AWS Migration Whitepaper

March 2018

Notices

Contents

Abstract

Adopting Amazon Web Services presents many benefits, such as increased business agility, flexibility, and reduced costs. As an enterprise's cloud journey evolves from building and running cloud-native applications on AWS, to mapping out the migration of an entire enterprise IT estate, certain challenges surface. Migrating at scale to AWS calls for a level of business transformation in order to fully realize the numerous benefits of operating in a cloud environment, including changes to tools, processes, and skillsets.

The AWS approach is a culmination of our experiences in helping large companies migrate to the cloud. From these experiences, we have developed a set of methods and best practices to enable a successful move to AWS. Here we discuss the importance of driving organizational change and leadership, how to establish foundational readiness and plan for migrating at scale, and our iterative approach to migration execution.

Migrating to AWS requires an iterative approach, which begins with building and evolving your business case as you and your team learn and uncover more data over time, through activities like application portfolio discovery and portfolio analysis. There are the common migration strategies that will inform your business plan, and a recommended approach to organizing and evolving your cloud teams as confidence and capability increases. You will stand up a Cloud Center of Excellence (CCoE) to lead and drive change, evangelize your cloud migration initiative, establish cloud governance guardrails, and enable and prepare your organization to provide and consume new services. Our approach walks you through what it means to be ready to migrate at scale, and how to establish a solid foundation to save time and prevent roadblocks down the road. We will cover our approach to migration execution, continuing on with building momentum and acceleration through a method of learn-and-iterate.

Introduction

Migrating your existing applications and IT assets to the Amazon Web Services (AWS) Cloud presents an opportunity to transform the way your organization does business. It can help you lower costs, become more agile, develop new skills more quickly, and deliver reliable, globally available services to your customers. Our goal is to help you to implement your cloud strategy successfully.

AWS has identified key factors to successful IT transformation through our experience engaging and supporting enterprise customers. We have organized these into a set of best practices for successful cloud migration. Customer scenarios range from migrating small, single-applications, to migrating entire data centers with hundreds of applications. We provide an overview of the AWS migration methodology, which is built on iterative and continuous progress. We discuss the principles that drive our approach, and the essential activities that are necessary for successful enterprise migrations.

Migrating to AWS is an iterative process that evolves as your organization develops new skills, processes, tools, and capabilities. The initial migrations help build experience and momentum that accelerate your later migration efforts. Establishing the right foundation is key to a successful migration. Our migration process balances the business and technical efforts needed to complete a cloud migration. We identify key business drivers for migration and present best strategies for planning and executing a cloud migration.

Once you understand why you are moving to the cloud, it is time to address how to get there. There are many challenges to completing a successful cloud migration. We have collected common customer questions from hundreds of cloud migration journeys and listed them here to illustrate common concerns as you embark on your cloud migration journey. The order and prioritization will vary based on your unique circumstances, but we believe the exercise of thinking through and prioritizing your organization's concerns upfront is beneficial:

- How do I build the right business case?

- How do I accurately assess my environment?

- How do I learn what I don't know about my enterprise network topology and application portfolio?

- How do I create a migration plan?

- How do I identify and evaluate the right partners to help me?

- How do I estimate the cost of a large transition like this?

- How long will the migration process take to complete?

- What tools will I need to complete the migration?

- How do I handle my legacy applications?

- How do I accelerate the migration effort to realize the business and technology benefits?

These questions and many more will be answered throughout this paper. We have included support and documentation, such as the AWS Cloud Migration Portal.[1] The best practices described in this paper will help you build a foundation for a successful migration, including building a solid business plan, defining appropriate processes, and identifying best-in-class migration tools and resources to complete the migration. Having this foundation will help you avoid the typical migration pitfalls that can lead to cost overruns and migration delays.

The AWS Cloud Adoption Framework (AWS CAF)

AWS developed the AWS Cloud Adoption Framework (AWS CAF), which helps organizations understand how cloud adoption transforms the way they work. AWS CAF leverages our experiences assisting companies around the world with their Cloud Adoption Journey. Assessing migration readiness across key business and technical areas, referred to as Perspectives, helps determine the most effective approach to an enterprise cloud migration effort. First, let's outline what we mean by perspective. AWS CAF is organized into six areas of focus, which span your entire organization. We describe these areas of focus as Perspectives: Business, People, Governance, Platform, Security, and Operations. For further reading, see the AWS CAF Whitepaper.[2] AWS CAF provides a mental model to establish areas of focus in determining readiness to migrate and creating a set of migration execution workstreams. As these are key areas of

the business impacted by cloud adoption, it's important that we create a migration plan that considers and incorporates the necessary requirements across each area.

Figure 1: AWS Cloud Adoption Framework People and Technology Perspectives

The following table presents a description of each Perspective and the common roles involved.

Perspective	Description and Common Roles Involved
Business	Business support capabilities to optimize business value with cloud adoption. Common Roles: Business Managers; Finance Managers; Budget Owners; Strategy Stakeholders
People	People development, training, communications, and change management. Common Roles: Human Resources; Staffing; People Managers.
Governance	Managing and measuring resulting business outcomes. Common Roles: CIO; Program Managers; Project Managers; Enterprise Architects; Business Analysts; Portfolio Managers.
Platform	Develop, maintain, and optimize cloud platform solutions and services. Common Roles: CTO; IT Managers; Solution Architects.
Security	Designs and allows that the workloads deployed or developed in the cloud align to the organization's security control, resiliency, and compliance requirements. Common Roles: CISO; IT Security Managers; IT Security Analysts; Head of Audit and Compliance.
Operations	Allows system health and reliability through the move to the cloud, and delivers an agile cloud computing operation. Common Roles: IT Operations Managers; IT Support Managers.

Motivating Change

> *Cultural issues are at the root of many failed business transformations, yet most organizations do not assign explicit responsibility for culture.*
> – **Gartner, 2016**

Culture is critical to cloud migration. Cloud adoption can fail to reach maximum potential if companies do not consider the impact to culture, people, and processes, in addition to the technology. On-premises infrastructure has been historically managed by people, and even with advancements in server virtualization most companies have not been able to implement the levels of automation that the cloud can provide. The AWS Cloud provides customers instant access to infrastructure and applications services through a pay-as-you-go pricing model. You can automate the provisioning of AWS resources using AWS service APIs. As a result, roles and responsibilities within your organization will change as application teams take more control of their infrastructure and application services.

The impact of culture on cloud, and cloud on culture, does not need to be a daunting or arduous proposition. Be aware and intentional about the cultural changes you are looking to drive and manage the people-side of change. Measure and track the cultural change, just as you would the technology change. We recommend implementing an organizational change management (OCM) framework to help drive the desired changes throughout your organization.

Table 1: Organizational change management to accelerate your cloud transformation

	1. Mobilize Team 2. Align Leaders	3. Envision the Future 4. Engage the Organization	5. Enable Capacity 6. Make It Stick
Tag Lines	This change is critical and will succeed! We are all leaders of this change!	This is the vision, where we are going! This is how we get there together!	This is how we make it happen! Are we where we want to be?
Objectives	• Confirm sponsorship • Secure resources, expertise • Form strong coalition of leaders • Build momentum	• Articulate vision and roadmap for transition to Cloud • Mobilize organization, build commitment, create change urgency • Establish communication channels to gain and maintain buy-in, support and participation throughout entire transition	• Ensure successful transition to Cloud • Align IT org structure, roles, processes with AWS Cloud platform • Ensure all IT staff/key stakeholders can operate in new environment • Ensure Cloud benefits and objectives are achieved
Key Actions	• Form team to lead change – executive sponsors, stakeholders, line leaders, PMO, change management, communication, training, etc. • Establish program charter, roles, milestones • Build guiding coalition, mobilize leadership • Shape program governance structure • Assess and align change leadership roles	• Leaders communicate future Cloud vision (via comprehensive messaging plan) • Impacted business leaders reinforce new op model (process/tech/org) • Identify/assess impacted stakeholders • Enlist and mobilize Change Champion Network • Drive ongoing communication, feedback – two-way conversations • Address *"How does this impact me?"* • Celebrate progress and control issues	• Identify change impacts to IT roles, policy, org structure, process, etc. • Modify IT roles, org structure, job descriptions and processes (if needed) to support AWS Cloud • Align IT staff to new operating model • Develop and implement targeted training • Setup measurement structures • Measure and evaluate outcomes • Course correct where needed

The AWS OCM Framework guides you through mobilizing your people, aligning leadership, envisioning the future state of operating in the cloud, engaging your organization beyond the IT environment, enabling capacity, and making all of those changes stick for the long term. You can find additional information on this topic in the Resources section of this paper.

Business Drivers

The number one reason customers choose to move to the cloud is for the agility they gain. The AWS Cloud provides more than 90 services including everything from compute, storage, and databases, to continuous integration, data analytics, and artificial intelligence. You are able to move from idea to implementation in minutes rather than the months it can take to provision services on-premises.

In addition to agility, other common reasons customers migrate to the cloud include increased productivity, data center consolidation or rationalization, and preparing for an acquisition, divestiture, or reduction in infrastructure sprawl. Some companies want to completely re-imagine their business as part of a larger digital transformation program. And, of course, organizations are always looking for ways to reduce costs.

Common drivers that apply when migrating to the cloud are:

Operational Costs – Operational costs are the costs of running your infrastructure. They include the unit price of infrastructure, matching supply and demand, investment risk for new applications, markets, and ventures, employing an elastic cost base, and building transparency into the IT operating model.

Workforce Productivity – Workforce productivity is how efficiently you are able to get your services to market. You can quickly provision AWS services, which increases your productivity by letting you focus on the things that make your business different, rather than spending time on the things that don't, like managing data centers. With over 90 services at your disposal, you eliminate the need to build and maintain these independently. We see workforce productivity improvements of 30%-50% following a large migration.

Cost Avoidance – Cost avoidance is setting up an environment that does not create unnecessary costs. Eliminating the need for hardware refresh and maintenance programs is a key contributor to cost avoidance. Customers tell us they are not interested in the cost and effort required to execute a big refresh cycle or data center renewal and are accelerating their move to the cloud as a result.

Operational Resilience – Operational resilience is reducing your organization's risk profile and the cost of risk mitigation. With 16 Regions comprising 42 Availability Zones (AZs) as of June 2017, With AWS, you can deploy your applications in multiple regions around the world, which improves your uptime and reduces your risk-related costs. After migrating to AWS, our customers have seen improvements in application performance, better security, and reduction in high-severity incidents. For example, GE Oil & Gas saw a 98% reduction in P1/P0 incidents with improved application performance.

Business Agility – Business agility is the ability to react quickly to changing market conditions. Migrating to the AWS Cloud helps increase your overall operational agility. You can expand into new markets, take products to market quickly, and acquire assets that offer a competitive advantage. You also have the flexibility to speed up divestiture or acquisition of lines of business. Operational speed, standardization, and flexibility develop when you use DevOps models, automation, monitoring, and auto-recovery or high-availability capabilities.

Migration Strategies

This is where you start to develop a migration strategy. , you want to consider where your cloud journey fits into your organization's larger business strategy and find opportunities for alignment of vision. A well-aligned migration strategy, with a supporting business case and a well-thought out migration plan, sets the proper groundwork for cloud adoption success.

One critical aspect of developing your migration strategy is to collect application portfolio data and rationalize it into what we refer to as the 6 R's: Re-host, Re-platform, Re-factor/Re-architect, Re-purchase, Retire, and Retain. This is a method for categorizing what is in your environment, what the interdependencies are, technical complexity to migrate, and how you'll go about migrating each application or set of applications. Using the "6 R" Framework, outlined below, group your applications into Re-host, Re-platform, Re-factor/Re-architect, Re-purchase, Retire and Retain. Using this knowledge, you will outline a migration plan for each of the applications in your portfolio. This plan will be iterated on and mature as you progress through the migration, build confidence, learn new capabilities, and better understand your existing estate.

The complexity of migrating existing applications varies, depending on considerations such as architecture, existing licensing agreements, and business requirements. For example, migrating a virtualized, service-oriented architecture is at the low-complexity end of the spectrum. A monolithic mainframe is at the high-complexity end of the spectrum. Typically, you want to begin with an application on the low-complexity end of the spectrum to allow for a quick win to build team confidence and to provide a learning experience. This will help build momentum.

It is important to choose an application that has some business impact. You want to build momentum with each migration; which is difficult to accomplish if you select an application business owners fail to see value in.

"The 6 R's": 6 Application Migration Strategies

The 6 most common application migration strategies we see are:

1. **Re-host** (Referred to as a "lift and shift.")

Move applications without changes. In large-scale, legacy migrations, organizations are looking to move quickly to meet business objectives. The majority of these applications are re-hosted. GE Oil & Gas found that, even without implementing any cloud optimizations, it could save roughly 30% of its costs by re-hosting.

Most re-hosting can be automated with tools (e.g. AWS VM Import/Export). Some customers prefer to do this manually as they learn how to apply their legacy systems to the new cloud platform.

Applications are easier to optimize/re-architect once they're already running in the cloud. Partly because your organization will have developed the skills to do so, and partly because the hard part—migrating the application, data, and traffic—has already been done.

2. **Re-platform** (Referred to as "lift, tinker, and shift.")

Make a few cloud optimizations to achieve a tangible benefit. You will not change the core architecture of the application. For example, reduce the amount of time you spend managing database instances by migrating to a database-as-a-service platform like Amazon Relational Database Service (Amazon RDS), or migrating your application to a fully managed platform like AWS Elastic Beanstalk.

A large media company migrated hundreds of web servers that it ran on-premises to AWS. In the process, it moved from WebLogic (a Java application container that requires an expensive license) to Apache Tomcat, an open-source equivalent. By migrating to AWS, this media company saved millions of dollars in licensing costs and increased savings and agility.

3. **Re-factor / Re-architect**

Re-imagine how the application is architected and developed using cloud-native features. This is driven by a strong business need to add features, scale, or performance that would otherwise be difficult to achieve in the application's existing environment.

Are you looking to migrate from a monolithic architecture to a service-oriented (or server-less) architecture to boost agility or improve business continuity?

This strategy tends to be the most expensive, but it can also be the most beneficial if you have a good product-market fit.

4. **Re-purchase**

Move from perpetual licenses to a software-as-a-service model. For example, move from a customer relationship management (CRM) to Salesforce.com, an HR system to Workday, or a content management system (CMS) to Drupal.

5. **Retire**

Remove applications that are no longer needed. Once you have completed discovery for your environment, ask who owns each application. As much as 10%-20% of an enterprise IT portfolio is no longer useful and can be turned off. These savings can boost your business case, direct your team's attention to the applications people use, and reduce the number of applications you have to secure.

6. **Retain** (Referred to as re-visit.)

Keep applications that are critical for the business but that require major refactoring before they can be migrated. You can revisit all applications that fall in this category at a later point in time.
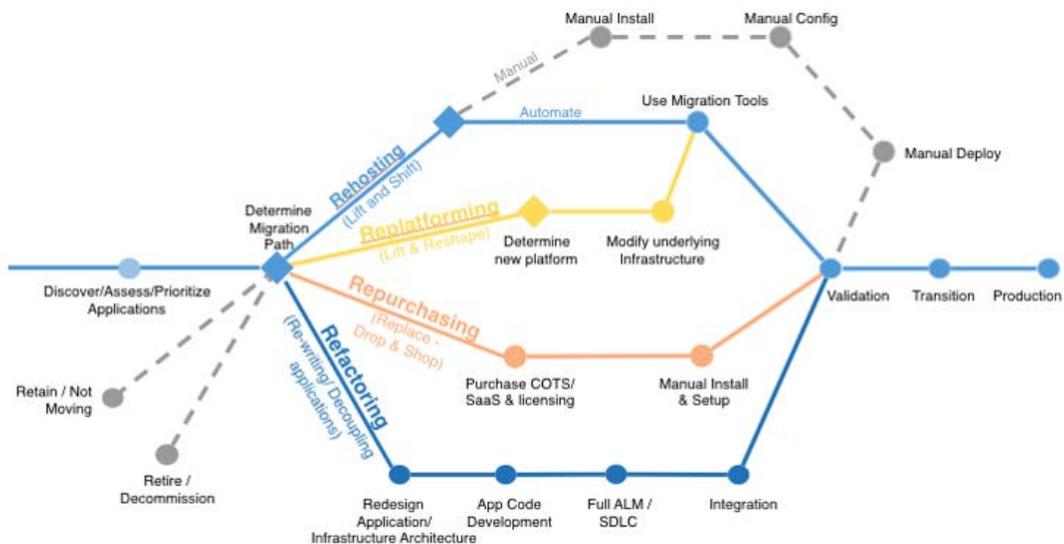

Figure 2: Six most common application migration strategies

Which Migration Strategy is Right for Me?

Choosing the right migration strategy depends on your business drivers for cloud adoption, as well as time considerations, business and financial constraints, and resource requirements. Re-platform if you are migrating for cost avoidance and to eliminate the need for a hardware refresh. Figure 3 shows that this strategy involves more effort than a Re-host strategy but less than a Re-factor strategy. Re-host the majority of your platform and Re-factor later if your data center contract will end in 12 months and you do not want to renew.
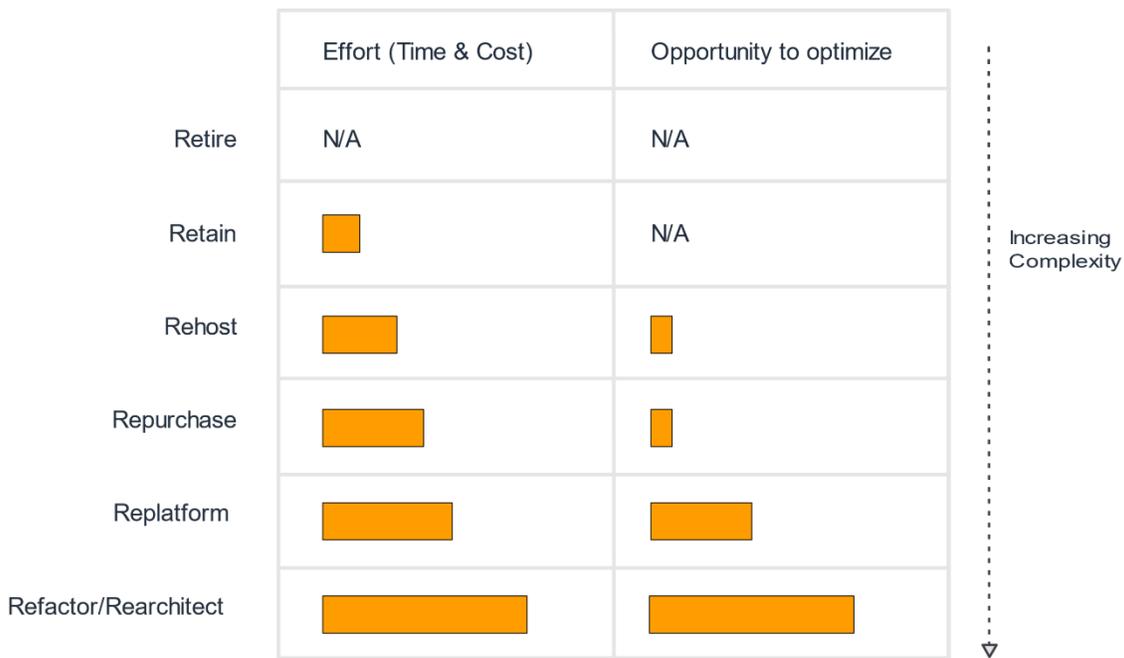
Figure 3: Comparison of cloud migration strategies

Consider a phased approach to migrating applications, prioritizing business functionality in the first phase, rather than attempting to do it all in one step. In the next phase, optimize applications where the AWS Platform can make a notable difference in cost, performance, productivity, or compliance. For example, if you are migrating an application that leverages an Oracle database and your strategy includes replacing Oracle with Aurora PostgreSQL, the best migration approach may be to migrate the application and stabilize it in the migration phase. Then execute the database change effort in a subsequent phase. This approach controls risk during the migration phase and focuses on the migration business case and value proposition.

There are common objectives that will improve application performance, resilience, and compliance across the portfolio that should be included in every migration. They should be packaged into the migration process for consistent execution.

Your migration strategy should guide your teams to move quickly and independently. Applying project management best practices that include clear budgets, timelines, and business outcomes supports this goal. Your strategy should address the following questions:

- Is there a time sensitivity to the business case or business driver, for example, a data center shutdown or contract expiration?

- Who will operate your AWS environment and your applications? Do you use an outsourced provider today? What operating model would you like to have long-term?

- What standards are critical to impose on <u>all</u> applications that you migrate?

- What automation requirements will you impose on applications as a starting point for cloud operations, flexibility, and speed? Will these requirements be imposed on all applications or a defined subset? How will you impose these standards?

The following are examples:

- We will drive the migration timeline to retire specific facilities and use savings to fund the transformation to cloud computing. Time is very important, but we will consider any changes that can be done quickly and safely while creating immediate savings.

- We will insource core engineering functions that have been historically outsourced. We will look at technology platforms that remove operational barriers and allow us to scale this function.

- Business continuity is a critical driver for our migration. We will take the time during the migration to improve our position. Where application risk and costs are high, we will consider a phased approach: migrate first and optimize in subsequent phases. In these cases, the migration plan must include the second phase.

- For all custom development, we will move to a DevOps model. We will take the time to build the development and release processes and educate development teams in each application migration plan matching this pattern.

Understanding your application portfolio is an important step for determining your migration strategy and subsequent migration plan and business case. This strategy does not need to be elaborate, but addressing the questions above helps align the organization and test your operational norms.

Building a Business Case for Migration

IT leaders understand the value that AWS brings to their organization, including cost savings, operational resilience, productivity, and speed of delivery. Building a clear and compelling migration business case provides your organization's leadership with a data-driven rationale to support the initiative.

A migration business case has four categories: 1) runcost analysis, 2) cost of change, 3) labor productivity, and 4) business value. A business case for migration addresses the following questions:

- What is the future expected IT cost on AWS versus the existing (base) cost?

- What are the estimated migration investment costs?

- What is the expected ROI, and when will the project be cash flow positive?

- What are the business benefits beyond cost savings?

- How will using AWS improve your ability to respond to business changes?

The following table outlines each cost or value category.

Table 2: Business case cost/value categorization

Category	Inputs for Consideration
Run Cost Analysis	• Total Cost of Ownership (TCO) comparison of run costs on AWS post-migration vs. current operating model

Category	Inputs for Consideration
	• Impact of AWS purchasing/pricing options (Reserved Instances, volume discounts)
	• Impacts of AWS discounts (Enterprise Discount Program, service credits, e.g., Migration Acceleration Program incentives)
Cost of Change	• Migration planning/consulting costs
	• Compelling events (e.g., planned refresh, data center lease renewal, divestiture)
	• Change management (e.g., training establishment of a Cloud Center of Excellence, governance, and operations model)
	• Application migration cost estimate, parallel environments cost
Labor Productivity	• Estimate of reduction in number of hours spent conducting legacy operational activities (requisitioning, racking, patching)
	• Productivity gains from automation
	• Developer productivity
Business Value	• Agility (faster time to deploy, flexibility to scale up/scale down, mergers and acquisitions, global expansion)
	• Cost avoidance (e.g., server refresh, maintenance contracts)
	• Risk mitigation (e.g., resilience for disaster recovery or performance)
	• Decommissioned asset reductions

For an enterprise Oil & Gas customer, cost savings was a primary migration driver. This customer realized additional financial and overall business benefits through the course of migrating 300+ applications to AWS. For example, this customer was able to increase business agility, operational resilience, improve workforce productivity, and decrease operational costs. The data from each value category shown in the following table provides a compelling case for migration.

Table 3: A case for migration

BUSINESS AGILITY	OPERATIONAL RESILIENCE	COST AVOIDANCE	WORKFORCE PRODUCTIVITY	OPERATIONAL COSTS
77% faster to deliver business applications	98% reduction in P1/P0's	52% average TCO savings	15 automated bots developed	35% reduction in compute assets (792)
Rapid experimentation	Improved security posture	80% cloud first adoption	8 cloud migration parties	50 applications decommissioned
Reduced technical debt	15 cloud services created		Shift to self-service culture	$14M YOY savings
Streamlined M&A activity	Improved performance		DevOps in practice	

$14.2M Investment **+** 18 Months **+** Focus **=** 300+ Apps Migrated **&** $14M YOY Savings

Drafting Your Business Case

Your business case will go through several phases of evolution: directional, refined, and detailed. The directional business case uses an estimate for the number of servers and rough order of magnitude (ROM) assumptions around server utilization. The purpose is to gain early buy-in, allowing budgets to be assigned and resources applied. You can develop a refined business case when you have additional data about the scope of the migration and workloads. The initial discovery process refines the scope of your migration and business case. The detailed business case requires a deep discovery of the on-premises environment and server utilization. We recommend using an automated discovery tool for deep discovery. This is discussed later in the Application Discovery section.

Items to Consider

In building your business case, consider the following items:

- Right-size mapping provides estimates of the AWS services (compute, storage, etc.) required to run the existing applications and processes on AWS. It includes capacity views (as provisioned) and utilization views

(based on actual use). This is a significant part of the value proposition, especially in overprovisioned virtualized data centers.

- Extend right-size mapping to consider resources that are not required full time, for example, turning off development and test servers when not in use and reducing run costs.

- Identify early candidates for migration to establish migration processes and develop experience in the migration readiness and planning phase.

This early analysis of the application discovery data will help you determine run rate cost, migration cost, resource requirements, and timelines for the migration.

AWS has a series of tools and processes that can help you develop your business case for a migration. The [AWS Simple Monthly Calculator](#) can provide directional business case inputs,[3] while the [AWS Total Cost of Operation (TCO) calculators](#) can provide a more refined business case.[4] Additionally, AWS has tools that can help you estimate the cost of migration.

People and Organization

It is important to develop a critical mass of people with production AWS experience are you prepare for a large migration. Establish operational processes and form a Cloud Center of Excellence (CCoE) that's dedicated to mobilizing the appropriate resources. The CCoE will lead your company through organizational and business transformations over the course of the migration effort. A CCoE institutionalizes best practices, governance standards, automation, and drives change throughout the organization. When done well, a CCoE inspires a cultural shift to innovation and a change-is-normal mindset.

Organizing Your Company's Cloud Teams

An effective CCoE team evolves over time, in size, makeup, function, and purpose. Long-term and short-term objectives, as well as key operating model decisions, will require adjustments to your team.

In the early stages of cloud adoption, team development begins as a small, informal group connected by a shared interest—experimentation with cloud implementation. As the cloud initiative grows and the need for a more formalized structure increases, it becomes beneficial to establish a CCoE

dedicated to evangelizing the value of cloud. While the CCoE establishes best practices, methods, and governance for your evolving technology operations, additional small cloud teams form. These small teams migrate candidate applications and application groupings, commonly referred to as migration waves, to the cloud environment. The CCoE directs the operating parameters of the migration teams, and both the CCoE and migration teams provide feedback. Collectively, lessons are learned and documented, improving efficiency and confidence through hands-on experience.

Creating a Cloud Center of Excellence

The following are guiding principles for the creation of a CCoE.

- The CCoE structure will evolve and change as your organization transforms. Diverse, cross-functional representation is key.

- Treat the cloud as your product and the application team leaders as your customers. Drive enablement, not command and control.

- Build company culture into everything you do.

- Organizational change management is central to business transformation. Use intentional and targeted organizational change management to change company culture and norms.

- Embrace a change-as-normal mindset. Change of applications, IT systems, and business direction is expected.

- Operating model decisions will determine how people fill roles that achieve business outcomes.

Structure the CCoE to Prepare for Migration at Scale

Designing a CCoE to include people from across impacted business segments, with cross-functional skills and experiences, is important for successful migration at scale. you build subject matter expertise, achieve buy-in, earn trust across your organization, and establish effective guidelines that balance your business requirements. There is no single organizational structure that works for everyone. The following guidelines will help you design a CCoE that represents your company.

A CCoE is comprised of two functional groups: the Cloud Business Office (CBO) and Cloud Engineering (see Figure 4). The functions of each group will help you determine who to include in each group and in the larger CCoE.

The CBO owns making sure that the cloud services meet the needs of your internal customer, business services. Business services, and the applications that support them, consume the cloud services provided by IT. IT should adopt a customer-centric model toward business application owners. This tenet represents a shift for most organizations. It is an important consideration when developing your cloud operating model, CCoE, and cloud team approach.

The CBO owns functions such as organizational change management, stakeholder requirements, governance, and cost optimization. It develops user requirements, and onboards new applications and users onto the cloud. It also handles vendor management, internal marketing, communications, and status updates to users. You will select IT Leadership responsible for the cloud service vision, Organizational Change Management, Human Resources, financial management, vendor management, and enterprise architecture. One individual may represent multiple functional areas, or multiple individuals may represent one functional area.

The Cloud Engineering group owns functions such as infrastructure automation, operational tools and processes, security tooling and controls, and migration landing zones. They optimize the speed at which a business unit can access cloud resources and optimize use patterns. The Cloud Engineering group focuses on performance, availability, and security.

The following figure shows the functional groups that require representation within your company's CCoE.

Figure 4: Functional organization of a CCoE

Migration Readiness and Planning

Migration Readiness and Planning (MRP) is a method that consists of tools, processes, and best practices to prepare an enterprise for cloud migration. The MRP method aligns to the AWS Cloud Adoption Framework and is execution driven. MRP describes a specific program that AWS Professional Services offers. However, we highlight the main topic areas and key concepts below.

Assessing Migration Readiness

The AWS Cloud Adoption Framework (AWS CAF) is a framework for analyzing your IT environment. Using this framework lets you determine your cloud migration readiness. Each perspective of the AWS CAF provides ways of looking at your environment through different lenses to make sure all areas of your business are addressed. Being ready for a large migration initiative requires preparation across several key areas.

Items to consider:

- Have you clearly defined the scope and the business case for the migration?

- Have you evaluated the environment and applications in scope through the lenses of the AWS CAF?

- Is your virtual private cloud (VPC) secure, and can it act as a landing zone for all applications in scope?

- Have your operations and employee skills been reviewed and updated to accommodate the change?

- Do you (or does a partner) have the experience necessary to move the tech-stacks that are in scope?

AWS has developed a set of tools and processes to help you assess your organization's current migration readiness state in each of the AWS CAF perspectives. The Migration Readiness Assessment (MRA) process identifies readiness gaps and makes recommendations to fill those gaps in preparation for a large migration effort. The MRA is completed interactively in a cross-group setting, involving key stakeholders and team members from across the IT organization, to build a common view of the current state. You may have representatives from IT Leadership, Networking, Operations, Security, Risk and

Compliance, Application Development, Enterprise Architecture, and your CCoE or CBO. The MRA output includes actions and next steps and visuals like a heat map (see Figure 5). The MRA is available through AWS or an AWS Migration Partner.
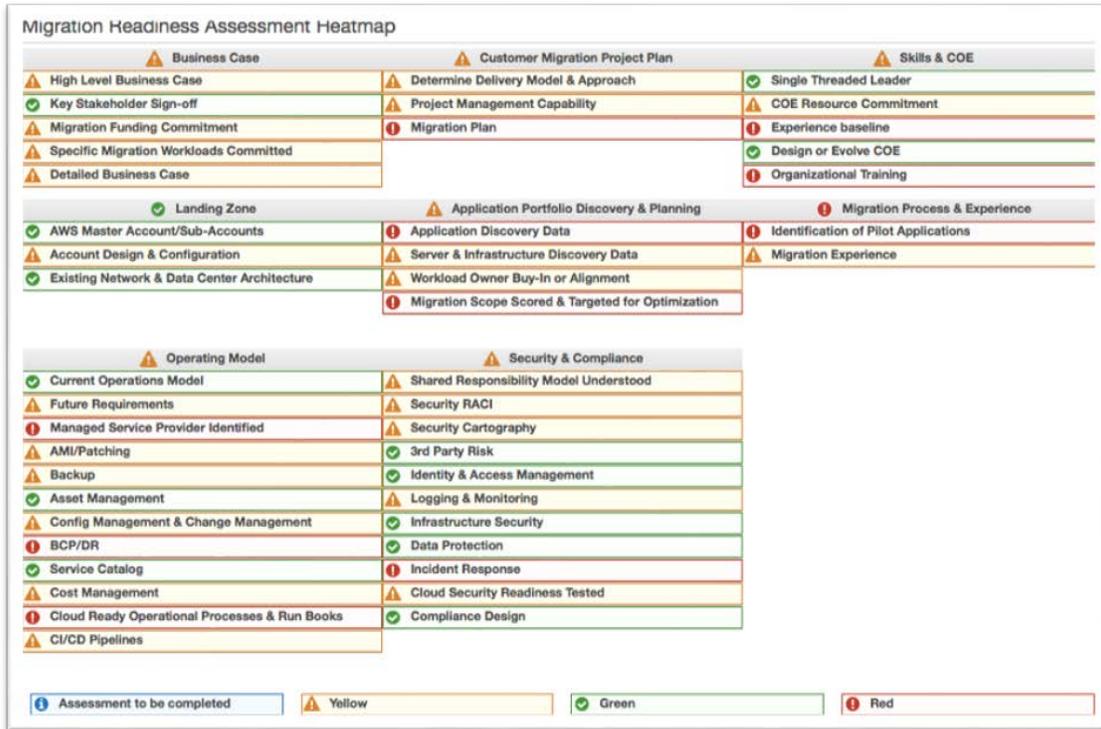

Figure 5: Migration Readiness Assessment heat map

Application Discovery

Application Discovery is the process of understanding your on-premises environment, determining what physical and virtual servers exist, and what applications are running on those servers. You will need to take stock of your existing on-premises portfolio of applications, servers, and other resources to build your business case and plan your migration. You can categorize your organization's on-premises environment based on operating system mix, application patterns, and business scenarios. This categorization can be simple to start. For example, you may group applications based on an end-of-life operating system, or by applications dependent on a specific database or sub-system.

Application Discovery will help you develop a strategic approach for each group of applications. Application Discovery provides you with the required data for project planning and cost estimation. It includes data collection from multiple sources. A common source is an existing Configuration Management Database (CMDB). The CMDB helps with high-level analysis but often lacks fidelity. For example, performance and utilization data need to pair the resources to the appropriate AWS resource (for example, matching Amazon EC2 instance types).

Manually performing discovery can take weeks or months to perform, so we recommend taking advantage of automated discovery tools. These discovery tools can automate the discovery of all the applications and supporting infrastructure including sizing, performance, utilization, and dependencies.

Items to consider:

- We recommend using an automated discovery tool.

- Your environment will change over time. Plan how to keep your data current by continuously running your automated discovery tool.

- It may be useful to do an initial application discovery during business case development to accurately reflect the scope.

Discovery Tools

Discovery tools are available in the AWS Marketplace under the Migration category. Additionally, AWS has built the Application Discovery Service (ADS). ADS discovers server inventories and performance characteristics through either an appliance connector for virtual servers, or agents installed on physical or virtual hosts.

An application discovery tool can:

- Automatically discover the inventory of infrastructure and applications running in your data center and maintain the inventory by continually monitoring your systems.

- Help determine how applications are dependent on each other or on underlying infrastructure.

- Inventory versions of operating systems and services for analysis and planning.

- Measure applications and processes running on hosts to determine performance baselines and optimization opportunities.

- Provide a means to categorize applications and servers and describe them in a way that's meaningful to the people who will be involved in the migration project.

You can use these tools to build a high-fidelity, real-time model of your applications and their dependencies. This automates the time-consuming process of discovery and data collection and analysis.

Items to consider:

- An automated discovery tool can save time and energy when bringing a CMDB up to date.

- Keeping the inventory up to date is key as the project progresses, and a tool helps make this less painful.

- Discovery tools on the market each have their special purpose or capability, so analyzing this against your needs will help you select the right tool for your environment.

Application Portfolio Analysis

Application portfolio analysis takes the application discovery data and then begins grouping applications based on patterns in the portfolio. It identifies order of migration and the migration strategy (i.e. which of the 6 R's, out lined on page 9, will be used) for migrating the given pattern. The result of this analysis is a broad categorization of resources aligned by common traits. Special cases may also be identified that need special handling.

Examples of this high-level analysis are:

- The majority of the servers are Windows-based with a consistent standard OS version. Some of the servers might require an OS upgrade.

- Distribution of databases across multiple database platforms: 80% of the databases are Oracle and 20% are SQL Server.

- Grouping of applications and servers by business unit: 30% marketing and sales applications, 20% HR applications, 40% internal productivity applications, and 10% infrastructure management applications.

- Grouping of resources across type of environment: 50% production, 30% test, and 20% development.

- Scoring and prioritizing based on different factors: opportunity for cost saving, business criticality of the application, utilization of servers, and complexity of migration.

- Grouping based on 6 R's: 30% of the portfolio could use a re-host pattern, 30% require some level of re-platforming changes, 30% require application work (re-architecture) to migrate, and 10% can be retired.

The data-driven insights you get from the application discovery work will become the foundation for migration planning as you move into the migration readiness phase of your project.

Migration Planning

The primary objective of the migration plan is to lead the overall migration effort. This includes managing the scope, schedule, resource plan, issues and risks, coordination, and communication to all stakeholders. Working on the plan early can organize the project as multiple teams migrate multiple applications. The migration plan considers critical factors such as the migration order for workloads, when resources are needed, and tracking the progress of the migration. We recommend your team use agile delivery methodologies, project control best practices, a robust business communication plan, and a well-defined delivery approach.

Recommended migration plan activities include:

- Review of project management methods, tools, and capabilities to assess any gaps.

- Define project management methods and tools to be used during the migration.

- Define and create the Migration Project Charter/Communication Plan, including reporting and escalation procedures.

- Develop a project plan, risk/mitigation log, and roles and responsibilities matrix (e.g., RACI) to manage the risks that occur during the project and identify ownership for each resource involved.

- Procure and deploy project management tools to support the delivery of the project.

- Identify key resources and leads for each of the migration work streams defined in this section.

- Facilitate the coordination and activities outlined in the plan.

- Outline resources, timelines, and cost to migrate the targeted environment to AWS.

Technical Planning

Planning a migration goes beyond cost, schedule, and scope. It includes taking the application portfolio analysis data and building an initial backlog of prioritized applications. Build the backlog by conducting a deep analysis on your portfolio by gathering data on use patterns. A small team can lead this process, often from the enterprise architecture team, which is part of your CCoE. The team analyzes and prioritizes the application portfolio, and gathers information about the current architecture for each application. They develop the future architecture and capture workload details to execute a streamlined migration. It is not important to get through every application before begging execution of the plan. To be agile, do a deep analysis of the first two to three prioritized apps, and then begin the migration. Continue deeper analyses of the next applications while the first applications are being migrated.

An iterative process helps you avoid feeling overwhelmed by the scale of the project or limiting your progress as the initial design plans become dated. Organize applications into migration patterns and into move groups to determine the number of migration teams, cost, and migration project timeline. Maintain a backlog of applications (about three 2-week sprints) for each migration team in the overall project plan. As you migrate, you gain technical and organizational expertise that you will build into your planning and execution processes. You will be able to take advantage of opportunities to optimize as you progress through your application portfolio. The iterative process allows the project to scale to support migration teams structured by pattern, business unit, geography, or other dimensions that align to your organization and project scope.

A high-fidelity model that provides accurate and current application and infrastructure data is critical to make performance and dependency decisions

during your migration phase. Having a well-informed plan with good data is one of the key enablers for migrating at speed.

Items to consider:

- Application discovery and portfolio analysis data are important for categorization, prioritization, and planning at this stage.

- An agile approach allows you to use this data for the migration before it becomes obsolete.

- Iteration helps migrations continue as the detailed plan evolves with new learnings.

The Virtual Private Cloud Environment

The VPC environment is an integrated collection of AWS accounts and configurations where your applications will run. It includes third-party solutions from the AWS Marketplace that address requirements not directly controlled on AWS. You can implement the AWS CAF Security, Operations, and Platform Perspectives to migrate and operate in the cloud environment securely and efficiently. They will be covered together in this section.

Security

Building security into your VPC architecture will save you time and will improve your company's security posture. Cloud security at AWS is the highest priority. AWS customers benefit from the AWS Cloud data centers and network architectures that are built to meet the requirements of the most security-sensitive organizations. A compelling advantage of the AWS Cloud is that it allows you to scale and innovate, while maintaining a secure environment. The AWS CAF Security Perspective outlines a structured approach to help you build a foundation of security, risk, and compliance capabilities that will accelerate your readiness and planning for a migration project. To learn more about cloud security, see the [AWS security whitepapers](#).[5]

The AWS CAF Security Perspective details how to build and control a secure VPC in the AWS Cloud. Figure 6 illustrates the AWS CAF Security Perspective Capabilities.
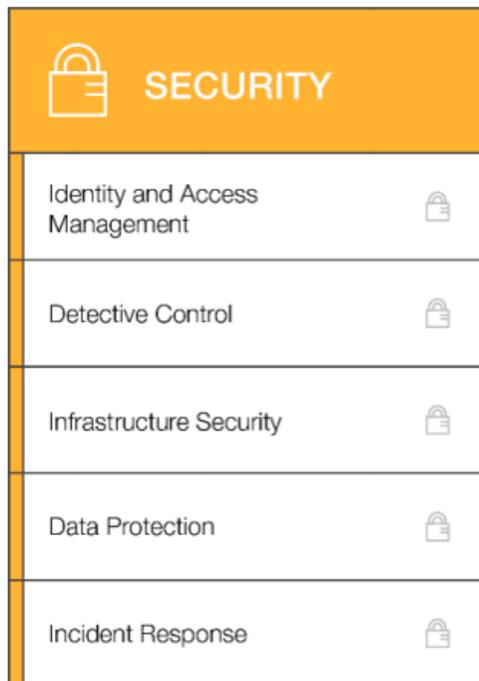
Figure 6: AWS CAF Security Perspective Capabilities

The AWS CAF Security Perspective is comprised of 10 themes:

- Five core security themes – Fundamental themes that manage risk as well as progress by functions outside of information security: identity and access management, logging and monitoring, infrastructure security, data protection, and incident response.

- Five augmenting security themes – Themes that drive continuous operational excellence through availability, automation, and audit: resilience, compliance validation, secure continuous integration/continuous deployment (CI/CD), configuration and vulnerability analysis, and security big data analytics.

By using the ten themes of the Security Perspective, you can quickly iterate and mature security capabilities on AWS while maintaining flexibility to adapt to business pace and demand.

Items to consider:

- Read the AWS security whitepapers for information on best security practices.

- Engage with AWS to run security workshops to speed up your teams' understanding and implementation.

- Read the AWS Well-Architected Framework and the AWS Well-Architected Security Pillar whitepapers for information on how to architect a secure environment.[6, 7]

Operations

The AWS CAF Operations Perspective describes the focus areas to run, use, operate, and recover IT workloads. Your operations group defines how day-to-day, quarter-to-quarter, and year-to-year business is conducted. IT operations must align with and support the operations of your business. The Operations Perspective defines current operating procedures and identifies the process changes and training that is needed for successful cloud adoption.

Figure 7: AWS CAF Operations Perspective Capabilities

The Operations Perspective helps you examine how you currently operate and how you would like to operate in the future. Operational decisions relate to the specific applications being migrated. Determine the appropriate Cloud Operating Model (COM) for a particular application or set of applications when envisioning the future state. To learn more about cloud operations, see the AWS

operations whitepapers[8] and the AWS Well-Architected Operational Excellence Pillar whitepaper.[9]

There are different uses and users for applications across your business. Products and services will be consumed in different patterns across your organization. Therefore, you will have multiple modes of operating in a cloud environment. When planning for your migration you will first define the use cases and actors, and then determine how to deliver the solution.

To build an organization that is capable of delivering and consuming cloud services, create a Cloud Services Organization. Cloud organizational constructs such as a CCoE, a CBO, and Cloud Shared Services teams all fall within this Cloud Services Organization. The last piece of the COM, is the set of capabilities such as ticketing workflows, service catalogs, and pipelines that are required to deliver and consume cloud services. These capabilities help the Cloud Services Organization function effectively.

Items to consider:

- Building a Cloud Center of Excellence early in the process will centralize best practices.

- Recognize that your organization will have multiple operating models (e.g., R&D applications are different than back-office applications).

- A managed service, such as AWS Managed Services,[10] can reduce the time needed to solve operational problems in the early phases. It lets your team focus on improving the migrated applications.

Platform

The AWS CAF Platform Perspective includes principles and patterns for implementing new solutions on the cloud and migrating on-premises workloads to the cloud. IT architects use models to understand and communicate the design of IT systems and their relationships. The Platform Perspective capabilities help you describe the architecture of the target state environment in detail.

Figure 8: AWS CAF Platform Perspective Capabilities

The Platform work stream provides you with proven implementation guidelines. You can repeatedly set up AWS environments that can scale as you deploy new, or migrate existing, workloads. You can establish key platform components that support flexible, baseline AWS environments. These environments can accommodate changing business requirements and workloads. Once in place, your platform can simplify and streamline the decision-making process involved in configuring an AWS infrastructure.

The following are key elements of the platform work stream:

AWS landing zone – provides an initial structure and pre-defined configurations for AWS accounts, networks, identity and billing frameworks, and customer-selectable optional packages.

Account structure – defines an initial multi-account structure and pre-configured baseline security that can be easily adopted into your organizational model.

Network structure – provides baseline network configurations that support the most common patterns for network isolation, implements baseline network connectivity between AWS and on-premises networks, and provides user-configurable options for network access and administration.

Pre-defined identity and billing frameworks – provide frameworks for cross-account user identity and access management (based on Microsoft Active Directory) and centralized cost management and reporting.

Pre-defined user-selectable packages – provide a series of user-selectable packages to integrate AWS-related logs into popular reporting tools, integrate with the AWS Service Catalog, and automate infrastructure. It offers third-party tools to help you manage and monitor AWS usage and costs.

Items to consider:

- If your business is new to AWS, consider a managed service provider, such as AWS Managed Services, to build out and manage the platform.

- Identify account structures up-front that allow for effective bill-back processes.

- You will have both on-premises and cloud servers working together, at least initially. Consider a hybrid cloud solution.

Migrating

First Migrations – Build Experience

MRP develops core operations, security, and platform capabilities to operate at scale. You will build confidence and momentum for your migration project. Running applications in the new operating model and environment will help you mature these capabilities. It is important to develop migration skills and experience early to help you make informed choices about your workload patterns. We recommend migrating three to five applications. These applications should be representative of common migration patterns in the portfolio.

One example is re-hosting an application using existing server replication tools. Other examples are re-platforming an application to have its database running on Amazon RDS, or migrating an application that has internet-facing requirements and validating the controls and services involved. Choose the applications before you start the MRP in order to develop an approach and schedule that accommodates your selections.

Working through these initial migrations builds confidence and experience. It informs the migration plan with the patterns and tool choices that fit your organization's needs. It provides validation and testing of the operational and security processes.

Items to consider:

- Identify patterns (e.g., common architectures, technology stacks, etc.) in the portfolio to create a list of application groupings based on common patterns. This creates a common process for group migrations.

- Your first three to five applications should be representative of common patterns in your portfolio. This will determine the process for moving that pattern in the mass migration to follow.

Migration Execution

In the early migrations, you tested specific migration patterns and your CCoE gained experience. Now you will scale teams to support your initial wave of migrations. The core teams expand to form migration sprint teams that operate in parallel. This is useful for re-host and re-platforming patterns that can use automation and tooling to accelerate application migration. In the next section, we will cover the migration factory process and expand on the agile team model.

Application Migration Process

Specific patterns with larger volumes, such as re-hosting, offer the opportunity to define methods and tools for moving data and application components. However, every application in the execution phase of a migration follows the same six-step process: Discover, Design, Build, Integrate, Validate, and Cutover.
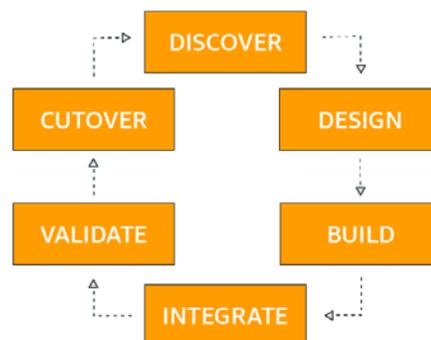
Discover

In the Discover stage, the application portfolio analysis and planning backlog are used to understand the current and future architectures. If needed, more data is collected about the application. There are two categories of information: Discover Business Information (DBI) and Discover Technical Information

(DTI). Examples of DBI are application owner, roadmap, cutover plans, and operation runbooks. Examples of DTI are server statistics, connectivity, process information, and data flow. This information can be captured via tools and confirmed with the application owner. The data is then analyzed, and a migration plan for that application is confirmed with both the sprint team and the application owner. In the case of re-host patterns, this is done in groups that match the patterns. The portfolio discovery and planning process provides this information.

Design

In the Design stage, the target state is developed and documented. The target state includes the AWS architecture, application architecture, and supporting operational components and processes. A member of the sprint team and engineering team uses the information collected during the Discover stage to design the application for the targeted AWS environment. This work depends on the migration pattern and includes an infrastructure architecture document that outlines what services to use. The document also includes information about data flow, foundational elements, monitoring design, and how the application will consume external resources.

Build

In the Build stage, the migration design created during the Design stage is executed. The required people, tools, and reusable templates are identified and given to the migration teams. A migration team is selected based on the migration strategy chosen for the application. The team will use these pre-defined methods and tools to migrate to AWS. They assert basic validations against the AWS-hosted application.

Integrate

In the Integrate stage, your migration team makes the external connections for the application. Your team works with external service providers and consumers of the application to make the connections or service calls to the application. The team then run the application to demonstrate functionality and operation before the application is ready for the Validate stage.

Validate

In the Validate stage, each application goes through a series of specific tests (that is, build verification, functional, performance, disaster recovery, and

business continuity tests) before being finalized and released for the Cutover stage. Your teams evaluate release management, verify rollout and rollback plans, and evaluate performance baselines. Rollback procedures are defined by application within a rollback playbook, which consists of an operations communication plan for users and defines integration, application, and performance impacts. You complete business acceptance criteria by running parallel testing for pre-migrated and migrated applications.

Cutover

In the Cutover stage, you execute the cutover plan that was agreed upon by the migration team and application owners. Perform a user acceptance test at this stage to support a successful cutover. Use the outlined rollback procedure in the cutover plan if the migration is not successful.

Items to consider:

- Make sure the team is familiar with agile practices.

- An iterative approach to maximizes immediate requirements gathering. You will not do up front work that will be out of date by the time you are ready to use it.

- The CCoE plays a key role in sharing best practices and lessons learned across the different migration teams.

Team Models

Core migration teams persist through the project as part of your new IT operating model. These teams each have their own areas of specialization.

Core Cloud Teams

The Core Cloud teams work across the migration teams. They act as a central hub for managing projects, sharing lessons learned, coordinating resources, and building common solutions. These teams include:

Cloud Business Office (Program Control) – Drives the program, manages resources and budgets, manages and reports risk, and drives communication and change management. Typically, this team reports to the overall migration or cloud lead and becomes the program office for your migrations.

Cloud Engineering & Operations – Builds and validates the fundamental components that ensure development, test, and production environments are scalable, automated, maintained and monitored. This team also prepares landing zones as needed for migrations.

Innovation – Develops repeatable solutions that will expedite migrations in coordination with the platform engineering, migration, and transition teams. They work on larger or more complex technical issues for the migration teams.

Portfolio Discovery & Planning – Accelerates downstream activities by executing application discovery and optimizing application backlogs. They work to eliminate objections and minimize wasted effort.

Migration Factory Teams

In the scale-out phase of a migration project, multiple teams operate concurrently. Some support a large volume of migrations in the re-host and minor re-platform patterns. These teams are called migration factory teams. Your migration factory team increases the speed of execution of your migration plan. Between 20%-50% of an enterprise application portfolio consists of repeated patterns that can be optimized by a factory approach. This is an agile delivery model, and it is important to create a release management plan. Your plan should be based on current workloads and information generated during the MRP phase. You should optimize it continually for future migration waves and future migration teams. We recommend that you have a backlog of applications that support three sprints for each team. This allows you to re-prioritize applications if you encounter problems that affect the schedule.

Larger and more complex applications often follow the re-factor/re-architect pattern. They are generally conducted in planned release cycles by the application owner. The factory teams are self-sufficient and include five to six cross-functional roles. These include operations, business analysts and owners, migration engineers, developers, and DevOps professionals. The following are examples of migration factory teams that are focused on specific migration patterns:

Re-host migration team – Migrates high-volume, low-complexity applications that don't require material change. This team leverages migration automation tools. This approach is integrated into patch-and-release management processes.

Re-platform migration team – Designs and migrates applications that require a change of platform or a repeatable change in application architecture.

Re-factor/re-architect migration team – Designs and migrates complex or core business applications that have many dependencies. In most cases, development and technical operations teams support this business capability. The migration becomes a release cycle or a few release cycles within the plan for that team. There can be many of these in flight, and the role of the CBO is to track timing, risks, and issues until migration completion. This team owns the application migration process.

Items to consider:

- Perform a portfolio analysis to understand common patterns across all applications. This can help build repeatable work for the factory teams to execute efficiently.

- Use a partner to help with resource constraints as your team supports regular business activities.

- AWS and the AWS Partner Network (APN) ecosystem can bring specialized resources for specific topics such as databases, application development, and migration tooling.

Conclusion

We have introduced both the preparation and execution steps required for large migrations to the cloud. Analyzing your current state, building a plan, and iterating the work breaks a large migration into manageable activities for efficient execution. Looking at a migration as an organizational change project empowers you to build buy-in and maintain communications through each stage of the process. Build a business case and refine the return on investment as the project progresses. Use the AWS Cloud Adoption Framework to analyze your environment through the different Perspectives: Business, People, Governance, Platform, Security, and Operations. This gives you a complete view of which areas to improve before moving forward with a large migration effort. Use a migration factory construct and iterate the migration patterns to create an optimal move to the AWS Cloud. Today, migrating to the cloud has moved from

asking "why" to asking "when." Building an effective migration strategy and plan will change your response to "NOW!"

Migration is just the beginning of what is possible. Once you have migrated an application, consider your migration experience as a capability that you can use for the optimization phases for this application. You will have a current architecture and a future design. You will implement, test, and validate changes. You will cutover and go live. You now have a new IT capability that can drive speed, agility, and business value for your organization and your company.

Contributors

The following individuals and organizations contributed to this document:

- AWS Professional Services, Global Migrations Practice

Resources

- AWS Migration Competency and Partners:
  https://aws.amazon.com/partners/find

- AWS Whitepapers:
  https://aws.amazon.com/whitepapers

- AWS Migration Acceleration Program:
  https://aws.amazon.com/migration-acceleration-program/

- AWS Webinar: How to Manage Organizational Change and Cultural Impact During a Cloud Transformation:
  https://youtu.be/2WmDQG3vp0c

Additional Information

Articles by Stephen Orban, Head of Enterprise Strategy at AWS, on cloud migration:

- http://amzn.to/considering-mass-migration

- http://amzn.to/migration-process

- http://amzn.to/migration-strategies

- http://amzn.to/cloud-native-vs-lift-and-shift

- http://amzn.to/migrate-mainframe-to-cloud

FAQ

1. **How do I build the right business case?**
   Your business case should be driven by your organizational KPIs and common drivers, such as operational costs, workforce productivity, cost avoidance, operational resilience, and business agility.

2. **How do I accurately assess my environment? How do I learn what I don't know about my enterprise network topology and application portfolio and create a migration plan?**
   Consider the volume of resources used by each application, and automate the assessment process to confirm that it's done rapidly and accurately. Assessing your environment manually is a time-consuming process. It exposes your organization to human error. Automating the process will help you gain insight into what you don't know, and it will help you more clearly understand and define these uncertainties so they can be factored into your migration strategy.

3. **How do I identify and evaluate the right partners to help me?**

   Details on Partner offerings can be found at:

   o AWS Migration Partner Solutions[11]

   o Migration Solutions in AWS Marketplace[12]

4. **How do I estimate the cost of a large transition like this?**
   The AWS Pricing Calculator can compare how much it costs to run your applications in an on-premises or colocation environment to what it costs on AWS.[13]

5. **How long will the migration process take to complete?**
   Enterprise migrations that are completed within 18 months generate the greatest ROI. The duration of a migration depends on scope and resources.

6. **How do I handle my legacy applications?**
   Consider taking an incremental approach to your migration by determining which of your legacy applications can be moved most easily.

Move these application to the cloud first. For legacy applications that require a more complicated approach, you can develop an effective plan for migration.

7. **How do I accelerate the migration effort to realize the business and technology benefits more quickly?**

Automate the migration process as much as possible. Using migration tools from AWS and APN Partners is the best way to accelerate the migration effort.

Glossary

- **Application Portfolio** – Collection of detailed information about each application of an organization, including the cost to build and maintain the application, and the business value.

- **AWS Cloud Adoption Framework (AWS CAF)** –A structure for developing an efficient and effective plan for organizations to successfully move to the cloud.

- **Cloud Center of Excellence (CCoE)** –A diverse team of key members who play the primary role in establishing the migration timeline and evangelize about moving to the cloud.

- **Landing Zone** – The initial destination area that is established on AWS where the first applications operate from to ensure they have been migrated successfully.

- **Migration Acceleration Program (MAP)** –Designed to provide consulting support and help enterprises who are migrating to the cloud realize the business benefits of moving to the cloud.

- **Migration at Scale** – The stage in the migration process when the majority of the portfolio is moved to the cloud in waves, with more applications moved at a faster rate in each wave.

- **Migration Method or Migration Process** – Refers to Readiness, Mobilization, Migration at Scale, and Operate.

- **Migration Readiness and Planning (MRP)** – A pre-planning service to prepare for migration when the resources, processes, and team members who will be engaged in carrying out a successful migration to AWS are identified. Part of the Readiness stage of the migration process.

- **Migration Readiness Assessment (MRA)** –A tool to determine level of commitment, competence, and capability.

- **Mobilization** – The stage in the migration process in which roles and responsibilities are assigned, an in-depth portfolio assessment is conducted, and a small number of select applications is migrated to the cloud.

- **Operate** – The stage in the migration process when most of the portfolio has been migrated to the cloud and is optimized for peak performance.

- **Readiness** – The initial stage in the migration process when the opportunity is evaluated, the business case is confirmed, and organizational alignment is achieved for migrating to the cloud.

- **Stage** – The individual topics of the migration process. Readiness, Mobilization, Migration at Scale, and Operate are all stages in the migration process.

Notes

[1] https://aws.amazon.com/cloud-migration/

[2] https://d0.awsstatic.com/whitepapers/aws_cloud_adoption_framework.pdf

[3] https://calculator.s3.amazonaws.com/index.html

[4] https://aws.amazon.com/tco-calculator/

[5] https://aws.amazon.com/whitepapers/#security

[6] https://d1.awsstatic.com/whitepapers/architecture/AWS_Well-Architected_Framework.pdf

[7] https://d1.awsstatic.com/whitepapers/architecture/AWS-Security-Pillar.pdf

[8] https://aws.amazon.com/whitepapers/#operations

[9] https://d1.awsstatic.com/whitepapers/architecture/AWS-Operational-Excellence-Pillar.pdf

[10] https://aws.amazon.com/managed-services/

[11] https://aws.amazon.com/migration/partner-solutions/

[12] https://aws.amazon.com/marketplace/search/results?searchTerms=migration&page=1&ref_=nav_search_box&x=0&y=0

[13] https://awstcocalculator.com/