aws

An AWS how-to guide

Public Sector Cloud Transformation

Public Sector Cloud Transformation: An AWS how-to guide

Table of Contents

..... v
Abstract i
Abstract 1
Executive summary 2
Introduction 4
AWS Professional Services 6
Phase 1 - Vision 8
Building the leadership team (executive leadership / steering committee) 8
Building a CCOE to transform the entire enterprise 9
Things to remember regarding CCOE 10
Procuring cloud 11
Envision and align - AWS Cloud Adoption Framework (AWS CAF) 12
AWS Cloud Adoption Framework overview 12
Immersion Day workshops 15
Pilot projects 15
Migration Readiness Assessment (MRA) 16
Phase 2 - Getting started 18
Architecting 18
AWS Well-Architected Framework 18
Secure Environment Accelerator (Canada) 20
Selecting the right cloud for workloads – differences between public, private, and hybrid 21
The AWS public cloud 21
The private cloud 21
The hybrid cloud 22
AWS Outposts 23
Application migration strategies 23
Accelerating training – The AWS Skills Guild 24
Continuous upskilling 26
Operations and governance (cloud operating model) 26
Culture and change management 28
Budgeting and cost optimization 31
Understanding Total Cost of Ownership (TCO) and Government Workload Assessment (GWA) 31
Government Workload Assessment (GWA) 32

Cost optimization 33
Phase 3 - Gaining momentum and optimization 36
Programs 36
Migration Acceleration Program 36
MAP methodology 36
Experience-based Acceleration (EBA) 37
Continuous optimization 39
The continuous optimization process 39
Core services and additional services 41
Core services 41
Additional services 41
Leveraging new technologies (AI / ML / analytics) 42
Two pizza teams, from Ops to DevOps 43
Conclusion 46
Contributors 47
Document revisions 48
Notices 49

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Public Sector Cloud Transformation

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Abstract

People, process, and technology

A successful digital transformation is more than simply digitizing data and moving it to the cloud. The process should include evolving the needs, organization, and culture of the enterprise. Organizations must transform their people, processes, and technologies to be successful in the cloud. Embracing the Amazon Web Services (AWS) Cloud enables governments and public sector organizations to move away from their reliance on outdated traditional IT hosted in on-site data centers so they can offer innovative opportunities to better serve citizens, improve security, and cut costs. The expectations of an increasingly digital citizenry are high, yet all levels of government face budgetary and human resource constraints. Cloud computing can help government organizations increase innovation, agility, and resiliency, all while reducing costs.

Although many public sector organizations recognize the need to transform, *how to* guidance is often missing. This whitepaper provides a phased approach that governments can use to break down steps into segments. This will help them take advantage of the cloud, reduce cost, and transform the way they deliver on their mission, from initial vision to establishing cloud centers of excellence and measuring performance. The prescriptive guidance in this document provides pragmatic and tactical advice for the initial setup activities, and best practices extrapolated from working with a large number of customers.

Executive summary

This guide offers a list of strategies and tactics that governments worldwide use to break down innovation barriers and tackle mission-critical operations with the cloud in four distinct phases. These strategies can be adopted as a whole, or in component pieces.

In the initial ***Vision*** phase (2-6 months), AWS recommends setting the vision and laying the foundational elements to permit the organization to flourish in a new cloud-based environment in five actions:

1. Establish the leadership team and dividing responsibilities allows the organization to understand who is accountable for which workstreams.
2. Create a Cloud Center of Excellence (CCoE). This must include people from across all impacted business segments, with cross-functional skills and experiences. This is important for successful migration at scale. Organizations build subject matter expertise, achieve buy-in, earn trust, and establish effective guidelines that meet their business requirements.
3. Host AWS Immersion Days . These are day-long, in-person technical workshops that AWS Solutions Architects create to help customers learn how to best leverage the AWS platform to unlock business potential and meet key objectives.
4. Complete a Migration Readiness Assessment (MRA). This is a process of gaining insights into your organization maturity. It helps you understand your current cloud-readiness strengths and weaknesses, and builds an action plan to close identified gaps.
5. Build a pilot / proof of concept and start validating the technologies. To inform decision making, testing is a must-have practice for enterprise application development teams. With the elasticity and scalability provided by the cloud, it is important to predict and understand application behavior in a real-world scenario.

As part of the second ***Getting Started*** phase, (2-6 months) AWS recommends getting started and diving into more hands-on approaches to early-stage adoption. AWS works with customers to advise on:

1. Architecting secure landing zones for workloads that are slated for the public, private or hybrid cloud.
2. Broadening the training landscape to develop a dedicated AWS Skills Guild, providing access to cloud education across the organization.

3. Planning for operations and governance. AWS can help guide the development of an organizational Cloud Operating Model.
4. Understanding cost via a Government Workload Assessment. This provides a high-level financial estimate of a government's total compute, storage, and database requirements, including a comparison Total Cost of Ownership (TCO) analysis to identify the cost savings between traditional IT and cloud adoption and operations.
5. Managing the culture and change management via established operational processes, and leadership dedicated to mobilizing the appropriate resources. This includes leading teams through the many organizational and transformational challenges presented over the course of a large-scale migration effort. For more information, see *AWS Prescriptive Guidance*.

In the third phase, ***Gaining Momentum*** (6-24 months), AWS recommends leveraging various programs offered, exploring how to leverage core such as Amazon Elastic Compute Cloud (Amazon EC2) compute, and additional services such as Amazon Connect, as well as advanced technologies in fields like Artificial Intelligence such as Amazon Rekognition, Machine Learning (ML) such as Amazon Sagemaker, Serverless or Internet of Things applications. In this phase it is also recommend implementing mechanisms and policies that support continuous improvement. Engage with AWS to obtain ongoing learning for your cloud teams, including attending re:Invent, AWS Summits, and tracking new products and services via the daily blog.

In the fourth and final phase, ***Strengthen and Reinforce*** (6-24 months), AWS recommends instituting mechanisms to measure the organization's project implementations to the cloud. AWS provides a set of flexible services designed to enable companies to more rapidly and reliably build and deliver products using AWS and DevOps practices. These services simplify provisioning and managing infrastructure, deploying application code, automating software release processes, and monitoring your application and infrastructure performance. DevOps is the combination of cultural philosophies, practices, and tools that increases an organization's ability to deliver applications and services at high velocity: evolving and improving products at a faster pace than organizations using traditional software development and infrastructure management processes. AWS also believes it is time to institute the *two-pizza rule*, where internal project teams should be small enough that they can be fed with two pizzas, to maintain focus on efficiency and scalability.

Introduction

Cloud transformation is more than simply digitizing data. It requires evolving from rigid, legacy platforms to an IT environment that is designed to adapt to the changing needs of an organization. It calls for innovation, and changes in policy, procurement, talent, and culture, to take full advantage of new opportunities that come with cloud-based technologies.

Governments around the world embrace the cloud to deliver services faster to citizens and to spur economic development. At the same time, this transformation helps them better cope with budgetary and human resource constraints. However, organizations should understand that there is more to transformation than just migrating workloads and data to the cloud. To fully benefit from cloud technologies, organizations need to modernize all aspects of the enterprise to enable the agility, speed and flexibility the cloud can afford.

Public sector leaders who leverage cloud technology can empower business outcomes through the effective use of cloud services. AWS cloud-based digital transformation frees up resources, which enables your team to engage deeply within your business units to identify opportunities for digital enablement. Look for opportunities to support and accelerate digital literacy across the enterprise, and work cross-functionally with your business partners to define what *digital* means for your organization.

To meet this larger demand for innovation, public sector leaders must empower their teams to find new ways of innovating for the business. This requires the leadership to be more comfortable with technology autonomy. Instead of defining and controlling IT delivery, public sector leaders must provide a sense of purpose to their team by making them accountable for the customer / citizen experience. Defining and communicating such a strategy while leaving room for the team's decisions is not trivial. Organizations that have autonomous teams need more and better leadership, not less.

Teams need to operate off a common platform to avoid unnecessary diversity. Cloud platforms enable teams to build amazing customer experiences because they enable creativity and collaboration while reducing accidental complexity. Changing the mindset within your IT organization is the first step to changing the mindset outside of IT. Leading with business needs first earns trust with key business partners, enabling alignment on joint decision-making, shared accountability, and how digital business initiatives are measured.

Budgeting, controlling, tracking, and monitoring IT projects that solve discrete problems must give way to leading your IT teams in a way that inspires and creates space for innovation. By unlocking

innovation, and enabling innovation at speed, you can reposition your IT organization as a valued business partner, rather than as technology support.

AWS Professional Services

The AWS Professional Services team is a team of experts located in Quebec and around the globe. It provides AWS customers with high-touch assistance, leading them through the change to a cloud-based IT operating model built on AWS. Their expertise enables organizations to realize their desired business outcomes on the AWS Cloud. The vision of AWS Professional Services is to accelerate customer business outcomes as a result of innovative usage of the AWS platform. As AWS pursue this vision, the strategic focus is:

- Being the most customer-centric professional services team in the IT industry.
- Providing organizations with the best available AWS Cloud Migration, Change Management, and technology specialist expertise.
- Providing unique and valuable methodologies for fast cloud adoption.

The AWS Professional Service offering uses a unique methodology based on Amazon's internal best practices to help you complete your projects faster, while accounting for evolving expectations and dynamic team structures along the way. Supplementing with the specialized skills and experience of AWS Professional Services resources can help organizations achieve their results.

AWS helps customers achieve specific outcomes related to cloud adoption. Each offering delivers a set of activities, best practices, and documentation reflecting AWS experience in supporting hundreds of customers in their journey to the AWS Cloud.

AWS Professional Services, accelerated business outcomes

Organizations need both leadership and technical expertise to accelerate and optimize their cloud journey, reduce risk, and shorten their time to value. The AWS Professional Services offering was developed based on AWS best practice, leveraged from thousands of delivery engagements, achieving results by working backwards and focusing on the business outcomes to increase speed of value. Focusing on customer outcomes enables AWS to define success through the customer's eyes to enable sustainable innovation the right way, the first time.

Phase 1 - Vision

Building the leadership team (executive leadership / steering committee)

The first activity, and the most critical to transformation success, is establishing the executive leadership team. This includes defining roles and responsibilities, and identifying team members through staff organizational structures. An aspect of mapping team and staff structure involves mapping traditional roles to cloud roles. This includes mapping architecture, infrastructure, operations, security, business and IT alignment, project management, data, and applications on-premises roles. The necessary skills and competencies to successfully fill the positions are critical.

It is important to indicate the initial roles that are crucial to the success of the instantiation of the CCoE. The initial team members should be knowledgeable leaders across service lines from networking, security, operations, and application development, to migrations, databases, and infrastructure. They should be passionate about technology, but also have business acumen, the ability to internally evangelize technology and the value of the CCoE, and have enough internal political capital to directly access and communicate to line of business leaders. Organizations typically limit the initial leadership team to 3-5 people. This ensures an agile team that is empowered to make quick decision.

The first team members include:

1. An infrastructure and operations lead
2. A security and networking or migration lead
3. A Cloud Platform Engineering lead
4. A CCOE leader that is hands-on and a respected member of the IT organization

Part of building the team involves identifying the core services to be offered, and setting the team goals and metrics. At the initial creation of the team, less is more. AWS recommends keeping the list of services offerings and capabilities offered to under six in the first 2-6 months.

Building a CCOE to transform the entire enterprise

A CCoE team should start small, develop an approach for implementing cloud technology at scale for your organization. This team can become the fulcrum by which your organization transforms the way technology serves the business.

The following tenets are key guiding principles for creating a CCoE:

1. The CCoE structure will evolve and change as the organization changes.
2. Treat the cloud as your product, and treat application team leaders as the customers you are enabling.
3. Build company culture into everything you do.
4. Organizational change management is central to business transformation. Use intentional and targeted organizational change management to change company culture and norms.
5. Embrace a change-as-normal mindset. Changes in applications, IT systems, and business direction is expected.
6. Operating model decisions will determine how people fill roles to achieve business outcomes.

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:

- Start with a very aggressive vision but work incrementally in small steps to get there.
- Engage employees by setting goals and letting people tackle them creatively.
- Maintain a relentless focus on becoming ever leaner, with ever shorter lead times.
- Use a lot of automation to enable stability and speed at the same time.
- Have extreme clarity on business objectives, and simpler business cases as a result.
- Ensure that there is a consistent sense of urgency around the transformation to avoid needless debate and delay.

A CCoE is comprised of two functional groups:

- The Cloud Business Office (CBO)

- Cloud Engineering

The functions of each group will help you determine who to include in each group and in the larger CCoE. The CBO owns ensuring that the cloud services meet the needs of your internal customers and 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.

Things to remember regarding CCOE

The CCOE is in service to other teams, not a gatekeeper. By building a partnership and open lines of communication early on, trust can be established and course corrections made as the CCOE evolves. The CCOE is a living organization, the form and function of which will likely change over time and may not be required at some point of future maturity.

Look at embedding some or all of the CCOE close to customers, your lines of business. While coordination becomes more challenging, it offers several advantages, including faster internal customer feedback, and the ability to tap into a wider range of resources. It also acts as a forcing function, removing impediments to educate your end customers and reducing stagnation that can afflict teams working in isolation.

See the following guidelines from *A leader's guide to cloud transformation*:

- Identify key business and technology outcomes and make the people who are accountable for those outcomes also be accountable for the delivery of the technology.

- Don't build new technology to fit a legacy process that was designed to manage risk in a very different technological landscape — modernize, optimize, and create new processes that maximize value from the technology.
- Engage the broader organization and turn potential blockers into advocates.
- As leaders of organizations, it's our role to facilitate the smooth adoption of change — in a world where a constant state of change is becoming the norm, we have to create cultures and organizations that can embrace change and adapt quickly.

Also look at the metrics the team is judged on. There is a reason that metrics that matter are a core part of a digital transformation. If a central team is measured purely on building tech, more and more tech is built, but the use of the technology is an afterthought or assumed to be someone else's responsibility. Your metric should be how many other teams are enabled with self-sufficiency through the CCOE's work, the number of times the CCOE is on the critical path for initiatives, the number of education events held, or the breadth of adoption of the CCOE's output.

Be honest about where decision-making power resides in your organization. A well-constructed, trusted CCOE can be a stepping stone to a larger organizational transformation built on trust.

Procuring cloud

Procurement of cloud is unlike traditional technology purchasing. Traditional public sector procurement and contracting approaches that are designed to purchase products, such as hardware and related software, can be inconsistent with cloud services. A failure to modernize contracting and procurement approaches can reduce the pool of competitors and inhibit customer ability to adopt and leverage cloud technology. Well-designed procurement strategies and cloud-centric contract vehicles make a significant difference. Getting procurement right can lead to accessing a vast portfolio of cloud technology and services that truly achieves organizational digital transformation goals.

As the adoption rate of cloud computing grows, many public sector entities have established approved publicly awarded contract vehicles to purchase cloud services. Taking advantage of existing contracts can help accelerate deployment.

If your organization should choose to proceed with the development of a cloud procurement and issuance of a cloud contract vehicle, this presents an opportunity to reevaluate existing procurement strategies so you can create a flexible acquisition process that enables your organization to access cloud. There are best practices and considerations for cloud procurement from avoiding overly prescriptive requirements to incorporating a utility pricing model (such as

pay-as-you-go). Your organization should leverage third-party accreditations for security, privacy, and auditing, and define cloud evaluation criteria for bidders.

Writing cloud-friendly requirements and RFPs

Do:

- Focus on the outcomes
- Maintain flexible language
- Focus on functionality needed and overall performance-based requirements
- Encourage recommended alternatives to deliver and/or enhance the services and outcomes you seek
- Take advantage of fluctuating prices rather than a fixed-price model
- Specify commercial terms

Don't:

- Be overly prescriptive
- Include specific details, which may outdate the contract
- Dictate the specific methods, hardware, and equipment to be used
- Refer to part numbers to achieve desired outcomes

Envision and align - AWS Cloud Adoption Framework (AWS CAF)

AWS Professional Services created the AWS Cloud Adoption Framework (AWS CAF) to help organizations develop and complete efficient and effective plans for their cloud adoption journey. The guidance and best practices provided by the framework help you build a comprehensive approach to cloud computing across your organization, and throughout your IT lifecycle. For more information, see the *Overview of the AWS Cloud Adoption Framework* whitepaper.

AWS Cloud Adoption Framework overview

- **Envision** — Delivered as a workshop, the **Envision** phase helps you create a foundation for your cloud strategy that returns ongoing measurable value to your organization, connecting your business goals and outcomes to enabling technologies, identifying key measures, and helping you prioritize your cloud initiatives.

- **Align** — Delivered as a facilitator-led workshop that will result in an usable action plan, the **Align** phase helps you determine what cloud adoption means to your organization, understand the key benefits for stakeholders, establish the best approach, and drive clarity to guide your organization's change management during your cloud journey.
- **Launch** — AWS CAF Action Plans helps you develop workstreams for production cloud deployment, complete your cloud projects, proactively address stakeholder's concerns, and start leveraging cloud for incremental business value.
- **Realize Value** — Recognize and measure incremental business value and iterate to deliver against plans. Continually evaluate your cloud strategy to align with envisioned outcomes and identify additional cloud projects to realize ongoing value.

  The AWS CAF organizes guidance into six areas of focus, called *perspectives*. Each perspective is used to create workstreams that uncover gaps in your existing skills and processes, which are recorded as inputs. These perspectives cover distinct responsibilities owned or managed by functionally related stakeholders. In general, the Business, People, and Governance perspectives focus on business capabilities, while the Platform, Security, and Operations perspectives focus on technical capabilities.

AWS CAF perspectives

Following is a brief description of each AWS CAF perspective:

1. **Business perspective** — Common roles: Business Managers, Finance Managers, Budget Owners, and Strategy Stakeholders. Helps stakeholders understand how to update the staff skills and

organizational processes they will need to optimize business value as they move their operations to the cloud.

2. **People perspective** — Common roles: Human Resources, Staffing, and People Managers. Provides guidance for stakeholders responsible for people development, training, and communications. Helps stakeholders understand how to update the staff skills and organizational processes they will use to optimize and maintain their workforce, and ensure competencies are in place at the appropriate time.
3. **Governance perspective** — Common roles: CIO, Program Managers, Project Managers, Enterprise Architects, Business Analysts, and Portfolio Managers. Provides guidance for stakeholders responsible for supporting business processes with technology. Helps stakeholders understand how to update the staff skills and organizational processes necessary to ensure business governance in the cloud, and manage and measure cloud investments to evaluate their business outcomes.
4. **Platform perspective** — Common roles: CTO, IT Managers, and Solution Architects. Helps stakeholders understand how to update the staff skills and organizational processes necessary to deliver and optimize cloud solutions and services.
5. **Security perspective** — Common roles: CISO, IT Security Managers, and IT Security Analysts. Helps stakeholders understand how to update the staff skills and organizational processes necessary to ensure that the architecture deployed in the cloud aligns to the organization's security control requirements, resiliency, and compliance requirements.
6. **Operations perspective** — Common roles: IT Operations Managers and IT Support Managers. Helps stakeholders understand how to update the staff skills and organizational processes necessary to ensure system health and reliability during the move of operations to the cloud and then to operate using agile, ongoing, cloud computing best practices.

By identifying the gaps in skills and processes between the current IT environment and the future cloud environment, an organization can create an action plan designed to close these gaps. The AWS CAF perspectives, capabilities, skills, and processes are designed for organizations to use as they develop plans and workstreams to move from their current IT environment to the AWS Cloud, or to deploy a new environment in the AWS Cloud. Stakeholders with organizational buy-in who apply the AWS CAF structure can create an actionable plan that helps the organization quickly and effectively achieve their desired cloud adoption.

Immersion Day Workshops

Addressing cultural resistance to transformation, change management and workforce development is crucial. Governments need to take a leadership role in training staff to become not only cloud users, but ultimately cloud application builders. Organizations need individuals with cloud skills to help transform their business. AWS Training and Certification helps you build and validate your cloud skills so you can get more out of the cloud. Our content is built by experts and updated regularly to keep pace with AWS technology launches, so you can be sure you are learning the latest and keeping your cloud skills fresh.

AWS Immersion Day workshops are day-long, in-person workshop that AWS Solutions Architects created to help customers walk through different areas of AWS. This in-depth approach helps technical experts learn how to best leverage the AWS platform to unlock business potential and meet key objectives. AWS Immersion Day workshops are available in many solution areas, such as database migration, containers, artificial intelligence, edge services, and more.

AWS provides access to workshop content and tools developed by our AWS Solutions Architects and packages it for use with customers. Included in this package is a full suite of event management resources, including presentations, hands-on labs, and other assets that are custom built and address key customer questions. AWS can offer both digital and classroom training. Digital training enables you to learn online at your own pace. With classroom training, learn best practices from an expert instructor. In addition to in-person classes, virtual training lets you take courses from anywhere. Whether you are just starting out, building on existing IT skills, or sharpening your cloud knowledge, AWS Training and Certification can help you be more effective and do more in the cloud.

Pilot projects

Many organizations start their journey through the right pilot projects before moving to full migration and production. A good start is critical in defining the success of the whole journey.

- **Start with a business problem** — Technology for the sake of technology is a bad strategy. If you are experimenting with cloud technologies, identify a compelling business use case no matter how small it may seem. Then, set clear goals on how that particular business problem can be solved using technology working backwards. This is critical to ensure stakeholder buy-in. Most importantly, take constant inputs from the business before and during the project execution. All successful cloud projects are done in close collaboration with the business units who will use the technology.

- **Start small** — Trying to solve a large-scale problem through the pilot project may turn out to be risky. Pilot projects are all about experimentation. By limiting the scope of the project, you have better control over implementation and end result. It helps to go after specific problems, rather than broad-based goals. If automation is the ultimate goal, aim to automate tasks rather than automating jobs.
- **Define and measure the outcome** — Set clear metrics to assess the progress and performance of the project. Define well in advance the desired state of affairs, to avoid any expectation mismatch among stakeholders. Work closely with business stakeholders and other leaders within the organization to lay out the expectations and measurable gains. It is also important to translate the results into business language. Talk in terms of business goals, how the project improved retention and reduced churn, how costs and speed of completion are improved, and so on.
- **Start from the comfort zone** — It might be a good idea to choose a project that is specific to the business unit in which you operate. This way you can ensure confidence across the board and ensure that the value of the project is quite visible. Such a project will have more long-term impact on your organization. Every organization needs to find its unique components while crafting a successful digital transformation strategy.

Migration Readiness Assessment

Evaluating migration readiness is a process of gaining insights into how far along an organization is in their cloud journey, understanding their current cloud-readiness strengths and weaknesses, and building an action plan to close identified gaps. AWS CAF and its six perspectives (business, people, governance, platform, security, and operations) help ensure that you have a holistic view of the transformation initiative required for an effective move to the cloud. The AWS Prescriptive Guidance migration strategy uses MRA as the prescriptive model for the assessment phase. Although other methods are available, they might compromise the completeness or depth of the review.

Three outcomes are expected from a readiness review:

1. An understanding of where an organization is in its cloud journey.
2. Identified areas of strength and weakness from a cloud-readiness perspective.
3. An action plan to resolve the identified gaps, so the organization can migrate at scale without having to pause to solve foundational issues.

In addition, there are often additional outcomes:

- Alignment and consensus building within the team.
- Identification of best practices within the organization that can be leveraged and scaled.
- A reduction in roadblocks that can disrupt progress.

Phase 2 - Getting started

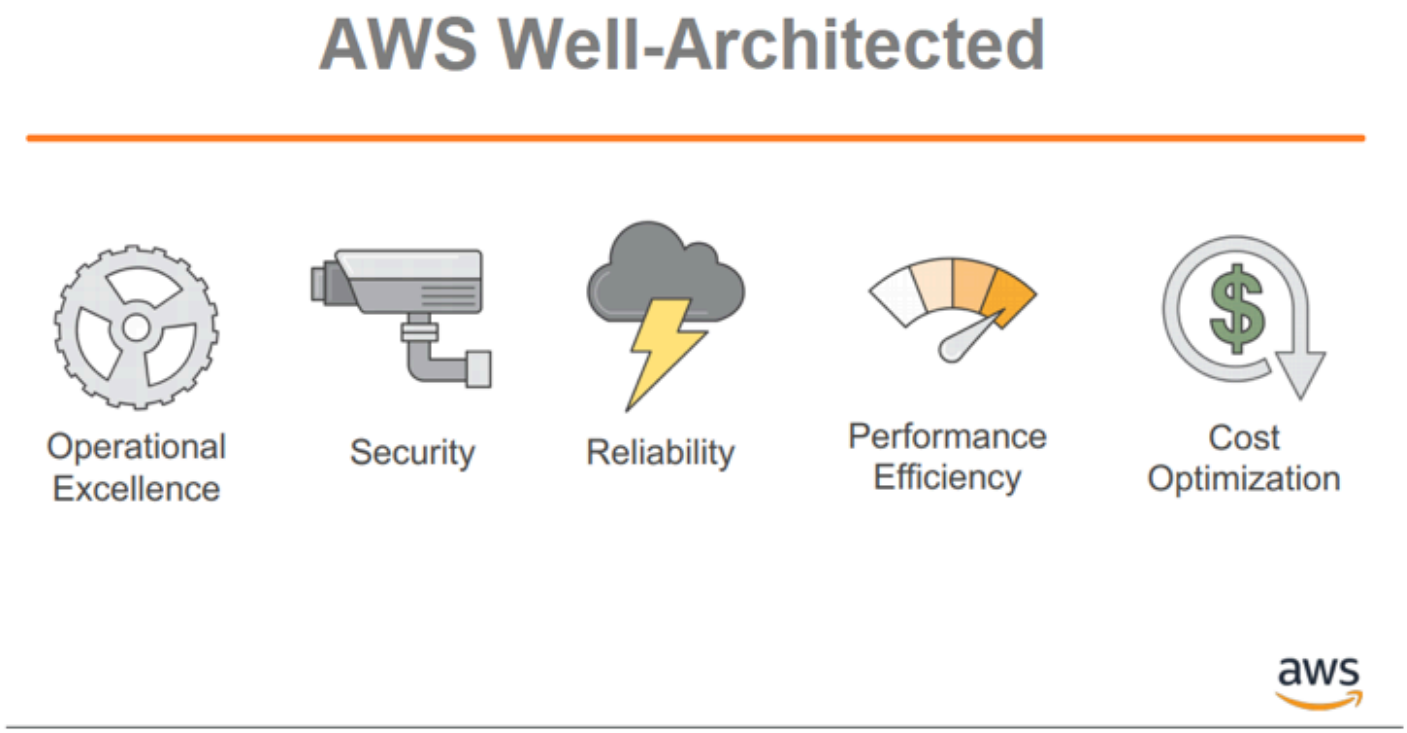
Architecting

Architectural principles and services are used to develop technical cloud strategies, assist with cloud migration efforts, review workload architectures, and provide guidance on how to address high-risk issues. AWS uses these skills to assist customers in building secure, reliable, cost efficient, high performance, and operationally sound applications that simply could not exist on premises. AWS formalized these architectural best practices into a framework called the AWS Well Architected Framework.

AWS Well-Architected Framework

The AWS Well-Architected Framework helps your organization understand the pros and cons of decisions while building systems on AWS. By using the Framework, you will learn architectural best practices for designing and operating reliable, secure, efficient, and cost-effective systems in the cloud. It provides a way for you to consistently measure your architectures against best practices and identify areas for improvement.

The process for reviewing an architecture is a constructive conversation about architectural decisions, and is not an audit mechanism. Having well-architected systems greatly increases the likelihood of business success.



AWS Well-Architected elements

The framework provides a consistent approach to evaluating systems against the qualities you expect from modern cloud-based systems, and the remediation that would be required to achieve those qualities. The AWS Well-Architected Framework describes the key concepts, design principles, and architectural best practices for designing and running workloads in the cloud. By answering a set of foundational questions, you learn how well your architecture aligns with cloud best practices and are provided guidance for making improvements.

- **Operational excellence pillar** — The operational excellence pillar focuses on running and monitoring systems to deliver business value, and continually improving processes and procedures. Key topics include automating changes, responding to events, and defining standards to manage daily operations.
- **Security pillar** — The security pillar focuses on protecting information and systems. Key topics include confidentiality and integrity of data, identifying and managing who can do what with privilege management, protecting systems, and establishing controls to detect security events.
- **Reliability pillar** — The reliability pillar focuses on ensuring a workload performs its intended function correctly and consistently when it is expected to. A resilient workload quickly recovers from failures to meet organizational demand. Key topics include distributed system design, recovery planning, and how to handle change.

- **Performance efficiency pillar** — The performance efficiency pillar focuses on using IT and computing resources efficiently. Key topics include selecting the right resource types and sizes based on workload requirements, monitoring performance, and making informed decisions to maintain efficiency as business needs evolve.
- **Cost optimization pillar** — The cost optimization pillar focuses on avoiding unnecessary costs. Key topics include understanding and controlling where money is being spent, selecting the most appropriate and right number of resource types, analyzing spend over time, and scaling to meet organizational needs without overspending.

The AWS Well-Architected Framework provides a set of questions that enable you to review an existing or proposed architecture. It also provides a set of AWS best practices for each pillar. Using the Framework in your architecture will help you produce stable and efficient systems, which allow you to focus on your functional requirements.

Secure Environment Accelerator (Canada)

To meet the high security standard required by the Government of Canada, the AWS Canada (Central) Region was assessed against hundreds of controls. This security assessment provides additional assurance to customers of all sizes and across all industries, including local and provincial governments that AWS has passed a significant technical review set forth by the Government of Canada.

The Government assessed whether AWS has the ability to address the requirements of the Government of Canada selected security controls and enhancements, as outlined in ITSG-33 IT Security Risk Management: A Lifecycle Approach, Annex 3 – Security Control Catalogue. The AWS compliance program descriptions are posted publicly, and the SOC 3 report, as well as all of the AWS ISO certifications, are downloadable usiing the AWS Artifact portal. Detailed reports of compliance and the detailed audit results are available to customers and potential customers under NDA.

The AWSSecure Environment Accelerator (SEA) is a tool designed to help deploy and operate secure multi-account, multi-Region AWS environments on an ongoing basis. The power of the solution is the configuration file that drives the architecture deployed by the tool. This enables extensive flexibility and for the completely automated deployment of a customized architecture within AWS without changing a single line of code.

While flexible, the AWS SEA is delivered with a sample configuration file which deploys an opinionated and prescriptive architecture designed to help meet the security and operational

requirements of many governments around the world (initial focus was the Government of Canada). Tuning the parameters within the configuration file allows for the deployment of customized architectures and enables the solution to help meet the multitude of requirements of a broad range of governments and public sector organizations.

While the installation of the provided prescriptive architecture is reasonably simple, deploying a customized architecture requires extensive understanding of AWS.

Selecting the right cloud for workloads – differences between public, private, and hybrid

With the adoption of cloud computing at scale globally, three main cloud models appear: *private*, *public*, and *hybrid* clouds. The following sections explore which models are the most suitable for which workloads.

The AWS public cloud

In the public cloud space, AWS provides services such as the Amazon Elastic Compute Cloud (Amazon EC2), which provides infrastructure and services over the public internet and are hosted at an identified AWS Region (for example, Canada Central). Although the infrastructure and services are provisioned from a remote location, the customer has no control and limited visibility over where the service is hosted. But they can use those services anytime anywhere as needed. The AWS public cloud offers advantages such as low cost of ownership, automated deployments, scalability, security, recovery and reliability. AWS public cloud is well-suited for the following:

- Data storage
- Data Archival
- Application Hosting
- Latency intolerant or mission critical web tiers
- On-demand hosting for microsite and application
- Auto-scaling environment for large applications

The private cloud

A private cloud, as the name suggests, is cloud infrastructure for use exclusively by a single organization. The cloud is owned, managed and operated exclusively by the organization, by a

third-party vendor, or both. In this cloud model, the infrastructure is provisioned on premises using a virtualization layer (for example, VMware). Private cloud environments offer greater configurability support to any application, and support those legacy applications that suffer from performance issues in the public cloud.

While the private cloud offers the greatest level of control and security, it demands that the organization purchase and maintain the entire infrastructure and acquire and retain the skill to do so. This makes the private cloud significantly more expensive. Choosing a private cloud makes sense for:

- Strict security, latency, regulatory and data privacy levels not met by the public cloud.
- Organizations that are highly regulated and need data hosted privately and securely.
- Organizations that are large enough to support the costs.
- Organizations that need high-performance access to a file system, such as media companies.
- Hosting applications that have predictable usage patterns and demand low storage costs.
- Organizations that demand greater adaptability, configurability, and flexibility.
- Hosting business-critical data and applications.

In the private cloud space, AWS provides the Amazon Virtual Private Cloud (Amazon VPC).

The hybrid cloud

When an organization wants to leverage the cloud both for its efficiency and cost saving but also wants on-site security, privacy, and control, it looks to the hybrid cloud, which almost serves as a midway point between the public and private clouds. The hybrid cloud uses a combination of at least one private and one public cloud. A hybrid cloud can also consist of multiple private and public clouds and may use many active servers, physical or virtualized, which are not a part of the private cloud. With the hybrid cloud, organizations can keep each business aspect in the most efficient cloud format possible. However, with the hybrid cloud, organizations have to manage multiple security platforms and aspects and also ensure that all the cloud properties can communicate seamlessly with one another.

A hybrid cloud is best suited for:

- Large organizations that want the flexibility and scalability as offered by the public cloud.
- Organizations that offer services for vertical markets- customer interactions can be hosted in the public cloud while company data can be hosted in the private cloud.

- Organizations that demand greater operational flexibility and scalability. For them, mission critical data can be hosted on the private cloud and application development and testing can take place in the public cloud.

Given today's dynamic and increasingly complex business environment, organizations have to constantly reevaluate their cloud infrastructure, whether public, private, or hybrid, to ensure that the cloud delivers results. Because there are different security and management demands for each of these cloud models, organizations must ensure that they select their application candidates for the cloud wisely so that they can foster innovation and improve agility by leveraging their IT resources optimally.

AWS Outposts

AWS Outposts is a fully managed service that offers the same AWS infrastructure, AWS services, APIs, and tools to virtually any datacenter, co-location space, or on-premises facility for a truly consistent hybrid experience. AWS Outposts is ideal for workloads that require low latency access to on-premises systems, local data processing, data residency, and migration of applications with local system interdependencies.

AWS compute, storage, database, and other services run locally on Outposts, and you can access the full range of AWS services available in the Region to build, manage, and scale your on-premises applications using familiar AWS services and tools.

Application migration strategies

This is where you start to develop a migration strategy. 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 AWS refers to as the 6 Rs:

- **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. Most re-hosting can be automated with tools (such as 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 are 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.

- **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.
- **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 serverless) 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.
- **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.
- **Retire** — Remove applications that are no longer needed. After 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.
- **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 time.

Accelerating training – The AWS Skills Guild

Your organization is investing in cloud, modernizing applications and workloads, transforming the way you work and do business. You have run some initial Immersion Days, and now it's time to

invest in your people and give energy and momentum to your ongoing cloud journey, creating an innovative culture of continuous learning that will help propel your organization into the future.

The AWS Skills Guild is a tailored educational experience that helps build the skills your organization needs to get the best from the AWS Cloud and support key initiatives and projects. Purposefully structured, but also fun and engaging, the program generates excitement about AWS, increasing affinity with the technology and creating an enthusiastic learning culture. Building a groundswell of cloud knowledge and skills across your organization, will also drive AWS Certifications for staff to lead successful future cloud projects, which also helps both attract and retain top talent.

A mix of the common workshops and training opportunities below will combine to form a program that creates momentum for your cloud adoption processes and cultural transformation:

1. **Formal training courses** — Let your teams develop the skills to design, deploy and operate infrastructure and applications. This will be through instructor-led classes, labs, self-explore learning materials and certification preparation workshops.
2. **Digital Innovators workshop** — Working with your business leaders, AWS helps to enable them in the process of working backwards from customer requirements, to innovate on their behalf.
3. **Game Days and Hackathons** — Having fun is essential to any learning journey. Game Days and Hackathons are engaging ways to put what your teams have learned to the test in a fun and idea-filled environment.
4. **Lunch and Learns** — Part of the continuous development phase, *Lunch and Learns* enable experienced staff to engage with new technologies, practices, and services to keep their skills on the cutting edge.
5. **Cloud for Business workshops** — Learn from AWS senior leaders and cloud experts who will address non-technical groups on topics such as collaboration, the agile workplace, innovation, and AWS Cloud fundamentals.
6. **Digital learning** — AWS Digital Training is designed to let you learn at your own pace, providing on-demand access to fundamental digital training courses with previews of paid technical specialty content.
7. **Focus on certification** — Set goals to get a minimum number of technical staff certified on AWS. AWS provides leadership and support to drive the focus on AWS Certifications.

Organizations can also continue to leverage further Immersion Days to strengthen capabilities with particular technologies and AWS services.

Continuous upskilling

Organizations need individuals with cloud skills to help transform their business. As outlined previously in this guide, AWS Training and Certification helps you build and validate your cloud skills so you can get more out of the cloud. After your organization has the foundational elements of training and certifications, your cloud experts should access AWS additional learning opportunities by attending AWS events (such as re:Invent and Summits) and by tracking theAWS daily blog. Staying engaged will enable your cloud teams to stay up to speed on services and features as they roll out to customers.

Operations and governance (cloud operating model)

Many organizations start by taking a traditional project-based approach adding cloud as an additional technology layer into their existing operating model and landscape. While they may start to realize value and savings from reduced infrastructure spend over traditional and legacy on premise approaches, adding yet another technology into the mix does bring in challenges. It can mean they are unable to adopt and support new business initiatives at a pace demanded by the business. It is not until one or more events and issues arise that many IT leaders are forced into acting and doing something different.

Establishing an appropriate cloud operating model is critical to forming your organization's successful adoption of cloud and delivering greater business agility. The impact of the cloud will be felt across your entire organization (not just information technology) and will significantly affect, and be affected by, your organizational culture and Information technology delivery structures. Understanding these implications and your company's desire to change are important elements of building a successful cloud operating model.

Unlike some of the more technical domains, building out and establishing a cloud operating model is more fluid in terms of prescriptive outcomes. Our experience in working with successful cloud Technology Leaders (CIO/CTO) is that they look to establish a capability that is value generating before they are faced with failures and firefighting.

Examples of value generation seen by some AWS adopters include:

- 60% reduction in downtime
- 51% efficiency savings
- 14x reduction in time to deliver
- 43% reduction in operational costs

Unfortunately, there is often a sole focus on the technology of cloud and it is not until issues arise that that many IT leaders are forced into acting and doing something different.

A successful cloud operating model (COM) enables organizations to operate applications reliably and securely in the cloud with a faster pace of innovation and value to the business. A key component of leading COM approaches is the adoption of a Product based approach of the cloud platform. By adopting a product mindset, each team can take the responsibility and accountability for increased awareness, ownership and operational excellence through self-healing systems that can recover quickly using integrated failure detection and remediation.

A number of key activities can facilitate, support, and even accelerate the achievement of cloud adoption and delivery of business outcomes. Enterprises usually have a multitude of competing priorities, even within their cloud strategy. Failure to transform operating models can result in a great stall phenomenon where adoption momentum stops or slows to a crawl. One of the key factors observed in those customers who have avoided this effect has been the successful establishment of a cloud delivery and governance function, often referred to as a Cloud Center of Excellence (CCOE).

There are six steps that companies should follow to build out a successful CCOE:

1. Work backwards from the customer
2. Re-envision the world as products
3. Organize teams around products
4. Bring the work to the team
5. Reduce risk through iteration
6. Own your entire lifecycle

Platform optimization can be added through the measurement of known application baselines and testing those baselines using chaos engineering (failure injection) and game days (interactive team-based hands-on learning exercise). Achieving these recommendations most likely needs a culture shift around how organizations design, deploy, and operate their cloud platform and a focus on automation with repeatable, ongoing processes.

To set the stage for transformation, organizations need to move towards iterative and incremental operating model improvements and a product-based mindset to IT delivery. This section covered best practices for establishing a cloud operating model, including:

- Start small, but keep the end in mind.

- Strive to define a future state model that the cloud affords, and aligns to outcomes that are core to your business.
- Be intentional about how you drive change and bring people along on the journey, and do so via iterative continuous improvements, cross-functional teams and experimentation.
- Pilot what success looks like by establishing an initial cloud foundation team, identifying several candidate workloads to run on AWS, tracking clearly defined metrics, creating opportunities for continuous learning, and celebrating early wins.

By following these guidelines, you can set a foundation that can be emulated and scaled to other parts of the organization.

Culture and change management

The people, culture, and change leadership domain is critical to establishing your organization's cloud readiness and implementing a migration at scale. The impact of the cloud will be felt across your entire organization and will significantly affect, and be affected by, your organizational culture. Understanding these cultural implications, your organization's receptivity to change, prior change successes and failures, organizational communication patterns to date, organizational structure, and level of executive sponsorship, commitment and alignment, are all important elements of building a successful approach to cloud adoption.

To prepare for an enterprise migration, your organization must have a critical mass of people with production experience in the cloud, established operational processes, and a leadership team dedicated to mobilizing the appropriate resources and leading teams through the many organizational and transformational challenges presented over the course of a large-scale migration effort. Based on many years of experience leading and advising enterprises across a wide array of industries, AWS has found that organizational adoption of change and political and cultural impact are the most challenging and underestimated roadblocks to cloud adoption success.

Government organizations are comprised of disparate agencies and departments that in some cases can be considered enterprise class in their scope and scale. Often, managing the IT services for each of the lines of business is handled by an IT organization, which is dedicated to supporting that individual unit. In other cases, there is a centralized IT organization providing services to all agencies. Therefore, having strategic alignment across the enterprise, including non-IT leadership, from the beginning is crucial to a digital transformation's success. Not involving stakeholders,

defined as those that have an influence over or consume the enterprise's technology and aligning the business and technology strategies, has shown to hinder or even prevent widespread cloud adoption. Organizations need to get buy-in from the right stakeholders early in the planning and implementation process to develop a holistic cloud vision, which will drive and accelerate organizational and cultural change.

As discussed earlier, the primary business objectives to set the foundation for this domain are the alignment of critical organizational leaders and commitment of executive sponsorship, the mobilization of migration resources, and envisioning the organization's future state. A number of key activities can facilitate, support, and even accelerate the achievement of these business outcomes by preparing and enabling the people in the organization who will be impacted by the business transformation.

Enterprises usually have a multitude of competing priorities, even within their cloud strategy. Additionally, there is often an expectation that a single executive sponsor can produce the intended business outcomes. In reality, the impact of cloud adoption on an organization is far-reaching and requires cross-functional leadership and alignment as well as clear prioritization. In the MRA phase of adoption, you lay the foundation; get the right leaders in place; pull together a capable team that can deliver a body of work (like migrating an application to AWS, or standing up a new environment); envision what the future will look like culturally, organizationally, and for internal and external customers; and start to learn and demonstrate, through action, what success looks like. This cross-functional set of leaders, who may later become part of a CCoE team, should strive to achieve alignment across the organization and define value-add within their own teams, drive organizational urgency and prioritization of cloud adoption, and envision the future state of the organization.

Some questions that you will answer at this stage are:

- How will our culture change or stay the same?
- How will we operate differently than we do today?
- Who will our internal customers be, and how will we engage them to drive better outcomes for external customers?
- How will our teams look compared to today? Will they operate in a *you build it, you run it; you run it, you build it* model? If so, what skills and capabilities will that require each team to be self-sufficient? What attitudes and behaviors will that require?
- How will leaders help managers and teams adopt this new way of operating and delivering results to customers?

- How will our teams adopt a product-based operating model, if that is different from how the organization has historically operated?

This stage is the opportunity to learn and grow through experience before taking the migration project to the next level. Nothing is more effective and builds momentum faster than the opportunity to learn by doing. AWS recommends providing that opportunity through a number of different avenues, which we will outline in detail in the next section. Begin by pulling together a group of cross-functional leaders, making decisions about what the future will look like for the people in the organization, mobilizing an initial implementation team and an initial body of work to gain the necessary insight and learnings, and demonstrating results that can be emulated and scaled. These are the first steps to setting the foundation for future state culture, change, and leadership.

For more information, see the *AWS Prescriptive Guidance* whitepaper.

Guidelines and steps to set the foundation:

- Design the team(s) responsible for mobilizing critical cloud resources (cross-functional leaders who are able to make day-to-day decisions quickly and efficiently).
- Define how the organization builds and implements their cloud strategy by designing teams for the future state of operations.
- Establish a dedicated team with single-threaded ownership and strong, visible, engaged executive sponsorship (this is not an IT project).
- Set functional areas to be managed throughout the migration journey.
- Start to establish a cloud governance model, set of standards, best practices, and guiding principles or tenets.

To set the stage for transformation, organizations require a diverse set of views, experiences, and leadership styles. No one leader or team can achieve what a cross-functional group of influencers and change agents can do together. This section covered best practices for dealing with organizational changes, including:

- Start small, but keep the end in mind.
- Strive to define a future state model that the cloud affords, but also honor the cultural values that are core to your business.

- Be intentional about how you drive change and bring people along on the journey, and do so through strong executive sponsorship, cross-functional leadership, defining what success looks like early in the journey, and learning through hands-on experience and delivering results.
- Pilot what success looks like by establishing an initial cross-functional team, identifying a candidate workload or set of workloads to run on AWS, tracking clearly defined metrics, creating opportunities for continuous learning, and celebrating early wins.

By following these guidelines, you can set a foundation that can be emulated and scaled to other parts of the organization.

Budgeting and cost optimization

Understanding Total Cost of Ownership

Determining total cost of ownership (TCO) for a cloud migration can be challenging when evaluating what-if scenarios, over-provisioning, outdated servers, legacy applications, or spreadsheets of stale data. There are many indirect and difficult to calculate costs such as downtime and lack of productivity. It also requires finding time to dive into your IT Infrastructure to figure out what you have and if you need it. To avoid spending more time on this project, many organizations simply lift and shift all of their assets to the cloud. The issue with the lift-and-shift strategy is it will likely increase your TCO, which defeats one of the main reasons for migrating to the cloud – saving money.

When migrating to AWS, many organizations fail to consider the benefits of rightsizing before migrating their workloads. If your infrastructure is in the cloud and you have rightsized your assets properly, the resources you need for peak utilization will be there when needed, and in addition, you do not have to pay for more resources than you need. For this reason, a TCO analysis is essential for a successful cloud migration.

Running a TCO analysis on your assets (physical machines, servers, labor, storage, software licenses, and data centers) is vital to understanding what you are paying for your current IT infrastructure and how that translates into the pricing for a cloud environment. Migrating to the cloud without making a migration plan can actually increase your monthly spending. It is never a good thing to receive a bill that is higher than you have budgeted, but a TCO assessment can help prevent this from happening. For more information, see Cloud economics: the value of a TCO assessment.

Understanding Government Workload Assessment (GWA)

The GWA is a research engagement that identifies the potential benefits to the government organizations if they re-architect to the AWS Cloud. These organizations will be enabled to plan their cloud transformation based on year-over-year workload forecasts, complementary analyses and recommendations provided by AWS subject matter experts.

Governments and public sector organizations are hesitant to undertake large-scale cloud migration and transformation projects because they have significant unknowns regarding their current total IT estate. They do not have visibility into the scale of potential cost savings achievable with a move to the cloud. This impedes their readiness to start any transformation process. Customers have sought AWS assistance to efficiently gather data, produce forecasts, and demonstrate savings over time – activities which led to successful outcomes on TCO analyses. GWA has the capability to detail the potential benefits (such as cost savings), migration options, and infrastructure considerations of a government-scale cloud transformation with a suitable degree of certainty.

GWA is a free service, provided to the customers seeking whole-of-government cloud transformations. The core output of this engagement will be a customer-facing report containing both organization-specific and whole-of-government cloud adoption forecasts; a TCO analysis; and recommendations for migration- and/or infrastructure-related solutions. This report will accelerate transformation by clearly articulating organization-specific cost savings opportunities, and is designed to be a compelling asset for champions of cloud transformation within the government.

GWA will present to the customer the following benefits:

- High-level understanding of the customer current IT estate (such as servers, storage, usage).
- Potential cost benefits from its conversion (infrastructure migration) to AWS.
- Whole-of-government style of assessment. GWA is not about taking a snapshot in time with a well-defined workload for assessment, it is about knowing the unknown and extrapolate over a 10-year period to plan a longer-term transformation that includes several entities under the government umbrella.
- GWA will be provided to the customer at no cost.

Following is a high-level overview of the GWA engagement process:

- **Program kick-off** — Formal kick-off with the program sponsor to agree on the targeted organizations under the assessment and marshal the support of the necessary stakeholders (for example, CIOs and technical staff).

- **Data collection** — Collect the information from each entity under the assessment about the current IT estate, applications and plans for the next five years. AWS utilizes Migration Evaluator (Formerly TSO Logic) software to analyze the compute footprint, including server configuration, utilization, and annual costs to operate.
- **Data analysis** — Validate assumptions with the sponsor, aggregate and extrapolate the data to produce a whole-of-government perspective.
- **Deliverables presentation** — Presenting the final report, which will include the following:

- A usage estimation for each organization under the assessment, along with the extrapolated whole-of- government estimation.
- A full list of GWA assumptions signed off by all relevant parties.
- A cloud economics showcase to demonstrate the real business benefits of moving to the cloud.

Cost optimization

Cloud cost optimization improves forecasting and cost predictability and provides visibility into usage patterns to right size for organizations' specific needs and can help identify mismanaged resources, reserving capacity for higher discounts, and right-sizing services to scale. One place to start is to look for unused resources. Often a temporary compute instance is *spun-up* to perform a function, and forgotten when the job is complete. As an example, AWS estimates that by using automated instance scheduling, customers can lower costs up to 70% when shutting down non-production instances outside of work hours.

What are some other common oversights customers make that can drive up their cloud spend? Avoid the following missteps:

- **Orphaned resources** — Often customers mistakenly set up compute or storage instances without using auto-scaling or other monitoring tools. This is common with dev/test environments because of their temporary nature. However, it is not uncommon for customers to have large storage pools or database workloads orphaned and consuming valuable financial resources.
- **Misconfigured storage resources** — Storage can cause pitfalls for customers. Customers forget to release their storage resources from their compute instances, and their storage costs continue despite the compute instances being terminated. Another common mistake is the misalignment of data types and storage class. Often customers will allocate warm or cold storage into local or

pools of higher-performing data storage. Right-sizing storage by data type and usage can reduce your associated costs by up to 50%.

- **Over-provisioned resources** — Right-sizing is the process of matching instance types and sizes to performance and capacity requirements at the lowest possible cost. A key cloud cost optimization priority includes identifying such instances and consolidating computing jobs into fewer instances. In the past, administrators often over-provisioned so they would have capacity for a spike in traffic. By right-sizing workloads and using automation, AWS customers have seen up to 36% in cost savings.
- **Incorrect pricing plans** — Many organizations do not use the cloud pricing plans that best align to their usage requirements. AWS offers multiple pricing models options such as Spot Instances, which enable you to request spare computing capacity for up to 90% off the On-Demand price. Reserved Instances also provide a significant discount compared to On-Demand pricing. For more information, see Instance purchasing options.
- **Overlooking newer technologies** — AWS routinely updates its service portfolio, and these new technologies offer unique advances in productivity, and can potentially reduce your cloud spend. Some customers can benefit from re-platforming their existing deployments with newer cloud services. For example, a customer could replace their hosted monitoring services with Amazon CloudWatch, or they could replace traditional compute instances with a serverless implementation to save significant costs.

AWS provides a set of out-of-the-box cost management tools to help you manage, monitor, and optimize your costs. These key services and solutions to help you manage your cloud spend include:

- **Migration Evaluator** — To assist potential customers with planning a migration, TSO Logic (an AWS company) provides data-driven Total Cost of Ownership (TCO) and cost modelling analysis, so customers can plan for their ideal future state on AWS.
- **AWS Budgets** — Gives you the ability to set custom alerts for when your costs or usage exceed your budgeted threshold. You can also use AWS Budgets to set reservation utilization or coverage targets and receive alerts when your utilization drops below defined parameters. Reservation alerts are supported for Amazon Elastic Compute Cloud (Amazon EC2), Amazon Relational Database Service (Amazon RDS), Amazon Redshift, Amazon ElastiCache, and Amazon OpenSearch Service (OpenSearch Service).
- **AWS Cost & Usage Report** — Contains the most comprehensive set of AWS cost and usage data available. The AWS Cost & Usage Report lists AWS usage for each service category used by an

account and its AWS Identity and Access Management (IAM) users in hourly or daily line items, as well as any tags that you have activated for cost allocation purposes.

- **AWS Cost Explorer** — Helps visualize and manage your AWS costs and usage over time. A set of default reports are included to help you quickly gain insight into your cost drivers and usage trends. Use forecasting to get a better idea of what your costs and usage may look like in the future.
- **AWS Trusted Advisor** — Since 2013, AWS customers have viewed over 2.6 million best-practice recommendations and realized over $300M by using AWS Cloud cost optimization tools. AWS Trusted Advisor provides you near real-time guidance to help you provision your resources, following AWS best practices. Trusted Advisor helps optimize your entire AWS infrastructure to increase security and performance and reduce your overall costs. For more information, Watch a technical walkthrough of the service and console.

Phase 3 - Gaining momentum and optimization

Programs

Once you have garnered a certain level of maturity and have begun advancing your cloud journey beyond initial pilots and migrations, your organization will be able to take advantage acceleration and cost savings programs.

Migration Acceleration Program

The AWS Migration Acceleration Program (MAP) is designed to help enterprises committed to a migration journey achieve a range of these business benefits by migrating existing workloads to AWS. MAP has been created to provide consulting support, training and services credits to reduce the risk of migrating to the cloud, build a strong operational foundation and help offset the initial cost of migrations. It includes a migration methodology for completing legacy migrations in a methodical way, as well as robust set of tools to automate and accelerate common migration scenarios. By migrating to AWS, enterprises can focus on business innovation instead of dedicating time and attention to maintaining their existing systems and technical debt. Sacrifices and painful trade-offs no longer have to be made to get something to market quickly. Enterprises can focus on differentiating their business in the marketplace and taking advantage of new capabilities.

MAP methodology

The Migration Acceleration Program consists of a three-step approach for migrating to AWS that includes the following:

- **Migration Readiness Assessment (MRA) phase** — As discussed earlier, the MRA phase determines the current state of your readiness to migrate and identifies areas where you already have strong capabilities and where further development is needed to migrate at scale. The MRA is based on the AWS Cloud Adoption Framework (CAF) and evaluates cloud readiness along eight dimensions (landing zone, operating model, security and compliance, migration process experience, skills and center of excellence, migration plan and business plan). The MRA typically involves a one-day workshop conducted by AWS and/or a MAP Partner.
- **Migration Readiness & Planning (MRP) phase** — During the MRP phase, you will team with AWS Professional Services and/or a MAP Partner to build the foundation for a large-scale migration and gain experience migrating and operating several workloads on AWS. AWS and

MAP partners have developed a prescriptive methodology and approach based on best practices gleaned from hundreds of customer migration projects that significantly reduce time to migrate while lowering cost and risk. To prepare a cloud operational foundation, you will follow an agile approach with workstreams for cloud center of excellence, landing zone, operation model, and security and compliance. In addition, AWS will work with you to develop a strong migration plan and compelling business case that articulates the total cost of ownership (TCO) and return on investment (ROI) for a cloud migration. At the end of this phase, which is usually completed in 2-4 months, you will be ready to migrate at scale.

- **Migration phase** — In the Migration phase, you will complete the migration plan developed during the MRP phase, typically with the assistance of AWS Professional Services and/or a MAP Partner. A key component is establishing a *migration factory* composed of teams, tools and processes to streamline the movement of workloads from on-premises to AWS. The migration factory teams work through a prioritized backlog of workloads based on migration patterns identified in the portfolio discovery and planning process. Where possible we apply known migration and operational patterns to accelerate the movement of workloads, reduce risk and improve the final outcome. With this approach, you will quickly start to achieve the business benefits of lower operating costs and gaining agility and scalability. Once in the cloud, you can focus on optimization of applications, processes, operations and costs. This phase typically takes 12-24 months to complete.

Experience-based Acceleration

Experience-based Acceleration (EBA) is a transformation methodology designed to help customers accelerate cloud adoption and create sustained momentum for modernization initiatives. EBA brings together the right combination of cloud experience, change management principles, and AWS experts to help customers unblock cloud adoption. Enterprises and governments have leveraged EBA methodology for their strategic migration and modernization initiatives. EBA delivers acceleration workshops and activities called *EBA Parties*. These workshops align an organization, accelerate decision-making, create new processes, impart training, and change the way people work.

EBA sprint-based activities (virtual and in-person) are called *parties*, because they are self-contained. They invite representatives from every part of an organization and the hands-on experience is rewarding and fun. Each party has a purpose and brings together specific resources, decision makers, and experts to solve distinct challenge.

The sequence of planned EBAs depends on your customer needs:

1. **Assess — Cloud Acceleration Workshop** — The Cloud Acceleration Workshop is an AWS facilitated activity that develops a critical-path roadmap for cloud adoption. Importantly, as part of the process, the activity aligns leader stakeholders, business objectives and known success patterns for enterprise transformation and how to work efficiently and quickly through the roadmap.
2. **Platform Party — Stress test your AWS Landing Zone** — Utilizing the Cloud Adoption Framework, the Platform Party is a sprint based, three-day interactive event designed to accelerate the validation of the AWS Landing Zone and the development of the required operating and governance models. This party facilitates identification of needs and blockers to remove in order to get to a full-functioning production platform. Resolving these blockers is often problematic in regular working environments. The Platform Party will facilitate accelerated problem solving, with relevant stakeholders present to resolve points of friction and align to best practices suitable for your environment.
3. **Migration Party — Migrate three applications in three days** — The Migration Party is a sprint-based, interactive workshop designed to accelerate application migration. Using AWS CAF, the Migration Party builds on your AWS Landing Zone and focuses on the development of customized patterns that enable your organization for rapid lift and shift or re-factor migrations, operational and governance scaling, and developing a pipeline for applications that are candidates for migration and automation. This workshop is designed to migrate 3-5 applications to AWS in three days and identify blockers and resolve them with cross functional resources.
4. **Modernization Party — Transform applications and build new workflows** — The Modernization Party targets customer needs to re-architect applications and business workflows; containerize and/or breaking down applications into micro-services (deconstructing the monolith); and building cloud native applications. Similarly structured to a Migration Party, the Modernization Party utilizes AWS CAF, moving data and workflows to cloud – but as part of re-architecting applications or building net-new capability.
5. **People Party — Build your Cloud Enablement Engine (aka CCOE)** — The People Party is a two-day interactive workshop designed to enable an enterprise's ability to create, sustain and govern the change that occurs to accelerate cloud adoption. AWS experts will work with your organization to build and grow your initial cloud team responsible for strategy and operations. AWS starts with the needs of your internal customer, discussing existing organization structures, current constraints, key roles for delivering value, and map skills and roles to future needs in the context of hiring. Experience-Based Accelerators (EBAs) are a leading AWS customer program designed to provide *learn-by-doing* workshops that help large enterprises experience new ways of working, communicate, ignite initiatives, and remove barriers to internal transformation.

EBAs are immersive engagements that change the way customers work – from legacy siloed teams to cross-functional empowered teams; from waterfall project-based focus to iterative product-based completion; long-lead analysis to bias for action. For each EBA engagement, cross-functional customer teams and AWS SMEs are collocated for 3-5 days, focused on delivering specific outcomes and starting their transformation journey.

Continuous optimization

Continuous optimization is an iterative process where we implement a set of simple, high-impact cost reduction methods across all applications, and then measure and report the cost savings results. The process is then repeated on a regular cadence. Following are two essential tenets of continuous optimization:

- **Tenet 1: Cost optimization is not a project, it's a way of life**.

  AWS is never finished with continuous optimization. It is integrated into existing operating procedures, and AWS works to improve the process every cycle. The process is designed to be low-cost and low-overhead. Within those limitations, continuous optimization is designed to find out exactly what level of super-optimization is possible. How inexpensively can we run each application? is the question to be answered
- **Tenet 2: Focus on big impact / low effort**.

  Each optimization idea should be ranked by its impact/effort ratio, and ideas should be implemented starting from the top of the list and progress downward until reaching a point where the effort exceeds the impact. This line will be drawn in a different place by different organizations, and can change over time to suit the business priorities.

The continuous optimization process

The following are three categories of optimization along with several examples of each.

Category 1: Remove

These are the easiest ideas that produce the most cost savings.

1. **Remove unused applications** — Determine whether the application is really needed. If not, delete all infrastructure and data associated with it.

2. **Remove unused instances** — Look for instances that are no longer used, and then shut them down. AWS CloudWatch Metrics can be a useful starting point to discover idle instances.
3. **Remove unused storage volumes** — Volumes unattached from instances (orphan volumes) are almost never needed any longer. A helpful policy is to require that needed orphan volumes have a tag specifying who needs it and why it is needed. Verify that they're not needed and remove them.
4. **Remove unused snapshots** — Storage and instance snapshots accumulate when there isn't an active process to remove them. Determine what is needed and remove the rest.
5. **Reallocate or sell unutilized reserved instances** — AWS Cost Explorer is a great tool for finding unused RIs. Either move an on-demand instance to an instance type that is covered by an RI or resell them on the Amazon EC2 Reserved Instance Marketplace.

Category 2: Resize

Everything that can't be deleted should be evaluated to ensure it isn't over-provisioned.

1. **Resize instances** — Use Amazon CloudWatch Metrics to determine which instances can be downsized.
2. **Resize storage volumes** — Look at storage volume utilization and reduce any unnecessary free space. Re-evaluate any overgenerous free space policies that were carried over from on-premises. It's possible to be far more efficient with storage in AWS.
3. **Reduce performance of storage volumes** — Use Amazon CloudWatch Metrics to determine if Provisioned Input/Output Operations Per Second (PIOPS) volumes can be detuned or moved to less expensive non-PIOPS volumes.

Category 3: Refactor

This category should be done less frequently, as it takes more effort and is less likely to produce results after the first pass. However, the first pass will likely produce significant results, so this step should be done at least once. After that a quarterly or annual review is a reasonable cadence. Look at each application and ensure that the architecture is as efficient as possible. If needed, ask your AWS account team to perform an AWS Well Architected Review.

Managing costs in AWS can be a simple and productive process. Experiment with these ideas and invent new ones.

Core services and additional services

AWS consists of many cloud services that you can use in combinations tailored to your organizational needs. To access the services, you can use the AWS Management Console (a simple intuitive user interface), the Command Line Interface (CLI), or Software Development Kits (SDKs).

For more information, see the *Overview of Amazon Web Services* whitepaper.

Core services

Core cloud capabilities are those that most applications will require simply to run. Amazon Web Services offers a broad set of global cloud-based products including compute, storage, databases, analytics, networking, mobile, developer tools, management tools, IoT, security, and enterprise applications. These services help organizations move faster, lower IT costs, and scale. Compute, storage and networking are core and critical to just about every application – old and new. Most customers should look to these first to get an application up and running on AWS. AWS is a platform that offers both core cloud capabilities and the services that enable them to evolve as they move along their cloud journey.

AWS provides building blocks that you can assemble quickly to support virtually any workload. With AWS, you'll find a complete set of highly available services that are designed to work together to build sophisticated scalable applications. You have access to highly durable storage, low-cost compute, high-performance databases, management tools, and more. All this is available without up-front cost, and you pay for only what you use. These services help organizations move faster, lower IT costs, and scale. AWS is trusted by the largest enterprises and the hottest start-ups to power a wide variety of workloads, including web and mobile applications, game development, data processing and warehousing, storage, archive, and many others. With so many capabilities, the key for AWS and customers is in understanding where such breadth has value and where depth in capability is important.

Additional services

The second group of services are those that customers may choose to use depending on their requirements. Many customers want to experience some of the basic capabilities of such products and services to experiment and test new solutions.

By offering such a broad scope of advanced solutions, from artificial intelligence (AI) and machine learning (ML) to internet of things (IoT), networking, and content delivery, AWS makes it easy

for customers to evolve and experiment. But sometimes, customers need additional support to leverage new technologies (see the ***AWS Professional Services*** section). More importantly, they do so without having to go outside of the familiarity and existing contractual relationship that the organization has with AWS, for all (at the time of this publication) 176 services. This is where breadth has greater value over depth. We are not just talking about customers adding new features to solutions, any of the capabilities of AWS help organizations with their entire application lifecycle. For example, AWS supports multiple technology stacks – just about any technology stack – and this is very powerful.

The benefit is that the flexibility of AWS means these third-party tools can be used with applications running on AWS.

Leveraging new technologies (AI/ML/analytics)

AI/ML help organizations differentiate from their counterparts. Customers want to build new AI/ML capabilities across every facet of their business, which will drive the next wave of adoption to the cloud. This will propel our customers to put more of their data and core workloads on AWS. AWS makes it easier than ever for our customers to gain insight from their data using machine learning. Our ML services continue to grow, which is why we have tens of thousands of customers using AWS machine learning.

Machine learning is a top priority for many customers. It can drive increased customer or citizen experiences, more efficient organizational operations, and faster, more accurate decision-making. For a long time, the technology was limited to a few major tech companies and hardcore academic researchers. Things changed when cloud computing entered the mainstream. Compute power and data became more available, and machine learning is now making an impact across every industry. It is moving from the periphery to being a core part of every business and industry. When customers choose a cloud provider, up to 50% of their decision is based on their assessment of the AI and ML capabilities of providers. This decision has a ripple effect that will influence their choice for data, compute, analytics, and management services.

AWS offers the broadest and deepest set of machine learning services and supporting cloud infrastructure, putting machine learning in the hands of every developer, data scientist and expert practitioner. See Machine Learning on AWS.

For example, Amazon SageMaker AI is a fully managed service that provides every developer and data scientist with the ability to build, train, and deploy ML models at scale. It removes the complexity from each step of the ML workflow so you can more easily deploy your ML use cases, anything from predictive maintenance to computer vision to predicting customer behaviors.

Pre-trained AI services provide ready-made intelligence for your applications and workflows to help you improve business outcomes — based on the same technology used to power Amazon's own businesses. You can build AI-powered applications without any machine learning expertise.

AI services easily integrate with your applications to address common use cases such as personalized recommendations, modernizing your contact center, improving safety and security, and increasing customer engagement. Because AWS uses the same deep learning technology that powers Amazon.com and AWS ML services, you get quality and accuracy from continuously-learning APIs. And best of all, AI services on AWS don't require machine learning experience.

Two pizza teams, from Ops to DevOps

One simple rule for maximizing team effectiveness. Former Amazon CEO Jeff Bezos has this rule: no team meeting should be so large that two pizzas can't feed the whole group. This is, of course, a shorthand method for ensuring that, as is often the case with big groups, no one's ideas get drowned out. Bezos believes that no matter how large your company gets, if you can't feed a team with two pizzas, that team is too large. The reasoning behind it is quite straightforward. More people = more of everything. More coordination, more bureaucracy, more chaos – basically, everything that slows things down. Individual performance suffers and people become less engaged.

The smaller the team the better the collaboration. Collaboration is very important, as software releases are moving faster than ever. A team's ability to deliver software can be a differentiating factor for your organization against your competition. Image a situation where a new product feature needs to be released or a bug needs to be fixed. You want this to happen as quickly as possible so you can have a smaller go-to-market timed. You don't want the transformation to be a slow-moving process.

Communication between the teams is important as we move toward the shared responsibility model and start moving out of the siloed development approach. This brings the concept of ownership in the team and shifts their perspective to look at this as an end-to-end project. Your team should not think about your production environments as black boxes where they have no visibility.

Cultural transformation is important, as you may be building a common DevOps team. Another approach is that you have one or more DevOps-focused members on your team. Both of these approaches introduce shared responsibility in to the team.

DevOps is the combination of cultural, engineering practices and patterns, and tools that increase an organization's ability to deliver applications and services at high velocity and better quality. Over time, several essential practices have emerged when adopting DevOps: Continuous Integration, Continuous Delivery, Infrastructure as Code, and Monitoring and Logging.

This highlights AWS capabilities that help you accelerate your DevOps journey, and how AWS services can help remove the undifferentiated heavy lifting associated with DevOps adaptation. AWS also highlights how to build a continuous integration and delivery capability without managing servers or build nodes, and how to leverage Infrastructure as Code to provision and manage your cloud resources in a consistent and repeatable manner.

- **Continuous Integration** is a software development practice where developers regularly merge their code changes into a central repository, after which automated builds and tests are run.
- **Continuous Delivery** is a software development practice where code changes are automatically built, tested, and prepared for a release to production.
- **Infrastructure as Code** is a practice in which infrastructure is provisioned and managed using code and software development techniques, such as version control, and continuous integration.
- **Monitoring and Logging** enables organizations to see how application and infrastructure performance impacts the experience of their product's end user.
- **Communication and Collaboration** practices are established to bring the teams closer and by building workflows and distributing the responsibilities for DevOps.
- **Security** should be a cross cutting concern. Your continuous integration and continuous delivery (CI/CD) pipelines and related services should be safeguarded and permissions of least privileges should be set up.

To make the journey to the cloud smooth, efficient, and effective, technology companies should embrace DevOps principles and practices. These principles are embedded in the AWS platform. They form the cornerstone of numerous AWS services, especially those in the deployment and monitoring offerings.

- Begin by defining your infrastructure as code using the service AWS Cloud Formation or AWS Cloud Development Kit (AWS CDK).
- Next, define the way in which your applications are going to use continuous deployment with the help of services like AWS CodeBuild, AWS CodeDeploy, AWS CodePipeline, and AWS CodeCommit.

- At the application level, use containers like AWS Elastic Beanstalk, Amazon Elastic Container Service (Amazon ECS), or Amazon Elastic Kubernetes Service (Amazon EKS), and AWS OpsWorks to simplify the configuration of common architectures. Using these services also makes it easy to include other important services like Auto Scaling and Elastic Load Balancing.
- Finally, use the Dev Ops strategy of monitoring such as Amazon CloudWatch, and solid security practices such as IAM. With AWS as your partner, your DevOps principles bring agility to your business and IT organization and accelerate your journey to the cloud.

  For more information, see the *Introduction to DevOps on AWS* whitepaper.

Conclusion

A Public Sector's cloud transformation requires strong leadership to drive change, as well as a clear vision. Organizations are experimenting with and benefiting from cloud technology to achieve digital transformation. The result of this transformation is a more resilient and innovative public sector organizations that can deliver services to citizens through the medium they now demand, and can help retain innovative talent within agencies. As an added bonus, this creates job opportunities because new talent is needed to solve new problems, and the entrepreneurship this brings can spur economic development. Whether it is transforming how individuals collaborate, or the way in which organizations execute large-scale processes, digital transformation offers significant upside for all agencies, regardless of their size or mission.

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