IBM **Services**

IBM continuous modernization for AWS migration

Part 2: Create and execute your application migration plan

Contents

Executive summary

Cloud enablement offerings from IBM extend to virtually all major cloud providers as part of our multicloud approach to enterprise transformation. This white paper is the second in a series on the collaboration between Amazon Web Services (AWS) and IBM to help clients modernize IT infrastructure and migrate applications to the cloud.

We'll discuss how to build a virtual data center—including account structure, region and network connectivity—and define the necessary processes, standards and conventions to manage your AWS environment. IBM can help you plan the migration to a virtual data center for each application, assessing the resources needed and tasks to be performed.

The paper also provides an overview of our differentiated tooling—co-developed with IBM Research—that helps to automate a significant set of activities across the cloud transformation process. Finally, we'll explore management and resource optimization techniques and discuss the five pillars of a well-constructed framework: security, reliability, performance efficiency, cost optimization and operational excellence.

Introduction

This paper is the second in a series that explores how IBM and AWS work together to simplify cloud migration for joint customers.

In the previous paper, we outlined the first critical steps toward making sure your company's unique business drivers are properly addressed during the migration process

- Conduct a series of assessments.
- Create a cloud enablement strategy.
- Gathering information about your data center and cloud consumption.
- Perform a proof point by deploying some applications to AWS.

Next, we discuss how we evaluate the costs and effort required to migrate individual applications and the recommended outcomes for each one.

- **Retire:** Stop using the application altogether.
- **Retain:** Continue using the application without changes.
- **Rehost:** Lift and shift the application with minimal changes.
- **Replatform:** Update the application's software and OS versions with minor changes.
- **Refactor:** Update the application to take advantage of AWS and third-party services or applications built in the cloud.
- **Repurchase:** Replace the existing application with a new one purchased in the cloud.

Finally, we describe the deliverables that are created following the assessment phase. These deliverables include a blueprint for the AWS virtual data center and a customized list of reference deployments. The blueprint covers important topics like account structure, security and connectivity, and the list can be used when deploying your applications to AWS.

Where the previous paper focused on the foundational aspects of a cloud migration plan, this paper outlines how to create your cloud migration plan—and how to put it into action.

IBM Garage Methodology for cloud

IBM Garage™ Methodology for cloud is designed to help business, development and operations teams continuously design, deliver and validate new solutions using cloud technologies. The methodology encompasses a holistic point of view and outlines the cloud adoption and transformation lifecycle, with enhancements to support your enterprise at scale.

IBM Garage Methodology also provides prescriptive guidance for cloud adoption and transformation, which is adaptable to your company's specific cloud journey and culture.

- **Co-create** in Enterprise Design Thinking workshops.
- **Co-execute** to build, measure, pivot and learn new ways of working.
- **Co-operate** to sustain rapid scaling and ongoing cultural change.

The methodology is designed to drive measurable business value from innovation projects and build upon the momentum of iterative innovation for scaled digital transformation. It can also be used to help ignite cultural change through co-creation with IBM experts in design, architecture, agile development, data science and AI, automation, blockchain, security and more. Simultaneously, the methodology taps into the latest hybrid cloud and AI technologies.

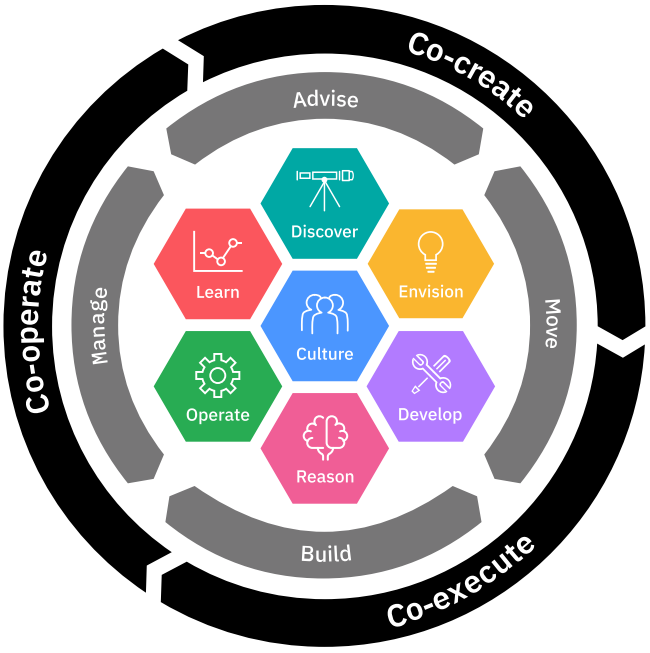


Figure 1. IBM Garage Methodology for cloud

Blueprint for an AWS virtual data center

Before going any further, let's take a look at some of the enterprise-level concerns that may arise when building your virtual data center and defining an implementation architecture on AWS.

The blueprint you create for your AWS virtual data center should follow the five pillars of a well-constructed framework—security, reliability, performance efficiency, cost optimization and operational excellence. The following best practices align with those pillars and should also be considered when creating your blueprint.

- Spending visibility, billing and account management
- Security and access management, including AWS application programming interface (API) and console, operating system, network, data access, asset management and provisioned AWS resources
- Integration architecture
- DevOps recommendations
- Audit and compliance process and tool recommendations
- Business continuity, including high availability, resilience, disaster recovery and backups
- Monitoring and integration into the incident management process
- Configuration and change management
- Release and deployment management

It's also important for the blueprint to define your account structure. You need to know where your users and data centers are located. The blueprint has to account for your network design and connectivity, and your security, identity and access management policies. Establish a series of processes, standards and conventions for naming resources, Classless Inter-Domain Routing (CIDR) addresses and more.

Accounts, users and groups

AWS allows you to have a master account and various child accounts that can be used to separate departments from billing, detach support from production deployments or isolate deployments that need to comply with industry regulations, such as the Federal Financial Institutions Examination Council (FFIEC) or Payment Card Industry Data Security Standard (PCI-DSS).

While child accounts provide useful functionality and organization, too many can become unwieldy. Fortunately, AWS provides central governance and policy-based management of multiple AWS accounts. Users can be defined at the account level and organized into groups that restrict them to specific AWS services.

Network

The Amazon Virtual Private Cloud (VPC) is designed to help you provision a virtual network where you can launch AWS resources. With Amazon VPC, applications are deployed on virtual servers, such as Amazon Elastic Compute Cloud (EC2), in the virtual network.

A virtual private network (VPN) connection between AWS and your network can be made using either a physical device or a software application. For solutions that require a continuous large data transfer, such as a hybrid cloud, you may need a high-speed 1 gigabit or 10 gigabit direct connection.

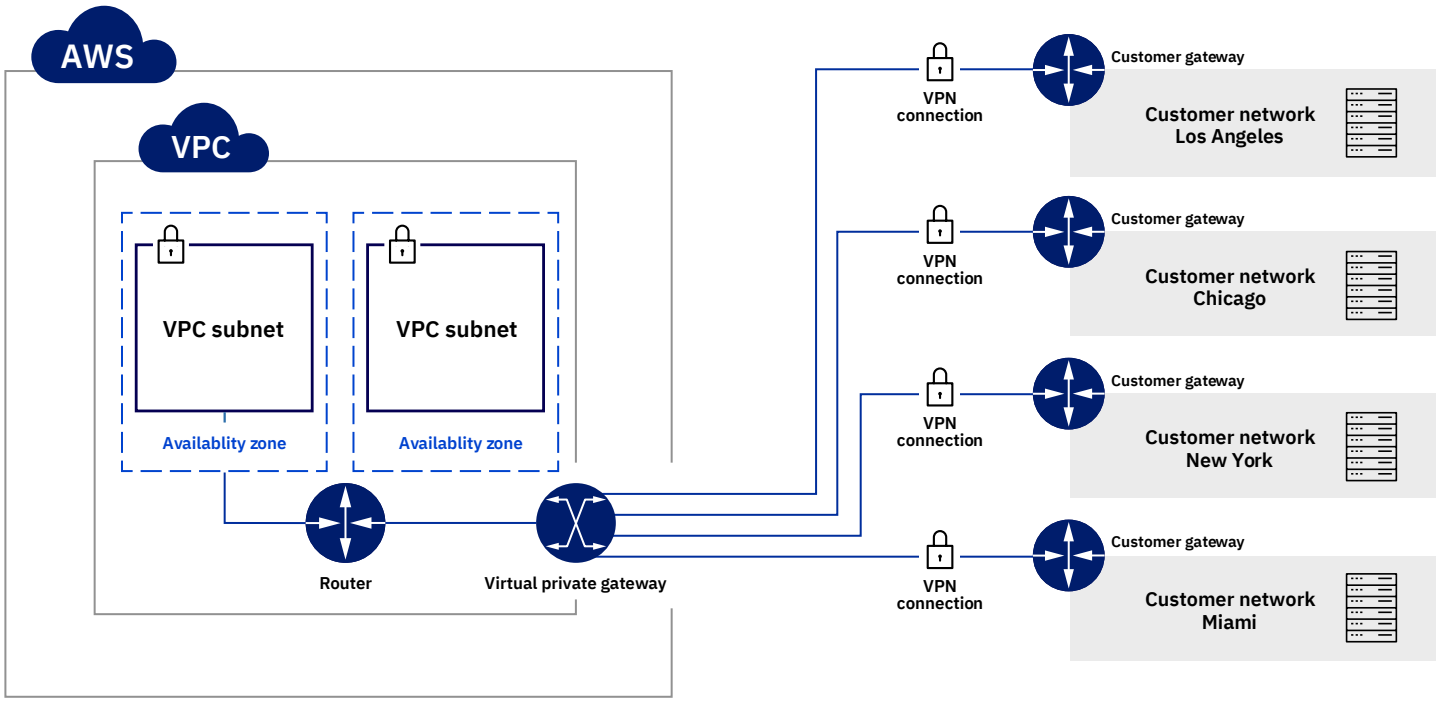


Figure 2. AWS Virtual Private Cloud

Security
Security in the landing zone is paramount, and requires a set of policies for accessing and making changes to AWS resources.

- **AWS Cloud Trail** configures audit logs that track who accessed AWS APIs.
- **AWS Config** monitors AWS resource and infrastructure changes.
- **Amazon VPC** analyzes flow logs for network traffic.
- **Amazon CloudWatch Alarms** trigger when metrics are breached.

Identity and access management
The AWS Identity and Access Management (IAM) service can help you define and manage access to your AWS services and resources. By configuring and integrating with AWS IAM, you can control what users can do in your AWS environment, when they can do it and from where. AWS IAM can also integrate with your existing corporate directory, so that you can set up identity federation and single sign-on (SSO) capabilities.

Continuous modernization

Many organizations are taking a proactive position in digital transformation; however, such transformation requires clear vision, the right skills and analytics-driven decisions across the enterprise. While the traditional approach to modernization usually centers on a single initiative, adopting a continuous modernization strategy is key to maximizing the full potential of disruptive technologies.

A continuous modernization strategy is designed to progressively and continuously evolve your existing architecture to incorporate emerging technologies. Implementing a continuous modernization strategy can help you:

- **Reduce cost** and improve cost efficiency by enhancing resource usage and reducing operational costs.
- **Boost efficiency** by simplifying, consolidating and optimizing the IT ecosystem and operations. Benefit from cloud analytical services like machine learning (ML) and AI and rationalize existing applications to identify the appropriate ones to move first.
- **Manage risk** and address high operating costs, technological redundancy, skills attrition, security, regulatory compliance and more by refactoring to generate clean, readable, maintainable code and documentation.
- **Align strategy** with practices, realize value and understand how an overall cloud transformation approach supports your long-term business and technology vision.

The IBM approach to continuous modernization is a program for application portfolio transformation that helps progressively and continuously evolve your existing investments. The program is built on principles of the IBM Garage Methodology to iteratively modernize IT and execute continuous modernization. By applying analytics to make informed decisions, continuous modernization helps you deliver on critical business outcomes and keep your portfolio up to date.

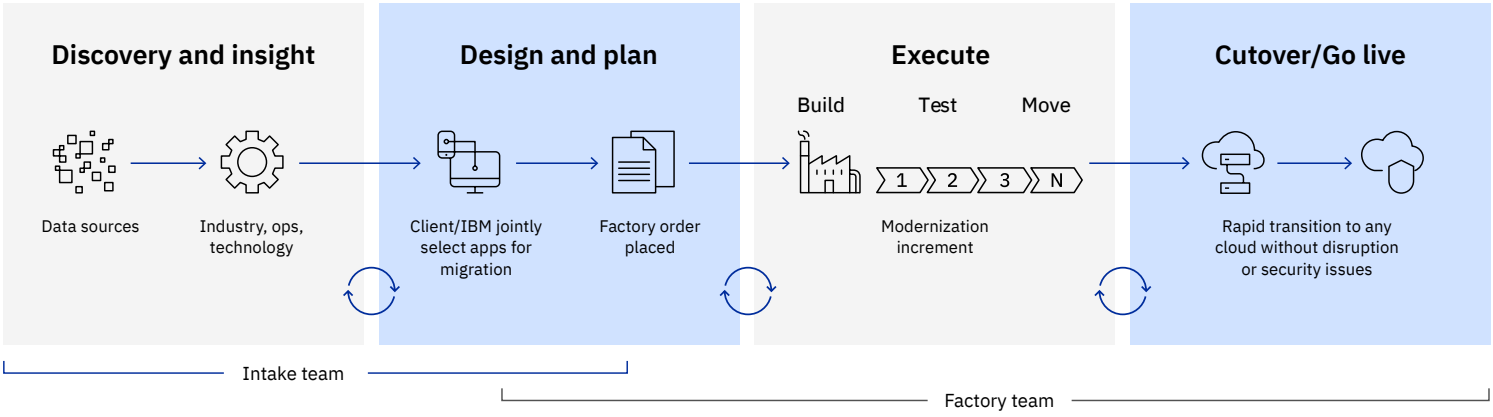


Figure 3. Continuous modernization

A continuous modernization framework can be classified into two main phases: the **intake phase** and the **factory phase**.

Intake phase
The intake phase of continuous modernization covers discovery and insight, where we review candidate applications for migration using existing data sources and assessment data. Intake also overlaps with the design and plan processes, where we jointly approve selected applications for migration.

For modernization discovery at scale, the foundation is to establish a business or IT context view of the current state. A continuous modernization framework establishes the current state application inventory and provides deeper insights into the IT landscape and application components. These structured insights from discovery tools help conduct static and dynamic analysis of the inventory of all application components.

Actions in the intake phase:
- Establish governance and organizational structure and align with stakeholders through the integrated delivery model.
- Use existing data from various repositories, such as a configuration management database (CMDB) and ticketing information.
- Identify and fix gaps in data with an automated discovery toolset and collaborative workshops.
- Review business and financial objectives of the modernization program.
- Evaluate pain points, as well as short-term and long-term modernization goals.
- Assess the portfolio, using analytics and tooling to evaluate application disposition, identify modernization techniques, decrease complexity and provide recommendations based on technical and application attributes.
- Analyze applications and their infrastructures using AI to identify explicit and implicit dependencies.
- Establish the priority and complexity of the business and application landscape, developing a modernization execution roadmap that's iteratively improved as new data is gathered.
- Establish target reference architecture, architectural principles and guidelines for each application.
- Build an end-to-end process by integrating our modernization process with your organization's internal processes.
- Create decision models that identify modernization patterns and where modernization investments should be made.
- Build the modernization pipelines for factory teams to execute.
- Create a framework to prioritize the migration application candidates and establish a mutually agreed upon migration roadmap.

Factory phase
The factory phase of continuous modernization is responsible for the design and implementation of migration and workload modernization for common scenarios. This phase spans design and plan processes, execution—building, testing and moving selected applications—all the way to cutover and go live. In this phase, we perform a detailed analysis, identify modernization patterns and design the execution plan. Modernization work is done in parallel through an automated tool within the factory model.

In the factory phase, you have the option to:
- Engage the factory team to execute the modernization with set costs through a service catalogue.
- Have another vendor use the roadmap produced to perform the modernization.
- Execute the roadmap yourself or choose to delay the activity for that workload.
- Choose a combination that suits your organization's needs.

IBM uses AWS reference deployments, or AWS Quick Starts, and we have developed a library of our own deployments to share with customers. We've also created an AWS cloud migration starter kit to help accelerate AWS adoption. The starter kit covers cloud pattern decision-making framework, architecture patterns, DevOps recommendations and base security policies.

During the design portion of the factory phase, each application is aligned to a reference deployment. Along with the standards set in the implementation architecture, these aligned reference deployments are used by the migration team when deploying the application into the virtual data center. The design phase also helps ensure that the migration design for each application is aligned with the AWS Well-Architected Framework. This approach helps promote consistency across the portfolio, maximize quality and reduce maintenance costs.

Artifacts created during the migration process include AWS CloudFormation scripts, a migration checklist and deployment and operations information for a runbook. We recommend that these documents be maintained with a managed source control service, such as AWS CodeCommit.

Additionally, the factory team can help migrate and modernize your applications using microservices with the AWS serverless capability, containers like AWS Elastic Container Service (ECS) or AWS Elastic Kubernetes Service (EKS), and other AWS managed services.

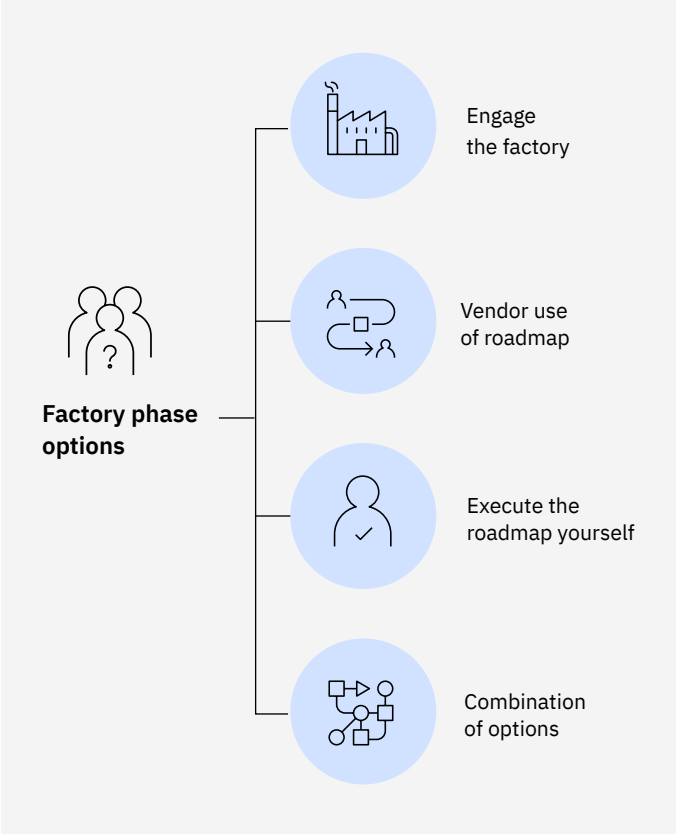


Figure 4. Factory phase options

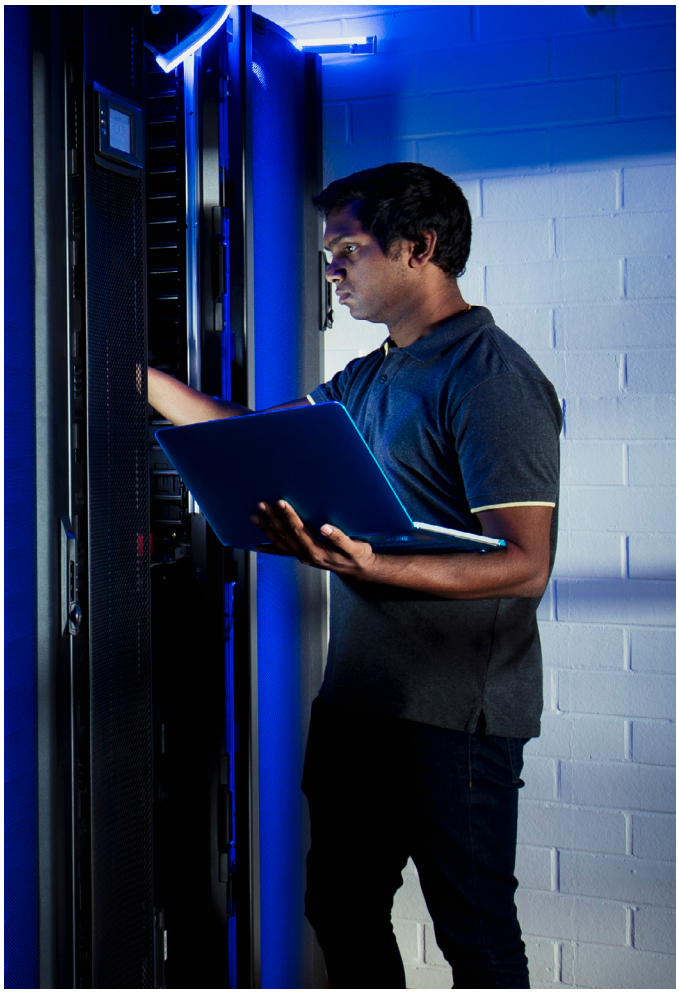
Actions for each application in the factory phase include:

- Conduct static source code analysis to identify remediation needed for code.
- Define database access by each component, document data dictionary and associated dataflows.
- Create reports of database access clauses, redefinition clauses, group levels and data fields.
- Collect, analyze and batch the transactional data.
- Validate the completeness of gathered information by discovering an overall perspective about the dynamics of application processing.
- Identify and collect necessary artifacts to replatform the application, including candidate APIs and microservices.
- Discover viabilities and dependencies to replatform the application.
- Validate application infrastructure, including provisioning requirements, firewall and load balancer requirements, and disaster recovery requirements.
- Obtain sign-off from the application owner.
- Create AWS CloudFormation templates. Develop playbooks for continuous integration and continuous deployment (CI/CD) pipelines for infrastructure provisioning.
- Remediate the application code and create CI/CD pipelines for application deployment.
- Migrate databases and data associated with the application.
- Perform end-to-end testing of the application.
- Transition the application to production in the target cloud.

Static source code analysis provides a deeper level of insights for the current state of applications and helps estimate the complexity of remediation and timeline required for the modernization roadmap and assessment. The objectives are to identify technical debt, code smells and remediation or refactoring of the candidate applications.

Transactional data includes volumetric performance and the activity of data store access, interfaces and cross-server interactions. During modernization, this data helps define or refine nonfunctional requirements (NFRs) for the applications in scope.

When you validate the completeness of gathered information, the objective is to find any gaps or data discrepancies and take action to close them. This process may require a rerun of applications with different configurations to identify and gather any missing information.



The factory phase of continuous modernization spans design and plan processes, to execution—building, testing and moving selected applications—all the way to cutover and go live.

Steps of application deployment
Next, let's look at the steps that appear in the application deployment project plan.

- **Develop migration scripts.** An IBM engineer iteratively designs and deploys the solution in a sandbox, including data migration. The engineer uses a series of tools from IBM's own toolbox, as well as AWS and third-party tools.
- **Develop test scripts.** The client team develops a test plan and a series of automated or manual test cases.
- **Execute migration scripts.** An IBM engineer deploys the application to the first support environment, which is often an integrated development environment.
- **Execute test scripts.** The client team executes the test plan.
- **Review.** The client team and the IBM engineer hold a joint review.
- **Gather feedback.** The teams make adjustments to the migration scripts and documentation that may be needed based on the results of the review.
- **Approve the migration.** The teams jointly approve the plan. The approval process is subsequently repeated for any additional support environments.
- **Validate application for migration.** The application is ready to migrate to production and is moved at the end of the next sprint.
- **Migrate production and disaster recovery processes.** The process, scripts and documents used for migrating the support environments are also used for production and disaster recovery.
- **Transition to production.** Users are now pointed to the new production environment.

− **Application 2357**	
− Develop	
Requirements	Joint
Develop migrate scripts	IBM
Develop test scripts	Client
Milestone: app 2357 scripts ready	
− Integrated-Dev Env	
Execute migrate scripts	IBM
Execute test scripts	Client
Review	Joint
Feedback	Joint
Sign off	Client
Milestone: App 2375 int-dev done	
. . .	
− **Performance Env**	
Execute migrate scripts	IBM
Execute test scripts	Client
Review	Joint
Feedback	Joint
Sign off	Client
Milestone: app 2357 perf env done	
. . .	
Milestone: App 2357 production ready	
− **Production**	
Execute migrate Scripts	IBM
Execute test scripts	Client
Review	Joint
Feedback	Joint
Sign off	Client
Cut over	IBM
Milestone: App 2357 migrated	

Figure 5. Application deployment project plan

Execution and delivery

IBM has an end-to-end delivery model that includes advisory squads, an architecture guild, migration factory squads and site reliability engineering (SRE)-based operations squads. The IBM Cloud® Migration Factory for the AWS cloud framework helps simplify AWS cloud modernization and migration projects with a single method, solution, process and end-to-end toolset.

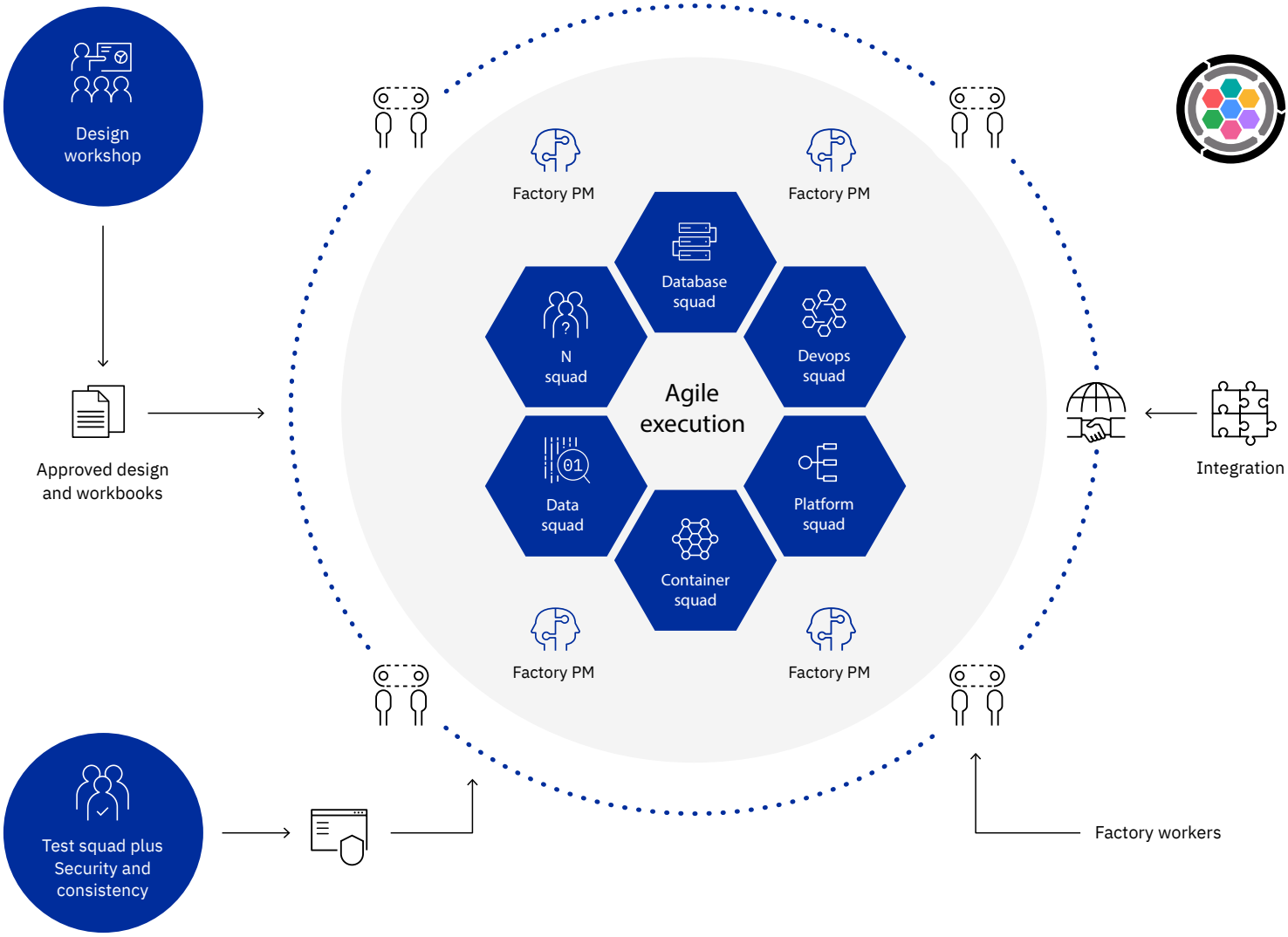


Figure 6. Agile delivery execution model for AWS migrations

The IBM migration and modernization tooling approach

IBM has built an end-to-end toolkit that supports your journey to cloud across the lifecycle, from planning and strategy to execution and operation.

Strategy tooling
Our cloud advisory tool is based on years of experience transforming clients' systems. We have built an extensive repository of disposition rules, patterns and ROI calculation benchmarks. Intuitive data collection models help establish a strategic transformation roadmap, ROI models and value-versus-analytic views for assessing various disposition and ROI dimensions.

Modernization accelerators
Modernization accelerators address the six potential migration outcomes—retire, retain, rehost, replatform, refactor or repurchase—using a combination of AWS and IBM-built tooling for automation across enterprise patterns.

Delivery curator
The delivery curator is a pattern-driven system designed to assist in the end-to-end modernization journey, from discovery through implementation. It provides a pluggable, API-based integration framework that enables the intake and factory phases of continuous modernization, as well as integration and exchange of data with AWS discovery and migration tooling. IBM modernization consultants, architects, project managers, and modernization specialists use a delivery curator at various phases of the modernization lifecycle.

Data collected from sources, such as CMDB, application portfolio management tools and the IBM cloud advisory tool, is fed into the delivery curator's data lake architecture. Each application is broken down into components and analyzed to identify optimal component modernization patterns or determine if additional discovery is required.

Discovery capabilities of the delivery curator support a data-driven, nonintrusive study of your IT environment, helping define optimal target state and modernization pattern analysis. This process helps identify dependencies between the applications, nonfunctional requirements and other business attributes to help determine the application move groups and develop your application modernization roadmap.

The delivery curator also helps improve the factory phase of continuous modernization by applying industry-standard benchmarks, repeatable models and accelerators, persona-based data accessibility and more. In the factory phase, the delivery curator uses our pattern repository to create a workbook—a set of tasks, resources and required effort—for modernizing and migrating the application to AWS. Where automation is available, each of these tasks is linked with AWS tooling or IBM offerings. The workbook can be synchronized with agile project management tools like JIRA to manage the modernization execution. A single dashboard shows the near real-time view of modernization status.

Operational accelerator tooling
IBM operational accelerator tooling provides a set of predefined, service-level agreement (SLA)-driven application and infrastructure monitoring tooling. Powered by AI-based models and industry-leading product frameworks, operational accelerator tooling addresses the monitor, analyze, plan and execute over shared knowledge (MAPE-K) process. It can be used with our prebuilt tooling set or integrates with your existing tooling.

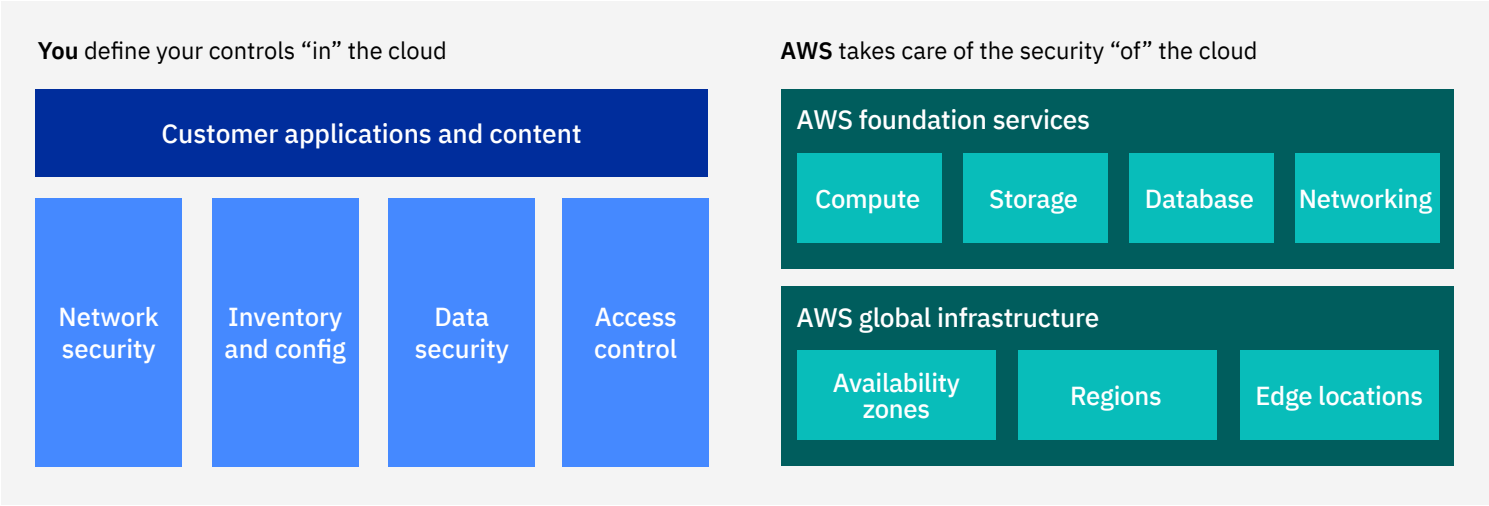


Figure 7. IT operations in AWS

Cloud management

Moving to the cloud helps alleviate many management concerns for IT operations; however, IT cloud operations still need to manage the virtual machine (VM), which includes operating systems, middleware, databases, data security, network security and access controls.

Managed services
Managing your virtual data center and maintaining an experienced staff trained in the latest tools requires an investment of effort that doesn’t necessarily provide a competitive difference. Instead, managed service providers (MSPs) can perform management tasks—leaving your staff free to focus on building and enhancing the systems that support your business.

AWS managed service offerings include change and incident management, security and access management, continuity management with backups and restores, and OS patching. With these offerings, you have access to the data being used by AWS to manage your infrastructure. Additionally, a cloud services delivery manager provides a monthly report that includes performance metrics and recommended optimizations.

The accountability for your systems—consequences of downtime, any failure to meet regulatory requirements—rests with you. That’s why it’s important to properly vet potential MSPs to see if they have a record of success in meeting the level of service required. It’s equally important that your MSP carry liability insurance, in case they don’t meet the required level of service at a critical point in time.

Optimize your applications
Once you’ve migrated your applications to the cloud, you can start taking advantage of the tools AWS and other cloud vendors offer to optimize those applications.

As part of the migration process, your applications will have been properly configured and patterned after the reference implementation architectures, standards and conventions following AWS best practices. Your applications will use AWS CloudWatch monitoring and AWS CloudTrail logging services. The data from these services can help you critically examine resource use, application performance and operational health, and then further optimize your applications to align the AWS resources to your business needs.

Data from monitoring services can also be used for security reviews and audits. AWS offers premium services like AWS Trusted Advisor that provide near real-time guidance to help you reduce cost, increase performance and improve security.

Optimization analytics goes beyond traditional monitoring. Data can also be captured about how users are interacting with each application. IBM Digital Analytics provides a cloud-based engine that analyzes visitor behavior trends in near real-time.

DevOps
Moving to the cloud is also an opportunity to look at your DevOps maturity level across your application portfolio. The premigration assessments and moving the application by rehosting, replatforming or refactoring provide data to help you review your overall application development lifecycle management and identify inefficiencies in specific applications.

Next steps

IBM solutions are designed to accelerate your journey to cloud. With experience migrating and modernizing more than 100,000 workloads across multiple clouds, we can help you optimize your investments today while anticipating your needs tomorrow.

The next paper in this series will take a closer look at DevOps maturity and go into more detail about building DevOps in your enterprise.

For more information
To learn more about IBM Cloud Migration Services, visit ibm.com/services/cloud/migration, or contact your IBM representative.

IBM Corporation
New Orchard Road
Armonk, NY 10504

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