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Hybrid Cloud

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Remove risk with steady pricing and services

Leverage one architecture across platforms

Migrate workloads as needs change

Ed Tittel

Oracle Special Edition

About Oracle

Oracle, a global provider of enterprise cloud computing, is empowering businesses of all sizes on their journey of digital transformation. Oracle Cloud provides leading-edge capabilities in software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS).

Hybrid Cloud

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Introduction

In today's world, the right kind of IT infrastructure is an essential ingredient for business success. A clumsy or inefficient IT infrastructure can prevent organizations from meeting business or mission objectives. The cloud truly changes everything, so it's vital to set up and use powerful, capable cloud connections to foster both success and innovation.

A hybrid cloud is an environment that combines public and private cloud components with on-premises data center elements to support a powerful and vigorous IT infrastructure. In fact, hybrid cloud likely represents the dominant computing model for the foreseeable future.

Oracle is uniquely positioned to help companies put cloud technology to work and to achieve the best available combination of price, performance, security, and agility. Oracle's cloud can run any workloads, including VMware, HPC, cloud-native Kubernetes containers, databases, and more. Oracle is recognized for its full-on ability to deliver cloud services in the public cloud, on customer premises (via Dedicated Region Cloud@Customer), or even at the network edge (via Roving Edge). Nobody else offers the breadth and depth of these offerings, which combine the power and innovation of the public cloud, with data sovereignty, enhanced security, and minimum latency.

Foolish Assumptions

I assume, dear reader, that you already possess strong foundational understanding of general principles and practices of cloud computing. In fact, odds are nearly certain that you're already using Amazon Web Services (AWS), Azure, or other public cloud platforms. For this reason, I don't cover basic cloud concepts or terminology except where they really matter. Instead, I show you how Oracle's hybrid cloud computing solutions provide a compelling alternative to other public cloud platforms.

Icons Used in This Book

Sometimes, you'll see icons appearing in the left margin. They call out important or notable topics and terms. Icons used include

REMEMBER

The Remember icon points out information worth committing to memory.

TIP

The Tip icon flags useful or helpful suggestions, advice, and observations.

Where to Go from Here

This book digs into the capabilities, advantages, and benefits of working with and using Oracle Cloud tools and technologies. To learn more about how Oracle can help your organization modernize, streamline, and improve its use of hybrid cloud technologies and achieve a winning combination of price, performance, security, and agility, visit `www.oracle.com/cloud/hybrid-cloud`. You may also find the National Institute of Standards and Technology's Definition of Cloud Computing useful and informative: `https://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf`.

IN THIS CHAPTER

- Understanding hybrid cloud
- Exploring hybrid cloud benefits

Chapter 1
Hybrid Cloud: Challenges and Opportunities

At its simplest a hybrid cloud combines two or more distinct and different cloud infrastructures. To be truly competitive, organizations will, for the foreseeable future, need to be able to pick amongst these infrastructures based on workload needs and timing. A workload may need to change locations dynamically with changing business needs, as we describe in this chapter. Such individual infrastructures may be described

as private or public clouds. The combination part is where things get interesting. A successful and usable combination depends on implementing technology to make data and applications portable between clouds. This enables them to interoperate and supports migration of workloads from one cloud to another. It also enables cloud bursting so that added capacity and capability can come from another cloud when one already in use has insufficient resources to handle the load.

The definition of what makes a cloud is also changing. Public clouds have been limited in the ways that providers built them in the past. Their approach has focused on immense hyperscale cloud regions. These cloud regions typically involve enormous data centers with oodles of equipment racks housing tens to hundreds of thousands of servers, along with all the power, networking, and connectivity they need. Such megacenters are incredibly expensive and available only at a limited number of locations. When smaller-scale locations are available, providers must often tether their megacenters for them to work. Thus, for example, AWS Outposts require a working connection to an Amazon Web Services (AWS) cloud region to function properly.

Unfortunately, this leaves organizations that may need data sovereignty, high performance and low latency, or high degrees of control over data, metadata, and applications unserved or underserved. There has to be a better way for hybrid cloud solutions to meet such needs and

offer the kind of location flexibility and local control that so many organizations want and need.

Truly Doing Hybrid Cloud

Before explaining how Oracle technology helps multiple clouds in multiple locations work together easily and well, I must explain the situation on the ground that companies and organizations face. According to analyst firm Gartner, that situation looks like this:

- Eighty-five percent of enterprises use cloud services for business-critical functions.
- A profound shift to digitalization is underway. It involves both transformation and enablement. Transformation occurs when new IT capabilities lead to new business capabilities. Enablement occurs when enterprises embrace cloud-first models that replace on-premises legacy applications and services with cloud-based (and usually more powerful) alternatives.
- Prevailing business conditions drive new priorities that include preserving cash and cutting expenses, supporting work-from-home practices, and ensuring business continuity and viability.

Right now, businesses are shifting from a tactical to a strategic approach to IT investment (up from 52 percent in 2020 to 71 percent in 2021, according to the same source). In fact, digitalization drives new considerations when it comes to deploying and using cloud technologies. Organizations want to meet current priorities, but they also want to take best advantage of new and emerging technologies.

In particular, organizations seek to manage and control costs involved in obtaining and using technology, particularly in the cloud. Its pay-as-you go, consumption-based pricing and billing models remain attractive and compelling. But organizations have learned that surprises — sometimes unpleasant ones — can pop up as payments come due. Organizations seek predictable, rational pricing and billing models, and also, to avoid surprises founded on unexpected peaks in demand, failures to exploit potential discounts and reservations, and so forth.

Modern business innovation works best when powered by the cloud's combination of rapid technical capability growth, its many hybrid deployment options, and its subscription-based elastic cost model. In concert, these are key characteristics that drive new possibilities and capabilities. In fact, organizations that exploit digital transformation early and well also get first-mover advantages.

Benefits of Hybrid Cloud

To explain what makes hybrid cloud attractive to organizations, consider the following attributes:

- **Location flexibility:** Organizations that choose hybrid cloud can access public and private options and — if the right platforms are involved — on their own premises or at network edge locations. In particular, on-premises deployments provide opportunities to keep data local and highly secure. In turn, such deployments help organizations meet data sovereignty requirements, maintain security for proprietary, confidential, or classified data and applications, and simplify the chain of evidence and responsibility in meeting compliance regimes.
- **More choices for deployment and use:** Opening the door to on-premises and at-the-edge access to hybrid cloud lets organizations match deployments to specific use cases around data sovereignty, control, and security. This breaks the obligation of cloud-native or cloud-first strategies to force-fit access to public cloud sites.
- **More nuanced, flexible approach to IT infrastructures:** Given an opportunity to deploy a "best fit" hybrid cloud across locations, organizations can build out infrastructures that meet their needs for processing, resources, location, and control on a

per-application or per-instance basis. This opens the door to easy workload migration for cloud bursting or scale-out maneuvers, while maintaining tight control over data and metadata location, application programming interface (API) access and usage, and backup data. There's no need for a one-size-fits-all approach any longer.

- **Speedier innovation and more business opportunities:** The right hybrid cloud offers DevOps-friendly application development tools, APIs, and support. This permits rapid uptake of emerging technologies and lets organizations race the clock to obtain first- or early-to-market advantage. In particular, customers should look for cloud providers to deliver the right APIs, the right development tools and frameworks, and custom support services.

Indeed, such a flexible, nuanced hybrid cloud approach represents the smartest, most effective strategy for business transformation available today. The Oracle Cloud Infrastructure (OCI) stands ready to deliver powerful cloud services — including compute, storage, networking, platforms, and infrastructures — for Oracle applications, services, and database engines.

What OCI customers get

Oracle clients that move to OCI accrue the advantages this environment delivers. Those advantages (explained

in Chapters 2 through 4 in this book) include the following:

- Improved return on investment (ROI) on their OCI investment
- Improved performance and scalability inside the OCI environment
- Reduced costs for cloud services and resource consumption
- Improved security, thanks to a second-generation infrastructure as a service (IaaS) approach built around security first
- Enhanced, more capable disaster recovery that takes advantage of broad and distributed geographical public cloud locations
- Deploy native OCI cloud infrastructures in their own data centers or at the network edge

In fact, a true hybrid cloud means organizations run the identical IT services on both sides of their corporate firewalls. Oracle's on-premises data center and at-edge OCI solutions support all services found in the Oracle public cloud — it is a true "copy-paste" of OCI into your IT world. They also provide the same support for and access to Oracle's IaaS, platform as a service (PaaS), and

software as a service (SaaS) capabilities, including Autonomous Linux, Autonomous Database, enterprise resource planning (ERP), and human capital management (HCM) services, and more.

Migration, vastly simplified

OCI customers can balance everyday workloads between sites as needed. They can move workloads from their data centers into the public cloud or from the public cloud into data centers as needs and circumstances decree. Among other use cases, simple, fast migration means that companies can add public cloud resources quickly and easily to accommodate seasonal, cyclic, or unexpected demand spikes (a practice called *cloudbursting*).

Ultimately, cloudbursting provides true pay-as-you-go price elasticity. Organizations can access, use, and pay for cloud resources when they need them, but pay no more when they turn them off.

Other good hybrid cloud outcomes

Many scenarios explain why a true hybrid cloud works to an organization's benefit and to the benefit of application or service users. These benefits derive from seamless workload migration operating behind the scenes.

For example, a true hybrid cloud lets users keep working even in the face of a serious outage in an on-premises data center. With OCI, you can have a complete DR site in the cloud. With the right kind of snapshotting and failover mechanisms, workloads can be transferred in seconds to an alternate location that remains accessible and available. Such users may not even notice an interruption or may be subject only to momentary delays while handoff occurs. These same capabilities also support disaster recovery, if an OCI-equipped data center or some public cloud region experiences an outage, natural or manmade.

In fact, a true hybrid cloud model gives organizations flexibility to comply with local legal or regulatory requirements. Many countries — including Canada, all European Union (EU) states, and Australia — impose data sovereignty laws. For the record, *data sovereignty* means that a government or business entity specifies the location or region where data must be physically stored and makes data subject to a nation's laws.

IN THIS CHAPTER

- Bringing self-contained cloud services into data centers
- Getting cloud-based VMware with full administrative control
- Adding cloud databases and services into data centers
- Extending Oracle Cloud Infrastructure into a rugged device

Chapter 2

Touring Oracle's Hybrid Cloud Portfolio

Important use cases for hybrid cloud and edge computing continue to transform and expand cloud deployments. In some cases, however, stringent requirements for data sovereignty, high security, low latency, and

in-the-field deployments nix adoption of public cloud for certain uses, some mission-critical. Oracle Cloud's hybrid and edge offerings meet those requirements:

- **Specialized deployment:** Meet specific service level agreement (SLA), security, compliance, or data sovereignty requirements without great complexity or expense.
- **Disconnected or intermittently connected operation:** Purely local compute, storage, and networking serve local Internet of Things (IoT) systems, without constant public cloud links.
- **Low latency and high performance:** You can acquire, analyze, and act on insights quickly and locally.
- **Data locality and security:** Edge computing offerings bring compute power and tight security controls to the edge, in easily deployable form. Smaller scale provides flexible locations that don't need to be tethered to the public cloud to operate.

Above all, Oracle Hybrid Cloud offers customers flexibility in the services they choose, where they're located, and how they control data and applications. Customers can put advanced cloud services where they make sense, including in the public cloud, on-premises, or in remote locations.

The Oracle Cloud portfolio includes four primary offerings:

- Oracle Dedicated Region Cloud@Customer
- Oracle Cloud VMware Solution
- Oracle Exadata Cloud@Customer
- Oracle Roving Edge Infrastructure

In the preceding list the term *Cloud@Customer* means that Oracle handles management, configuration, updates, and more for a cloud region with a full set of cloud services inside customers' data centers in self-contained fashion, opening up a great many interesting possibilities.

Oracle Dedicated Region Cloud@Customer

Oracle Cloud Infrastructure (OCI) offers technical and business options to empower customers and bring a full set of cloud services into their data centers. Customers enjoy the same architecture, billing models, operations, security, and services they find in public regions of OCI. This even includes Oracle's enterprise cloud applications.

No other cloud provider brings a full set of cloud services into customer data centers. As shown in Figure 2-1, this means more than 65 OCI services, with OCI support and SLAs, and a pay-as-you-consume model. Oracle installs and operates Oracle Dedicated Region Cloud@Customer onsite.

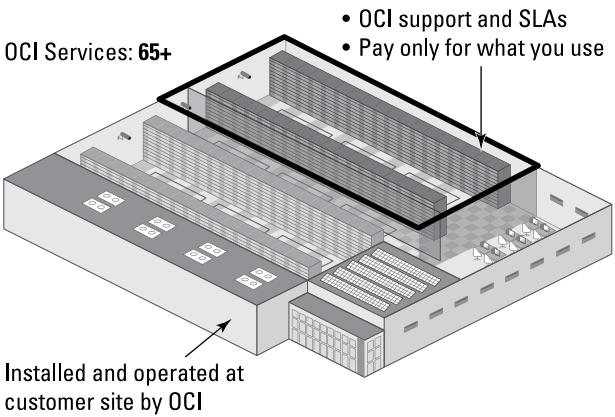

FIGURE 2-1: Thanks to Oracle Dedicated Region Cloud@Customer, OCI operates unchanged in customer data centers.

By contrast, Amazon Web Services (AWS) Outposts and Azure Stack Hub offer only a small subset of services (about 20 for AWS and Azure). Each is a small fraction of what's available in their public clouds. Today, users consume the same services available in its public cloud regions within Oracle Dedicated Region@Customer to leverage its high scalability, performance, and economic benefits.

Operations in Oracle Dedicated Region@Customer are the same as in OCI, and Oracle takes responsibility for managing end-to-end hardware, infrastructure as a service (IaaS), and platform as a service (PaaS) services (including break-fix, patching, upgrades, and more). For AWS Outposts, within the limits of the services available, they're the same as AWS public cloud, and AWS likewise handles end-to-end hardware, IaaS, and PaaS services. Azure Stack Hub differs from Azure Public Cloud: The customer's operators manage IaaS and PaaS services, and hardware vendors are responsible for the underlying hardware. Only Oracle offers a 99.95 percent availability SLA for Dedicated Region@Customer; neither AWS Outposts nor Azure Stack Hub does. Ditto for performance and manageability SLAs.


TIP

For more info and details, visit `https://www.oracle.com/cloud/hybrid-cloud/#dedicated-region`.

Oracle Cloud VMware Solution

Because VMware is deployed in so many enterprise data centers — more than 70 million workloads running on vSphere — customers find deployment of VMware services in the cloud attractive. Indeed, it offers benefits not found in traditional data center environments. These include just-in-time provisioning, elastic capacity (scale-up and scale-down), and pay-as-you-go models.

That said, traditional cloud services also force customers to give up full control over administration, access, and upgrades. Figure 2-2 depicts how things work in the OCI context.

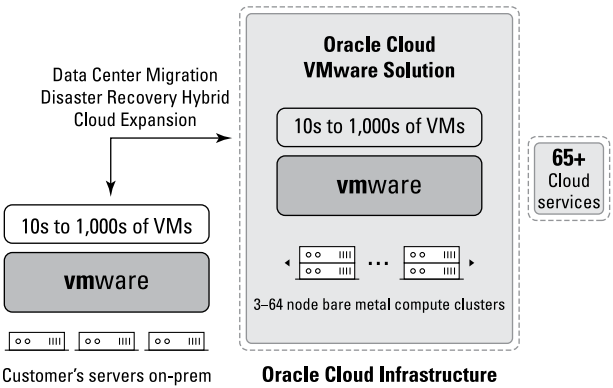

FIGURE 2-2: The Oracle Cloud VMware solution provides a native VMware-based cloud environment.

Oracle Cloud VMware Solution (OCVS) not only delivers a native VMware-based cloud environment, it gives customers complete control through the normal VMware tool set. Customers can migrate VMware workloads to the cloud without modification. They can use the cloud to gain scale and agility while using usual tools, processes, and policies. OCVS lets customers move or extend on-premises VMware workloads to OCI across all regions, including on-premises Dedicated Regions. No rearchitecting or retooling is needed.

Thus, OCVS offers a full transfer of skills, tools, and processes from on-premises VMware into its embrace. Competitors use different processes and deliver a different user experience in their cloud VMware environments. Likewise, in OCVS, organizations control upgrade policies (version, time, defer). Competitors determine what VMware version to use, and organizations must negotiate an upgrade time slot with them.

TIP

For more info and details, go to `https://www.oracle.com/cloud/hybrid-cloud/#vmware`.

Oracle Exadata Cloud@Customer

Oracle Exadata Cloud@Customer brings database access and services from the Exadata Cloud Service to the customer's data center. This lets organizations address data sovereignty and security requirements on-premises. At the same time, operational management occurs within an OCI-managed cloud service.

After they're provisioned, databases remain fully operational even if disconnected from the cloud. The optional Oracle Autonomous Database capabilities obviate four-fifths of manual database efforts. Customers can also scale up or down as their current workloads dictate. Table 2-1 offers a comparison against Amazon Relational Database Service (RDS) on Outposts and multiple original

TABLE 2-1 **Comparing DBMS Services from Oracle, AWS, and Azure**

	Oracle Exadata Cloud@Customer	Amazon RDS on Outposts	Azure Stack Hub
Minimum SQL read latency	19 µs	≥ 1,000 µs	OEM variable
Maximum SQL read input/output operations per second (IOPS)	12 million	960,000	OEM variable
Maximum SQL throughput	300GB/s	28.5GB/s	OEM variable
Maximum database size	476TB	64TB	4.75TB
Time in production	3.5 years	< 1 year	3.5 years

	Oracle Exadata Cloud@Customer	Amazon RDS on Outposts	Azure Stack Hub
Purpose-built for database workloads	Database-aware Flash Cache and persistent memory, offload SQL to storage; Hybrid Columnar Compression	Non-optimized infrastructure for database workloads	Non-optimized infrastructure for database workloads
Enterprise database capabilities	Oracle RAC, Oracle Active Data Guard, and advanced database security; Oracle Multitenant, multiworkload, multidata types in one engine	No AWS native DBs (Aurora, Redshift, and so on); RDS only for open-source MySQL, PostgreSQL	No DBaaS on Azure Stack Hub

equipment manufacturer (OEM) databases running on Azure Stack Hub.

Oracle Roving Edge Infrastructure

Edge computing applications usually reside at or outside the boundary of a cloud region or network. For such remote deployments, self-contained, independent operation is required, with isolated or intermittent connectivity. Edge installations must incorporate sufficient compute and storage capacity to handle demanding workloads quickly and efficiently.

The Oracle Roving Edge Infrastructure extends OCI capabilities into a self-contained, ruggedized device. It can host applications with low-latency, time-sensitive, and high throughput requirements even in the absence of network connectivity.

REMEMBER

RED devices may even be deployed in clusters, when more resilient, longer-lived compute resources or mobile data centers are needed.

IN THIS CHAPTER

- Ensuring disaster recovery
- Migrating workloads
- Managing the development life cycle
- Lifting and shifting, into the cloud
- Learning enduring lessons about location, choice, and control

Chapter 3

Top Hybrid Cloud Use Cases

Deploying the right hybrid cloud solution is, in large part, about overcoming constraints. It's also about finding the right tools and technologies to bring to bear at the right time, in the right place, and in the right way to meet specific application, data sovereignty, security, or performance needs. These benefits are real and tangible, not hypothetical. In this chapter,

I examine use cases where aspects of the Oracle Hybrid Cloud Infrastructure proved to be "just right" for certain customers specific situations and requirements.

Hybrid Cloud for Disaster Recovery

Disaster recovery is a well-known discipline within information technology. It's best understood as a set of processes and practices for resuming normal IT operations after a disaster. Thus, disaster recovery depends on regaining access to data, hardware, software, networking, and power to succeed.

Simply put, disaster recovery (DR) involves monitoring system and service availability and taking appropriate action to bring them back to life when they go down. The global convenience store chain 7-Eleven is the focus for this use case. The company consolidated production and disaster recovery for Oracle E-Business Suite and obtained a 30x performance increase in the cloud.

7-Eleven's business situation

For North America, the company's enterprise infrastructure group manages infrastructure for that region's core support applications. In turn, this depends on an extensive Oracle portfolio, including Oracle Exadata to support

an Oracle E-Business Suite ecosystem. Its components include

- Oracle Business Intelligence Enterprise Edition
- Oracle Product Lifecycle Management
- Oracle Retail Merchandise Operations Management
- Oracle Data Integrator
- Oracle Data Relationship Management
- Oracle Traffic Director
- Oracle SOA Suite
- Oracle API Gateway
- Oracle Service Bus

Initially, 7-Eleven had no DR for its essential business applications. Had disaster struck, the company had no DR instances to which it could fail over. Also, it wanted to lower total cost of ownership (TCO) for its infrastructure, while retaining performance and high-availability characteristics. At the same time, 7-Eleven wanted to modernize IT and tackle digital transformation. Moving to the cloud provided the foundation and framework for this initiative.

Why choose Oracle?

7-Eleven evaluated multiple cloud vendors. In the end, it kept Oracle Exadata. Why? Because Oracle offered more scalability and resilience than anybody else. According to Sanjay Date, Senior Program Manager in 7-Eleven's enterprise infrastructure group: "Oracle Cloud Infrastructure was undeniably the clear choice. There is no better solution for databases than Exadata, and Oracle is the only cloud that offers it."

Indeed, 7-Eleven's existing integration of Oracle applications also meant that migration without retooling its on-premises code was a huge win. The company had already built more than 150 integrations with back ends and mainframe environments, along with thousands of applications for geographical data, pricing, and process calculations. Choosing Oracle made migration simple, fast, and straightforward.

A happy ending

7-Eleven teamed up with Oracle Consulting Services to design and implement DR capabilities for its business-critical applications. That team built an environment to mirror on-premises capabilities and leveraged Exadata within the Oracle Cloud Infrastructure (OCI). It used the Oracle Maximum Availability Architecture for cloud deployment, along with Oracle Active Data Guard and Oracle Real Application Clusters (only available in Oracle Cloud).

In less than 16 weeks, 7-Eleven built a DR environment, culminating in a successful failover test of applications and database to OCI. Better yet, the team realized performance benefits immediately upon failover. During testing, team members logged into Oracle E-Business Suite to change an address that altered a Data Relationship record. This used to take around ten minutes on-premises. Inside OCI, that change took 20 seconds — a 30-fold speed boost!

Thanks to a stellar experience running applications inside OCI during testing, 7-Eleven sped up its production move into the cloud. It now runs core production E-Business Suite and Data Relationship Management applications in OCI. It also has projects underway for second-tier applications and dev/test environments. During this move, 7-Eleven also decommissioned 60 on-premises services.

Hybrid Cloud for Workload Migration

In a processing environment, a workload consists of a program or applications, along with all the resources it needs to run (including CPU, memory, storage, networking, middleware, and so forth). Migrating workloads means moving that entire collection from one runtime to another. A workload might migrate from an on-premises

data center into a public or private cloud, or from one cloud to another. Ideally, such migrations take little or no effort. In practice, time and effort involved depend on source and target environments and how tightly they're integrated.

Altair's business situation

Altair Engineering, Inc., is a technology company that provides solutions for data analytics, product development, and high-performance computing (HPC). A pioneer in simulation-driven design, Altair provides powerful engineering design tools that let its 11,000 customers fine-tune manufacturing, automotive, aerospace, high-tech, life science, and financial services designs quickly. This speeds time-to-market, and Altair's simulations confer savings when testing prototypes (otherwise, these incur substantial costs).

According to Sam Mahalingam, Altair CTO, "Our customers are driven to solve the world's toughest and most complex problems, and they use our software to do just that; making their products faster, better and smarter than ever before."

Why choose Oracle?

In 2020, Altair entered into a multiyear agreement with Oracle, wherein its internal workloads and commercial software as a service (SaaS) applications run on OCI. This

includes Altair's big portfolio of high-performance engineering simulation and analytics products.

Good results are getting better

By moving engineering simulation workloads from another cloud platform to OCI HPC services, Altair realized cost savings of 20 percent. In fact, they report latency-sensitive applications are especially suited for Oracle Cloud, including Altair Radioss (`https://altairhyperworks.com/product/RADIOSS`), Altair AcuSolve (`https://altairhyperworks.com/product/acusolve`), and Altair OptiStruct (`www.altair.com/optistruct`).

Generally, OCI's focus on price-performance dovetails perfectly with Altair's focus on helping customers innovate and bring products to market quickly and at lower cost. Oracle is uniquely positioned to support Altair with its industry-first bare-metal compute infrastructure with remote direct memory access (RDMA) cluster networking. This environment provides low latencies (2 μsec or less) and 100 Gbps bandwidth for large-scale HPC cloud migrations. This explains why Altair also uses Oracle bare-metal GPU technology for its ultraFluidX and nanoFluidX computational fluid dynamics (CFD) offerings. Altair is thrilled that Oracle supports a full array of HPC workloads, including CFD, crash testing, computer-aided design (CAD), electronic design automation (EDA), visual effects (VFX) rendering, reservoir simulations, and artificial intelligence (AI) training and inference capabilities.

Hybrid Cloud for Development Life Cycle

With widespread adoption of DevOps approaches, the software development life cycle (SDLC) has become the focus of intense and capable tools, methods, and dedicated organizational units. Basically, DevOps integrates people responsible for development, testing, deployment, delivery, and maintenance of software within an organization. It's generally built around the practices of continuous integration and continuous development and deployment (CI/CD).

The Pompei puzzle, solved

The Archaeological Park of Pompei resides near Naples in southern Italy. It exposes ruins of a Roman port town destroyed in AD 79 when Mount Vesuvius erupted. The Italian Ministry of Cultural Heritage runs the park. Its mission: to preserve and promote public use of this UNESCO World Heritage Site. In a typical year, the park hosts around three million visitors, who come to see hundreds of buildings "frozen in time."

With the onset of the COVID-19 pandemic, the park needed an application that could track visitors' movements within its 44 square kilometers to ensure social distancing.

Surprising successes

The park built a mobile application using OCI and the Oracle Autonomous Database. Together, they offer comprehensive cloud-native and DevOps capabilities. The park also teamed up with Oracle Consulting to build the app. Indeed, that team delivered a cloud-native mobile app in six weeks.

The MyPompei app launched in the Google Play and the Apple Stores in July 2020. As of February 2021, it had been downloaded more than 20,000 times. Tourists easily access the app by scanning a QR code on park tickets.

After they log in, visitors see a real-time heat map that shows other people present on any route (enabled by Oracle Spatial Analytics [`www.oracle.com/database/technologies/spatial-studio.html`]). Park officials use the app (which uses OCI's Blockchain, Oracle Cloud Functions, API Gateway, Oracle Container Engine for Kubernetes, Container Registry, Notification, Oracle Spatial Analytics, and Autonomous Transaction Processing) to track visitor movements in real time and redirect them to minimize congestion. Beyond helping park staff meet public health constraints, MyPompei helps visitors access points of interest, obtain additional facts and info, and find first-aid stations, restrooms, and more.

Succinctly put, the MyPompei app has allowed the park to continue functioning and meet its mission, even in the face of a pandemic.

Hybrid Cloud for Lift and Shift

"Lift and shift" means moving applications and data to the cloud by copying code from on-premises servers into the cloud with no changes. Mazda Motor Corporation used this strategy to migrate an on-premises inventory management system to OCI. That cut its five-year TCO by 50 percent.

Mazda's business situation

Mazda delivers 1.5 million automobiles yearly across 130 countries. Long after the sale, Mazda must provide customers with parts and accessories for their vehicles. Thus, Mazda manages 240,000 items, including parts for vehicles built decades ago. Hence, the company handles a massive parts inventory.

The company's global inventory management system for repair parts employs a large, complex datastore. It uses demand forecasting based on huge volumes of monthly order records. In a nutshell, Mazda needed to shorten and simplify its processing to boost forecast accuracy.

Originally, Mazda processed such transactions using on-premises servers and storage, along with other business functions.

Happy car owners coming up

Moving inventory management to a cloud-based platform meant demand forecasting wouldn't affect other critical systems and workloads. Mazda adopted OCI to leverage performance improvements and reduced ownership costs. The company already used a Linux version of the Oracle E-Business Suite, so Oracle Cloud made a perfect solution.

Beyond cost savings and performance gains, Mazda found it could scale transaction capacity up and down with rising or falling business demand. Thus, it could run inventory forecasts daily instead of monthly. Based on a three-month proof-of-concept trial, Mazda learned that running applications on OCI offers a 50 percent reduction in TCO over five years compared to its then-current data center. In addition, OCI provides a 70 percent performance gain.

Today, Mazda runs demand forecasts any time it likes, without worrying about impacts on other workloads. Now that this application runs on OCI, Mazda runs daily models. By incorporating the latest orders, it enjoys more accurate demand forecasts and inventory management.

In fact, the company uses a hybrid computing model. Some of its E-Business Suite applications run in OCI, and some run on-premises, interconnected using Oracle Golden Gate. No changes were required to run applications on OCI, for a genuine and efficient lift-and-shift operation.

Hybrid Cloud Lessons Learned

In general, organizations find using OCI offers improved performance, easy workload migration, reduced costs of ownership, and incredible flexibility.

As you find your own unique answers, be sure to consider the improved efficiency and performance that many OCI users have experienced (including Mazda, 7-Eleven, and Altair). Ponder the richer user experiences that Oracle's mobile-friendly cloud-native apps deliver (as at the Archaeological Park of Pompei). Appreciate the risk reduction and improved peace of mind that cloud-based DR brings with it (as at 7-Eleven). Think about how Oracle's Consulting Services — available as part of its industry-leading Cloud Lift program — help make things happen.

TIP

To learn more about Cloud Lift from Oracle, visit `www.oracle.com/cloud/cloud-lift`.

IN THIS CHAPTER

- Making the most of savings and unique features
- Running identical architectures
- Employing identical cloud services and operations
- Maximizing consistency and geography
- Using unique database optimizations

Chapter 4

Putting OCI's Advantages to Work

In the hybrid cloud world, where workloads can migrate from on-premises to the cloud and from one cloud to another, maintaining consistency

across environments means a lot. To be more specific, it means:

- Little or no work involved when moving workloads to replace code that runs in one environment and just as easily in another environment
- Assured interoperability, so that components can work together, even if some run on-premises and others run in one or more compatible clouds
- The ability to choose where to position workloads purely on criteria of greatest importance, including latency, performance, cost, reliability, availability, and so forth

This chapter explains how organizations can use the unique capabilities and features of the Oracle Cloud Infrastructure (OCI) to achieve digital modernization and transformation.

Key Oracle Differentiators

OCI offers unique capabilities that other cloud platforms can't match. When considering cloud infrastructures, weigh them carefully. They save time and money, reduce risk profiles, and enable options otherwise difficult or impossible to realize.

The Oracle Cloud Infrastructure offers three killer differentiators:

- **Price performance:** OCI delivers high performance, minimal cost, and easy cloud migration for existing on-premises applications. Compared to Amazon Web Services (AWS), OCI costs 75 percent less for outbound bandwidth, offers three or better times compute price performance, offers 44 percent lower HPC costs, and more. Use the savings calculator at `www.oracle.com/webfolder/workload–estimator/index.html`. These same effects apply to more cloud platforms, including Azure, Google Cloud Platform (GCP), and others.
- **Security:** OCI is a second-generation infrastructure as a service (IaaS) offering built to security-first design principles. It uses isolated network virtualization and pristine physical host deployment for superior customer isolation compared to other public cloud designs with reduced risk from advanced persistent threats.
- **Autonomous database and Linux:** Oracle Autonomous Linux, which is based on Oracle Linux, is 100 percent application binary compatible with IBM's Red Hat Enterprise Linux. This means that applications certified to run on Red Hat Enterprise Linux can run on Oracle Autonomous Linux unmodified. Oracle Autonomous Database is a

cloud database that uses machine learning (ML) to automate database tuning, backups, updates, and routine management, without DBA guidance. Running a database on Linux makes it ideal for containerized use inside OCI, in data centers, at the network edge, or in Oracle's Roving Edge Devices (REDs). Workloads based on this combination migrate seamlessly across all OCI environments.

Identical Architectures

Organizations want the benefits of the cloud but need location flexibility. They also want workloads to exercise all cloud functionality, wherever they run — in data centers, in the cloud, or at the edge. OCI maintains identical architecture everywhere. And Oracle keeps OCI operating at peak capability — including updates, patches, fixes, and more — everywhere it runs.

REMEMBER

Oracle Dedicated Region Cloud@Customer brings OCI into customer data centers. Oracle Exadata Cloud@Customer delivers Exadata Cloud Service capabilities to the data center. Oracle Roving Edge Infrastructure delivers self-contained, server-based OCI capabilities in ruggedized devices to field locations. See Chapter 2 for more information on these offerings.

Everywhere OCI runs, it runs one architecture. Most hybrid clouds can't make (or prove) this claim. So, for example, Oracle Dedicated Region Cloud@Customer delivers the same version of Oracle Public Cloud as a fully managed service, end-to-end, into data centers. Same feature set, same operating model, same billing and pricing model, and same service level agreements (SLAs).

Identical Cloud Services

Any proper hybrid cloud provider must provide a complete portfolio of services and applications. In the public cloud, customers need and use modern IaaS, platform as a service (PaaS), and software as a service (SaaS) offerings. Oracle Cloud Infrastructure provides all such capabilities and extends them into data centers through various offerings. Feature-level identicality means on-premises workloads run the same, complete cloud functionality as the Oracle public cloud.

Oracle Dedicated Region Cloud@Customer offers a full set of public cloud services on all layers. That means the IaaS layer supports all virtual machine (VM) sizes, all storage types, and all workloads, both virtualized and not. The PaaS layer supports all platform-level services, including Oracle Autonomous Database, Oracle Autonomous Linux, Oracle Analytics, and more. The SaaS layer supports all Oracle Enterprise SaaS applications,

including enterprise resource planning (ERP) and human capital management (HCM).

To learn more about Oracle Dedicated Region Cloud@Customer, go to `www.oracle.com/cloud/hybrid-cloud/#dedicated-region`.

Identical Operations

Enterprises usually tune on-premises environments for predictability and reliability. They want those same options available when choosing a hybrid cloud. Ideally, they'd like operations and management identical to native on-premises environments, with minimal (or no) modification. OCI makes this a snap.

Building around OCI means IT can migrate workloads to and from the public cloud, without changing familiar software, management tools, or IT processes. No extra complexity is entailed.

For enterprises invested in VMware, Oracle Cloud VMware matches customer installs on Oracle's public cloud hardware. Also, this public cloud VMware presence is accessible to enterprise VMware staff, who may manage and control the cloud portion just like the on-premises portion.

REMEMBER

In the Oracle Cloud VMware Solution, operations are sufficiently VMware-centric to make sense to any VMware-savvy engineer. No additional training is needed to put Oracle Cloud to work.

Preserving and continuing the same best practices in the cloud that they use locally gives customers the same level of confidence they enjoy on-premises, working with VMware inside the OCI.

TIP

To learn more about the Oracle Cloud VMware Solution, go to `www.oracle.com/cloud/hybrid-cloud/#vmware`.

Pricing and Billing

Enterprise customer workloads may run either in the public cloud or a data center. They don't want hidden or variable costs in a hybrid cloud model. In particular, they should pay no more to run workloads on-premises than in the public cloud. Equally important, there should be no need to buy hardware apart from cloud services.

Ideally, a proper hybrid cloud provider offers consistent pricing and billing across all runtimes. Service pricing should be consistent across products and across all regions in the cloud (and on customer premises). This

lets customers plan budgets and run their businesses rationally.

It costs the same to run workloads in the Oracle public cloud or in Oracle Dedicated Region Cloud@Customer. In fact, prices stay consistent across deployment models and regions.

TIP

For more information about Oracle Dedicated Region Cloud@Customer pricing compared to AWS, go to `https://blogs.oracle.com/cloud-infrastructure/post/oracle-dedicated-region-cloudcustomers-performance-and-pricing-advantages-over-aws-outposts`.

Geographic Reach

Enterprise customers run numerous workloads around the globe. Today, data centers run databases and applications to underpin critical business activities. This includes local capabilities like those from Oracle Dedicated Region Cloud@Customer. Tomorrow, they may run cloud services at the network edge. Customers expect a proper hybrid cloud solution to meet them wherever they are, whenever they need it.

The Oracle hybrid cloud portfolio lets customers position workloads where it makes sense for them to run. It extends cloud services across data centers and into edge locations. Thus, Oracle Cloud VMware Solution can run in more locations than other VMware in-public-cloud solutions. Also, Oracle Roving Edge Infrastructure runs cloud workloads outside data centers on ruggedized devices in remote and even disconnected locations (close to the source of important data or activity). Given OCI's broad reach, customers gain more insights, more quickly, and can act quickly on what they learn.


TIP

To find out more about the Oracle Roving Edge Infrastructure, go to `www.oracle.com/cloud/hybrid-cloud/#roving-edge`.

Governance and Security

Organizations want the benefits of the cloud, but they also need assurance that confidential or sovereign information stays on-premises (and in-country). When enterprises stay on-premises, they often have compelling reasons:

- Country-specific laws or regulations require data collected stays within specific borders (for example, the European Union's General Data Protection Regulation [GDPR]).

- Customers in regulated industries like finance or healthcare face specific data compliance regimes (for example, the U.S. Health Insurance Portability and Accountability Act [HIPAA] or the Payment Card Industry Data Security Standard [PCI DSS]).
- Many corporations enforce policies for data retention, security, and confidentiality that requires highly secure, on-premises storage.

Customer workloads running in Oracle Dedicated Region Cloud@Customer OCI don't have to leave data centers. All data and applications can be securely backed up onsite. Oracle offers better protection, compliance, and security because Dedicated Region inherits the same complete set of security services from the Oracle public cloud and keeps everything on-premises.

Oracle's Unique Optimizations

Enterprises spend years optimizing on-premises Oracle databases for performance, high availability and reliability, and resource consumption. They should get the same from hybrid cloud databases.

Oracle Exadata Cloud@Customer offers the best hybrid implementation for Oracle databases. Customers obtain exclusive access to Oracle Autonomous Database and self-repairing autonomous services. Oracle ML and artificial intelligence (AI) automates routine database tasks, without requiring DBA coverage. Thus, Oracle delivers better performance, security, and operational efficiency.


TIP

To learn more about Oracle Exadata Cloud@Customer, go to `www.oracle.com/cloud/hybrid-cloud/#exadata`.

IN THIS CHAPTER

- Establishing organizational alignment
- Scoping out the candidate workloads
- Planning for the journey
- Partnering with Oracle

Chapter 5

Ten Steps for a Hybrid Cloud Journey

Moses had his Ten Commandments, Letterman his Top 10 lists. Nearly every area of human interest and endeavor sports a list of leading lights numbered ten. By tradition, each and every *For Dummies* book ends with a short summary chapter in this same vein.

With this spirit in mind, this final chapter provides a practical ten-step checklist to help you plan and execute your own hybrid cloud journey.

Executive Sponsorship

Undertaking a journey to a hybrid cloud is like other strategic business endeavors, in that it's facilitated when there's backing from executives. The sponsorship benefits work in both top-down and bottom-up situations. Top-down initiatives have priority and drive individual contributor activities. Individuals know that the work they are doing is sanctioned as essential to the business and aren't trying to push on a rope to complete required tasks. Journeys are easier when folks march in one direction, to the beat of the one drum. That's not to say there won't be friction or challenges, but they'll be easier to manage. Additionally, if the project teams need additional support, they know that upper management has their back.

As you make the decision to set out for the journey, make sure you understand the difficulties that may be experienced, both with and without executive support. Obtaining top-level support will ease the journey considerably.

Build a Workload Inventory

Prior to undertaking the journey, you need to know the who, what, where, why, and when. To accomplish this, you need to take stock of the workloads that may be candidates for the journey. At this step, it's important to simply inventory and organize the "who" in such a fashion as to build a roster of applications, your travelers. Taking this methodical step to formally build this list has the benefit of accurately scoping the migration effort and often will turn up workloads that were out of sight, out of mind. It's up to you how you want to implement it, but it doesn't have to be fancy to be functional. In many cases, a business spreadsheet will be sufficient.

TIP

Take time to gather as comprehensive list as practical. It will become a living, breathing artifact that will be used for the duration of your journey.

Rationalize the Inventory

Now that you have a good sense of who's possibly up for the journey, it's time to document the "what" for each potential traveler. Some suggested factors to capture include

- Criticality of the system to the business
- Service-level agreement (SLA) requirements

- System complexity due to architecture, integration points, volume, and scale
- The all-important "6 Rs of Cloud Migration" designation (see the nearby sidebar)

When making the decision to move each workload, this is a prime opportunity to consider whether to lift and shift, move and improve or transform the workload, or not to move it all. Consider capturing data about the factors that are important to consider in your environment, which you'll know best.

THE 6RS OF CLOUD MIGRATION

The 6 Rs are a set of application migration strategies broadly accepted among cloud services providers:

- Re-host (referred to as a *lift and shift*)
- Re-platform (referred to as *lift, tinker, and shift*)
- Re-factor/re-architect
- Re-purchase
- Retire
- Retain

The goal of this exercise is to build a framework for deciding how each application will undertake its specific journey. Mapping the most important criteria drives how that journey will proceed across a variety of dimensions such as complexity, timing, and migration method.

Bonus points if you want to build out a scoring model for ranking the list, based on the criteria gathered.

Capturing these details provides context that will be carried along to the next step, the "when" of the journey.

Develop a Journey Schedule

With your detailed inventory in hand, the next step is to determine

- Which travelers will be taking the journey
- Their expected travel duration
- Which path they'll be taking

As in an actual hike, some will take a simple, straightforward path, some will take a more complex path, and perhaps one or two may cut their own path. At the outset, it's a worthwhile effort to plan out what the potential routes will be — the trails, so to speak. There may be many ways to the mountaintop, but having well-defined ways to get there is easier.

The preceding section has hopefully given you a good sense for how to plan out the schedule.

TIP

Start with "low-hanging fruit" workloads that have minimal complexity, flexible timing, and an ability to tolerate downtime. This gives operational teams the ability to minimize risk, get some quick wins, and learn lessons that can be useful for the future.

Designate a Project Manager

The hybrid cloud journey is one that can be fraught with peril. You can easily get caught up in organizational and technical challenges that result in missed deadlines and end user frustration. In extreme cases, costs can escalate and cause financial impact to the business or damage to your reputation.

To minimize migration risk, assign a "tour guide," in the form of an experienced project manager (PM), to each migration in the overall journey. According to *CIO* magazine: "Project managers play the lead the in planning, executing, monitoring, controlling, and closing out projects. They are accountable for the entire project scope, the project team and resources, the project budget, and the success or failure of the project." In short, the PM will work to keep the migration on the straight and narrow, alleviate the inevitable challenges that occur. Most important, they ease the burden on the implementors.

Consult Oracle for Lift Services

Did you know that Oracle Corporation has a designated team whose mission it is to ensure smooth cloud journeys for its customers? It may sound too good to be true, but it's real!

The Oracle Cloud Lift Services program was developed to enable all customers — small or large — to enable and accelerate their hybrid cloud journey. In Oracle's experience, customers succeed faster when experts help them onboard or migrate their applications. Cloud Lift Services allow for a streamlined point of contact for all technical delivery and remove barriers for critical technical expertise.

Engaging Oracle Lift Services is easy! You simply request assistance from your local account team. This initiates an Oracle process that leads to a PM or subject matter expert (SME) assigned to assist across the entire project life cycle, from initial plan development, up to and including delivery of a completed migration.

Oracle Lift Services teams are seasoned in cloud migrations and can impart the tribal knowledge or lessons learned from past successful efforts. They'll partner with your PM, identified in the previous step, to synchronize the mobilization resources to ensure safe passage to the cloud.

Utilizing Oracle Lift Services can ease the migration burden and accelerate successful migration outcomes.

TIP

Oracle Lift Services coverage is limited to straightforward lift-and-shift workload migrations. For more complicated scenarios, Oracle Consulting Services has proven migration methodologies that help customers succeed every day. Consult your Oracle account team for further information on migration options.

Tools for the Journey

Oracle can assist your technology teams in minimizing downtime during the cloud migration process. Downtime can truly be reduced to zero.

Oracle has created the Zero Downtime Migration utility to automate migration of Oracle databases to the cloud. It supports both physical and logical migrations, for single instance and Real Application Clusters (RAC) databases, version 11g and higher. For more information and to download, consult the Oracle ZDM site at `www.oracle.com/database/technologies/rac/zdm.html`.

In addition to minimizing database migration downtime, applications with minimal downtime requirements can be accommodated, too! Oracle offers a multitude of options:

- **Native workload migration tooling:** Oracle is an open-standards-based cloud. So you can use familiar migration utilities, such as VMware HCX.
- **Rackware:** Oracle has formed a partnership with Rackware, which provides a Hybrid Cloud Platform (HCP) that enables enterprises to migrate workloads to the cloud, configure disaster recovery, and provide comprehensive oversight and management of all cloud resources.

Finally, if your strategy calls for communication between on-premises and the cloud, consider the use of Oracle Integration and Data Mesh Services to maintain synchronization between systems. These can be useful both during, and after migration.

Systems Testing

Success for any migration is measured by the delivery of services in the cloud that operate the same as they do on-premises. Optimally, the end-user community should have no idea that any change was made. Far too often,

however, post-migration issues occur that were easily preventable. An ounce of prevention (in the form of testing) is worth a pound of post-migration cure.

To be able to achieve this level of success, a suite of tests should be documented and executed that will thoroughly test application function, performance, and ability to failover and fail back from a disaster recovery site:

- **Functional test:** Checks each function of the software application by providing appropriate input and verifying the output against functional requirements. Ensures that the major components have been migrated properly.
- **User acceptance testing (UAT):** Similar to the functional test except it's conducted by the end user or a software testing suite. Be thorough and include real-world scenarios.
- **Stress and performance test:** Checks the upper limits of a system by testing it under extreme loads. Stress tests should be modeled on actual user activity levels to be effective.
- **Disaster recovery test:** Disaster recovery switches the location of cloud services from the primary site to an alternate recovery site, with minimal interruption to SLA. Success is measured by full service availability and performance.

In the functional test, basic system operation is validated. If any issues arise, they need to be resolved before the UAT. In the UAT, actual users will put the system through its paces for both function and performance. The failure to do a stress and performance test often results in the "Monday morning blues" experienced by end users when the system performance they expect and require goes down the tubes. Finally, a full disaster recovery test should be completed prior to migration to assure that the system meet the availability SLA dictated by the business.


TIP

Testing should be taken seriously. Test plans should be fully documented in written form and cover what constitutes success, including aspects of both function and performance.

Arriving at the Destination

Lots of diligent hard work, across multiple teams, has led you here. The moment has arrived and it's time to perform the cutover to the cloud!

The arrival is an organizational change event, and it needs to be handled as such. Quite possibly, it may be more visible and of greater import, than the average run-of-the-mill event. With this in mind, it's essential to work with your designated PM to finalize the cutover plan ensure a smooth transition.

Consider adding the following milestones to your migration plan:

- Communicate the migration date with business stakeholders.
- Submit formal change management documentation.
- Document roles and responsibilities at each migration step.
- Document the expected time duration at a granular level.
- Document the go/no-go decision criteria.
- Document escalation contacts at each step.
- Repeat the functional, UAT, and stress and performance tests prior to releasing the system for general use.

By taking care to plan, communicate, and execute the cutover event, odds for success are greatly increased, raising satisfaction levels across the board.

Lessons Learned

Phew, you made it! With your end-user community rejoicing over the migration and the executive announcement of an all-expense paid vacation for the job well

done (okay, you can dream), your attention should turn to a review of the migration cycle for lessons learned. This is an essential step, because it shows you what was done well and areas for possible improvement. This information can be incorporated into future migration plans to improve the quality, reliability, and predictability of a successful future outcome.


TIP

You can document lessons learned during the migration process itself — there is no reason to wait until it's over. This is especially true in the event that the finding or improvement idea is significant. The PM can assist with capturing these items along the way, in preparation for the deeper review.

Let's consider some sample focus areas and questions for review:

- Schedule
  - Was the migration finished early, on time, or late?
  - What can be done in the next migration(s) to deliver on time?
- Cost
  - Was the migration delivered within the budget allotted?

- Staffing
  - What issues impacted staffing the migration (for example, competing deliverables)?
  - Did resource staffing and level of effort align?
  - What resources needed to be called in unexpectedly?
- Outcome
  - Was the cloud migration an overall success?
  - Did the business customers provide feedback on the migration?
- Challenges
  - What were challenges that impacted the migration?
  - What can be done to remove barriers and ease future migrations?

ORACLE CUSTOMERS SHARE THEIR EXPERIENCES

"Oracle Cloud Infrastructure was undeniably the clear choice. There is no better solution for databases than Exadata, and Oracle is the only cloud that offers it."

—Sanjay Date, Senior Program Manager, Enterprise Infrastructure Group, 7-Eleven

"This project was a true partnership between Mazda and our counterparts at Oracle."

—Masahiko Tamura, General Manager, Supply Chain Systems Department, Mazda Motor Corporation

"Reopening the Pompeii site to tourists after lockdown was tough. With Oracle's help, we delivered the cloud native mobile solution in just six weeks."

—Alberto Bruni, COO, Archaeological Park of Pompeii

"With Oracle Dedicated Region, we can use Oracle Exadata as a cloud service to achieve greater agility and seamless expansion, while maintaining high availability at the same level as on-premises environments."

—Tomoshiro Takemoto, Senior Corporate Managing Director NRI

"We looked for the best price-performance, security, and VMware integrations. We found that in Oracle Cloud Infrastructure."

—Sam Mahalingam, Chief Technical Officer for Enterprise Solutions, Altair

Modernize your business with a proper hybrid cloud

Most companies use multiple clouds, public and private. Only Oracle Cloud Infrastructure (OCI) offers a consistent, reliable, and secure cloud architecture that extends from the public cloud into the data center and out to the network edge. Only OCI offers consistent pricing and billing, so that on-premises or at-edge workloads cost the same as public cloud workloads, irrespective of region and location. And only OCI delivers the same complete set of applications, services, and capabilities everywhere.

Inside...

- Extend public cloud capability to data centers
- Pay one price for any workload wherever it runs
- Achieve the best cloud price performance
- Meet security and compliance needs
- Access advanced HPC and database services
- Run VMware in the cloud the same as in the data center

ORACLE

Ed Tittel is an author, trainer and consultant with more than 100 technology books under his belt. He writes regularly about cloud computing, web development, Windows, and security topics. Look for his articles at *ComputerWorld* and *Tom's Hardware*. For more info, visit edtittel.com.

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