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Strategies for Large-Scale Cloud Migration

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A process framework to help plan migrations

Recently, Gartner reported that "The CIO Survey identified cloud computing as one of the three top game-changing technologies."[1] A cloud migration — and the ability to take advantage of cloud benefits such as greater agility, scalability and enhanced security — is often seen as a primary way for organizations to positively affect change and create greater productivity at optimized cost.

And based on IDC's May 2020 COVID-19 Impact on IT Spending Survey, organizations worldwide are looking to utilize cloud. This includes moving more applications to the cloud because it provides better security and availability, investing in cloud data management to drive value from data, and migrating core business applications (for example, SAP and Oracle) to the cloud. However, there appears to be some divergence across stakeholders. C-level officers (CXOs) view cloud as a method to move applications for better security and availability, while non-CXOs want to right-size cloud to save cost.[2]

Although momentum is pushing enterprises toward these benefits, migrating to the cloud isn't without its challenges. According to Gartner, "through 2023, at least 99% of cloud security failures will be the customer's fault" and "through 2024, 80% of companies unaware of mistakes made by organizations in their cloud adoption will overspend in cloud by 20% to 50%."[3,1]

There are many approaches to large-scale cloud migration, which can make the process overwhelming and confusing, especially for large enterprises with myriad business-critical applications. This paper will discuss large-scale cloud migration approaches that drive strategic business change and are supported by a best-of-breed team and vendors.

Cloud migration options

As an organization begins looking at its larger technology landscape through the lens of cloud computing and strategic change, several options emerge. For companies that want to centralize and standardize their infrastructure to reduce both overall system maintenance and costs as well as grow governance, risk and compliance (GRC) capabilities that don't result in excessive rigidity, there are four distinct migration approaches and three non-migration choices.

These approaches also offer the opportunity to renovate hardware, software and processes, and to simplify systems in the process.

- **Re-host:** Sometimes referred to as lift and shift, re-hosting takes a forklift approach to moving business applications to the cloud without any code modification. In this case, a virtual machine (VM) is treated like a blackbox and simply copied bit by bit.

- **Reinstall:** Similar to re-hosting, a reinstallation entails a wholesale move of applications to the cloud. Although new VMs are created in the cloud, the same software is installed from scratch with no configuration changes. It's more work than a re-host, but this approach has the benefit of allowing some cleanup to happen during the migration, which enables companies to avoid copying unnecessary software and configurations that may have accumulated over the years and are no longer in use (for example, an agent that was installed for monitoring software that's no longer used). It also allows for the addition of new practices (for example, the installation of a new vulnerability detection agent on all VMs or the use of standardized VM images for all apps).

- **Replatform:** Called "lift, tinker and shift" by Stephen Orban, Head of Strategy at Amazon Web Services (AWS), replatforming is the process of moving applications to the cloud with a small amount of up-versioning — perhaps of an OS or database — to benefit from cloud infrastructure.[4] Replatforming takes advantage of containers and VMs, only changing application code when needed to use base platform services like cloud-native databases, storage, compute and autoscaling.

- **Refactor:** This is the process of re-architecting some portion of an existing application to leverage cloud-native frameworks and functionality. Most often, refactoring entails changing middleware and application components to deploy cloud-native features and advanced concepts like microservices and serverless computing. Application code itself isn't refactored, but rather the services composing it. Although the application business logic remains the same, the application itself is factored into different tiers and pieces, with services like databases swapped out for the cloud service equivalent.

- **Repurchase:** When software moves from a version that previously ran on data center hardware to a new software-as-a-service (SaaS) — or similar — version of the same application, it's repurchased (for example, moving from on-premises customer relationship management (CRM) to Salesforce's cloud-based option).

- **Retain:** Choosing to retain an application leaves it on-premises, running just as it currently does.

- **Retire:** When an application is retired, the organization determines that it has met end-of-life criteria.

Approach	Maturity	Pros	Cons
Re-hosting	Uses only pure infrastructure-as-a-service (IaaS) resources such as VMs and networking	• Faster migration with fewer resources thanks to automation tools • Migration operator can treat VMs like a blackbox, because it requires minimal tribal knowledge • Once a migration factory has been built, migration becomes a push-button activity	• Can be more costly to run apps in the cloud this way compared to a replatformed or refactored app • Apps don't benefit from all cloud features, like managed services
Reinstalling	• Uses fresh VMs in the cloud with some new tools, like a vulnerability detector • Automates the provisioning of infrastructure but not full-stack	• Although not the fastest, migration is still fairly speedy • Takes advantage of some new tools • Allows retirement of technical debt that may have accumulated with on-premises servers	• Can be more costly to run apps in the cloud this way compared to a replatformed or refactored app • Apps don't benefit from many cloud features • Migration operator requires a deeper knowledge of the application installation process • Manual installs require effort
Replatforming	• Uses advanced IaaS features, like autoscaling, native load balancers and container services • Also uses platform as a service (PaaS) • Automates installation of the entire stack	• This middle ground between re-hosting and refactoring allows apps to take advantage of cloud functionality • Automating operations like autoscaling saves effort • Automating software provisioning provides agility and continuous integration/continuous delivery (CI/CD) capabilities • Increased agility opens the door for more innovation • Once common app architecture patterns are identified and automated, migration happens at a rapid pace in a self-service manner	• Slows migration time • Requires more knowledge and resources
Refactoring	Uses advanced platform services that lead to paradigm changes (for example, moving a monolith to microservices using containers and serverless technologies)	• Apps can be modified to take full advantage of cloud-native features • Apps can be modified to maximize cost efficiency in the cloud • Offers the best cloud return on investment	• Takes longer to develop • Requires more resources upfront
Repurchasing (as SaaS)	Uses a brand-new application or the SaaS version of the app (for example, switching to Salesforce rather than an on-premises CRM app)	• Faster than refactoring • Generally cost-efficient • Permanently frees IT from upgrades and patching	• Scalability, availability, security, compliance and more are dependent on the SaaS provider • Integration can be challenging

Table 1: Migration options comparison guide.

Migration option self-assessment

Assessing the migration path is an exercise in feasibility and cost-benefit analysis. For example, although an application may benefit from cloud features, if it's only used once a year by two people in the organization, the cost is most likely not worth the benefit. To help assess the cost and benefit of each strategy, here are some sample questions and considerations that NTT DATA recommends organizations address for each application they may migrate to the cloud:

- **How strategically imperative is this application to the business?** Is it an application that contributes to revenue and should be invested in (otherwise known as an invest application), or is it an application necessary to just run the business that will be sustained at the lowest possible total cost of ownership (a sustain application)? This is important, because migrations are often bound by time and budget, and the energy required to replatform/refactor is better spent on invest applications rather than sustain applications. For example, an ecommerce website for a retailer is an app that should be invested in, but the employee vacation reporting system for HR is something to sustain. Given typical constraints, it's best to consider a replatform/refactor for the ecommerce website and a simple re-host for the vacation reporting app.

- **For sustain applications, is it even possible to re-host the application?** If all technologies can run in the cloud, then re-hosting is the best option. If not, look for a SaaS alternative. If an alternative is found, retire the app. If not, retain it. For example, if the vacation reporting app uses an IBM AS400 machine, it may be best to either replace the app entirely with a different tool or retain the application on-premises rather than investing developer resources to refactor (recode) it for the cloud.

- **Analyze the cost in terms of development resources and any business interruptions that may be required with a significant rewrite.** It's often impossible to refactor applications, because the original development teams are currently inaccessible due to other priorities. But if the

benefits outweigh the cost and the direction is achievable within the constraints, refactoring is the right choice. Due to these constraints, most applications aren't easy to refactor at the onset, and companies often refactor a very small fraction (less than 10%) of their portfolio. For example, if an application suits the serverless computing model (for example, using AWS Lambda) and the development team has the resources to refactor to use Lambda, refactoring is possible. Next, evaluate those resources against the effortless scaling and minimal maintenance made possible by a move to Lambda. If the benefits can be achieved with minimal business interruptions and/or impact to the teams, refactoring is the right choice.
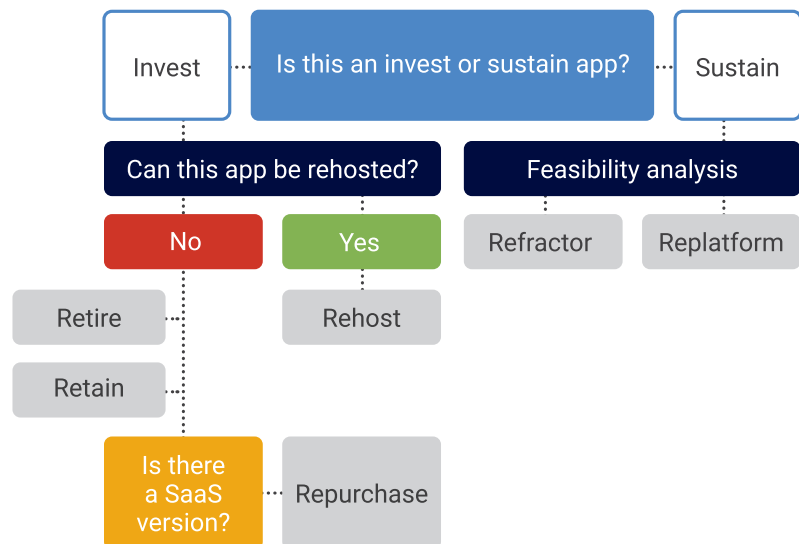

Figure 1: Assessing the migration path — an exercise in feasibility and cost-benefit analysis.

- **For invest applications, if refactoring isn't feasible, replatforming is the right choice.** Given tight constraints, we see companies opting to replatform 25% to 30% of their portfolios. In these cases, the burden is on the DevOps team to build a test harness or automated test framework for the application without requiring major code changes or leveraging the benefits of cloud features such as autoscaling, self-healing, containers, etc. For example, an ecommerce website written in a framework that's not suitable for serverless computing may be replatformed.

Rationalization in this way can be an effective first step before deciding which path to take for any given application. By looking at the totality of an IT system, it may be possible to identify which infrastructure and workloads are low complexity and low business value. These are ideal candidates for retirement. It can also identify which are low complexity but high business value, because these can be more easily relocated to the cloud.
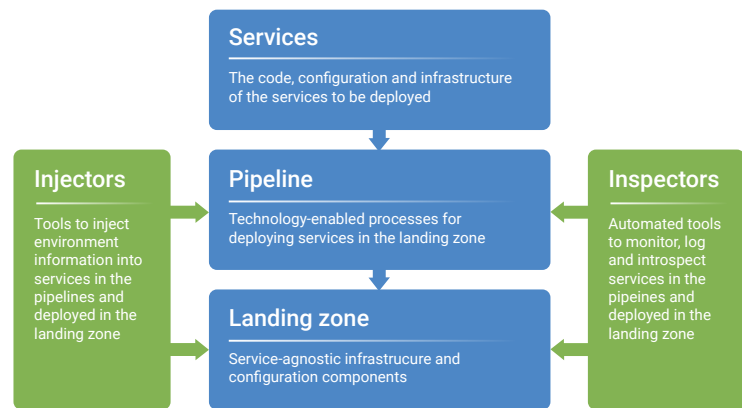
Yet, modernizing a highly complex system often meets resistance from the various interested members within the IT and management teams. A rationalization process should help combat political push-back against a comprehensive modernization project by making clear which systems need to be relocated or retired and why.

The Enterprise DevOps Framework

Once a migration strategy is established, NTT DATA consultants use our Enterprise DevOps Framework (EDF) as a foundation for migrating applications and creating the needed infrastructure to effectively support these apps in the cloud. Regardless of the migration approach, the EDF acts as a guide for planning and implementation. Organizations can build a platform for change that incorporates advanced cloud technologies with services, landing zones, pipelines, inspectors and injectors.

The EDF provides the following benefits:

- A clear structure and process for adoption, with technology mapping to DevOps processes
- Accelerated time frames for an initial proof of concept (POC)
- Reduced risk, by starting with best practices
- Hardened security through increased adherence to security and governance
- The agility of independent management

Services
The code, configuration and infrastructure of the services to be deployed

Injectors
Tools to inject environment information into services in the pipelines and deployed in the landing zone

Pipeline
Technology-enabled processes for deploying services in the landing zone

Inspectors
Automated tools to monitor, log and introspect services in the pipeines and deployed in the landing zone

Landing zone
Service-agnostic infrastrucure and configuration components

Figure 2: The NTT DATA Enterprise DevOps Framework: Mapping the EDF to cloud migration approaches, illustrating how each approach brings assets to the cloud.

Establish a beachhead

In the EDF, the traditional IT operations team leverages a concept called the landing zone. It creates a foundation where services deploy and, as a result, focus on catching service-agnostic components as they're delivered via pipelines. In cloud architecture, the concept of a service-agnostic foundation is very critical, as is the idea of service teams owning more of their dependencies. A strong cloud foundation is a requirement regardless of the migration strategy.

This approach provides a beachhead and allows teams to decouple field planning from the creation of a basic, scalable structure for cloud services. Teams can send applications to the landing zone quickly, because the work can be done in parallel. It starts with the applications teams prepping applications to be sent to the zone.

Because the basic foundation is agnostic, applications teams don't need to worry about what it looks like. The teams only need to get the applications set for migration. This approach can breed quick success, because the teams work in tandem.

This approach also helps speed the success of POCs, because it can support small, impactful first steps. While many teams might want to start by building a network architecture based on best practices, for example, that's not

impactful by itself, because it doesn't add business value. It's analogous to building an airport without having any airplanes to land. You need the airplanes to demonstrate the value. In this way, the foundation provides a landing zone to easily showcase early migration wins and, in turn, helps build internal momentum.

Sandboxes as a strategic enabler for cloud migration

For the list of applications to be moved — and as organizations discern whether to re-host, replatform or refactor them — secure sandboxes can be a helpful device. Teams use these environments to experiment to help determine where to start with a migration. Specifically, this approach allows business units to cultivate ideas on how a cloud migration can help their efforts by giving them a secure space to explore the platform without creating barriers to entry.

NTT DATA consultants recommend creating secure sandboxes as organizations start down the path to a cloud migration. These environments can help prioritize migration targets and generally shed light on the benefits cloud computing will bring to different applications.

Best-in-breed support

There are different types of professional services organizations, from managed services providers (MSPs) to traditional IT service houses, many of which have the expertise to help with large-scale cloud migrations. To find the best partner for a migration project, we recommend asking two best practice questions:

Specialist or jack of all trades? Service organizations tend to either grow deep, diving down into a few specific areas, or wide, expanding across a breadth of services. Because the latter is a jack of all trades but a master of none, this type of provider may not be the best choice — especially for organizations that need advice along the way or someone to design a migration blueprint. To that end, specialists are more likely to have implemented a similar project and, as a result, be more educated about potential pitfalls to avoid and what steps to take to ensure success.

In addition, specialists are more likely to have established partnerships with complementary vendors that help ensure success. For example, partnerships with tool and ecosystem vendors, from cloud platforms to Docker, Ansible, HashiCorp and more, are extremely helpful when designing and executing a mass cloud migration. This is especially true for migrations where advanced services are needed to replatform and refactor applications.

Managed services or self-managed? Digital transformation has opened up unprecedented compute power, instant access to the latest technology and revolutionary ways to empower businesses. This may make it easier to manage a migration project internally. At the same time, the resulting complex environments — where multiple technologies must be integrated with the legacy systems on which businesses currently rely — may lead some organizations to prefer to leverage the deep experience of an MSP. Doing so can help balance their time, efforts and budget. An MSP keeps existing critical applications running at peak levels while not disrupting the business, which keeps the organization's focus on the pressing need for transformation.

Migration success stories

Reinstall: TechnipFMC

TechnipFMC is a renewable energy leader that had two parallel goals. First, it wanted to use cloud migration as an opportunity to overhaul its business processes. Second, during the migration process, the organization wanted to build in standardization while increasing developer agility, growing global access for its workers and decreasing capital expenses.

Time was of the essence and Technip sought to move the enterprise wholesale to AWS, so it chose a reinstall approach. Following the migration, the company championed IT transformation, especially once it achieved standardization. The project, initially delivered by NTT DATA, began with migration experts reviewing critical data about the applications to be moved and designing push-button deployment frameworks that were then used to quickly select and stand up new environments. This allowed the client's DevOps team to focus their efforts on specific applications, not the foundational policies that are part of AWS automation. The teams moved one application at a time into AWS, starting with a web app for residential solar monitoring.

To establish standardization and maintain separation of duties, the NTT DATA team introduced AWS Service Catalog, where 80% of applications are defined by a small number of templates. In this way, the energy company was able to standardize builds with security controls in place, encouraging best practices to be followed by default. And, to streamline DevOps, AWS was used to create multiple environments for each team, increasing speed to market and operational efficiencies.

Single app replatform: Rent-A-Center

Rent-A-Center (RAC) wanted to move its ecommerce platform to the cloud in time for a busy holiday season. The company's goal was to roll out a platform that would support the entire online shopping workflow using SAP's Hybris platform. It required a cluster of Hybris servers, called nodes, that would cater to online web-based demand. Using advanced Amazon features like autoscaling, elastic load balancing and container services, RAC and NTT DATA created an architecture that would scale up to meet the client's growing demand and scale down once demand subsided.

With Amazon ECS as a backbone technology, RAC deployed a Hybris setup with autoscaling, self-healing, one-click deployment, CI/CD and PCI compliance consistent with the company's latest technology guidelines, meeting the requirements of its newly formed culture of DevOps and extreme agility. In addition to taking advantage of advanced cloud functionality — like extreme scalability — by refactoring its ecommerce platform, RAC has set the stage for refactoring in the future, allowing the company to plan for even greater agility and experimentation.

Migration success stories
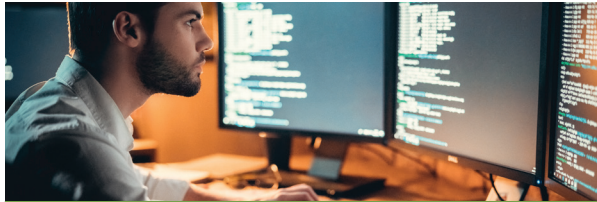
Mass replatforming: Enterprise media company

NTT DATA had the opportunity to work with an enterprise media group on its modernization project. Working with our specialists, the firm walked through the migration options for its on-premises applications and built a secure sandbox where business units could experiment and learn. From these exercises, the two teams created a 12-month roadmap, broken down by quarter, mapping each application to its migration path and a specific timeline.

Using the NTT DATA approach and our Enterprise DevOps Framework, the client identified systems of innovation and differentiation and then separated more than 200 apps from the strategy for systems of record. We designed a platform for innovation and helped the firm gain knowledge about the strategies and underlying technologies needed to gain greater business agility.

Of the firm's 400 apps that needed to be replatformed or refactored were application technologies that included 80 Microsoft .NET IIS apps on Windows, 40 Java/Tomcat apps on Kubernetes and 80 Java/Tomcat apps on Linux, as well as Adobe Experience Manager (AEM), Atlassian tools, WordPress and SugarCRM. Approximately 40% were maintenance-level yet business-critical and flagged for replatforming/refactoring. In this way, the firm was able to strategically migrate its assets, maximizing cloud benefits for applications that would gain the most while not spending resources on those that would provide minimal benefits.

Refactor: Healthcare provider

This healthcare organization was looking to move its monolithic application to the cloud and, in the process, re-architect it for greater agility, visibility and business responsiveness. Using a containerized approach, the NTT DATA team helped the client refactor its application, moving it to an AWS-based microservices architecture.

A blueprint for the new microservices environment was created, with AWS ECS and Docker as the backbone. One of the initial concerns the team had was how to create a new architecture and process flow that incorporated AWS automation, security controls, greater visibility and build repeatability. NTT DATA recommended AWS Service Catalog, and with it in place the development team was able to easily achieve AWS provisioning of the assets the client needed within minutes. By breaking its single code base into small, individual services, the healthcare provider achieved greater human resource utilization. Bottlenecks were removed and developers could work autonomously on their individual services, incorporating changes much more flexibly and nimbly and introducing new services to the business.

Conclusion

A mass migration from an on-premises data center to the cloud can seem formidable, especially for enterprises with hundreds of business-critical applications. Using the approaches outlined in this paper, including leveraging a best-of-breed team of specialists with deep cloud computing, migration and enterprise experience, can help organizations create a strategic migration roadmap that helps them fully achieve digital transformation.

NTT DATA: Building a platform for change

Enterprises ready to migrate to cloud infrastructure face hundreds of critical questions. To help increase the success and speed of migrations, NTT DATA created a suite of cloud transformation services for enterprises that need to meet the mounting demands on business and IT — and need both facets to be nimble, cost efficient and automated.

Using a toolbox of proven frameworks, NTT DATA empowers enterprises to migrate by providing infrastructure, coaching and automation through all phases of complex migration projects. Our end-to-end suite encompasses cloud consulting, actual movement to the cloud, and financial, operational and application management in the cloud. We bring together capabilities across multiple cloud providers, best-of-breed partnerships, global experts and proprietary NTT DATA expertise to meet our clients' needs.

See what NTT DATA can do for you.

- Deep industry expertise and market-leading technologies
- Tailored capabilities with your objectives in mind
- Partnerships to help you build and realize your vision

Visit nttdataservices.com to learn more.

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