructure enables automation and allows both Ops and Dev teams to program the infrastructure directly. This is sometimes referred to as "infrastructure as code."

Organizational Changes for DevOps

With a rational hybrid cloud infrastructure in place, you'll be well positioned to begin bringing Dev and Ops closer together, as illustrated in Figure 7-1, accelerating the transition to DevOps (as described in the previous chapter). However, you should anticipate a number of organizational hurdles as you move forward.
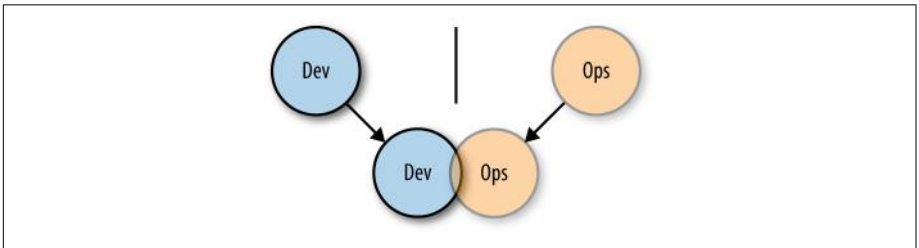

Figure 7-1. DevOps breaks down the organizational barriers between Dev and Ops so the two can coordinate efforts.

First, buy-in at the executive level is essential. As with any transition, DevOps will require some added expenditures and productivity may decline initially until you've worked the kinks out.

Second, you'll need to identify an organizational structure that works for your business needs. That structure may extend beyond IT boundaries:

> The key has been adhering to the "end-to-end principle" and working in multidisciplinary teams, or squads, that comprise a mix of marketing specialists, product and commercial specialists, user-experience designers, data analysts, and IT engineers—all focused on solving the client's needs and united by a common definition of success.

—Bart Schlatmann, Chief Operating Officer, ING

There's no single organizational structure for DevOps success. The website DevOps Topologies investigates potential organizational structures, including nine organization types and seven "anti-types" to avoid.

Finally, no matter what organizational structure you settle on, you'll have to make investments in training to help people entrenched in either Dev or Ops operate cross-functionally and adjust to their new responsibilities. As with most endeavors, DevOps success hinges on the success or failure of the people involved. Prolonged success cannot rely on continuous heroic efforts, no matter how dedicated the team.

Summary

The transition to a hybrid cloud model will in all likelihood require some significant adjustments to your IT organization.

Key takeaways

- Freeing up IT resources due to automation combined with reduced reliance on IT specialists, introduces opportunities to flatten your organizational structure or reorganize around new business priorities.
- The organizational changes to enable successful DevOps may require the formation of cross-functional teams with members from across the company.

About the Author

With over 25 years in the IT industry, **Philip Trautman**'s career has focused on understanding and writing about enterprise IT infrastructure and cloud. He was senior manager of technical support for Auspex Systems before becoming an industry consultant and writer in 1997. Areas of expertise include storage, data protection and disaster recovery, computer architecture including converged and hyperconverged infrastructure, server and desktop virtualization, and cloud. Philip has done extensive work for current and past industry leaders including Data Domain, LSI, Legato Systems, Microsoft, NetApp, Nutanix, SGI, and SUN Microsystems. He has authored hundreds of white papers, eBooks, success stories, and other collateral for these and other clients.