

Keys to mainframe transformation and application modernization

How to beat the odds and be successful in your mainframe to hybrid cloud journey



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Executive summary

Most enterprises with mainframes are examining their environments in response to various business challenges. Many have adopted a “right application on the right platform” model. Every platform has capabilities and attributes that make them “best for purpose” for some applications.

Digital transformation is difficult, and the risk of failure is very high because it involves much more than just the technology. In nearly all cases, work processes and even the culture in the business must change.

Successful mainframe transformation and application modernization starts with a well-informed strategy and uses an iterative process, capturing incremental value and building momentum. It is also key to have a partner in the journey with the knowledge, expertise, and a broad ecosystem to support a successful transformation.

As a full-service provider and integrator, Kyndryl can be with you at every stage of transformation—whether that is on the mainframe, off the mainframe, or integrated with public or private cloud.

Best for purpose

“Fit for purpose” is an often-used term, but what does it really mean? Simply put: something that is good enough to do the job it was designed to do.

Settling for good enough isn’t typically a winning strategy from a business perspective. Recent crises in the world demonstrate that not only the fitness, but also the purpose, may change very quickly. Getting locked into what is good enough today may limit the ability to be good enough tomorrow.

Just as it is for business, so it is for the information technology that enables businesses. Not settling is even more important for applications and data, which are the real focus (or purpose) of technology and the lifeblood of business processes. So rather than fit for purpose, a better approach is considering what is best for purpose—anticipating future requirements and incorporating the enhancement and operational flexibility to adjust as those requirements change.

Most large enterprises have examined their technology landscapes and have identified a need for some level of digital transformation. Many of them have been focusing on this journey for several years. Some are beginning to reach a point where the next steps require changes to core business processes that are, in many cases, enabled by applications running on mainframes.

The journey is difficult. Industry analysts estimate that between 70% and 95% of digital transformation projects fail.¹

The level of change needed generates several requirements, including the need for new or changed skills, the need to get to and use data on the mainframe from other platforms, and other challenges like the need to change the overall IT management and support culture. Further complicating the challenge is the fact that some mainframe applications and data, while performing well and to the intended purpose, have not been enhanced to be ready to support changing requirements. There can be substantial technical debt or other pending requirements caused by neglect. The applications must change quickly due to changes in business processes, changing regulations, attrition of skills, or any number of other compelling events.

Additionally, location and access to data can be a major challenge for new applications. Much of the data used by mission-critical applications resides on the mainframe. Emerging analytics and artificial intelligence solutions can provide important insights and drive automation if the data is made available to them.

The mainframe has always been fit for purpose but with the evolution of technology, increasing maturity of public cloud, and emerging requirements, it is no longer always best for purpose.

The modern mainframe

In December 2021, Kyndryl published a point-of-view paper sharing [Perspectives on the Modern Mainframe](#) that described critical approaches and pathways to transforming the mainframe environment to prepare it for or include it in the journey to hybrid cloud. It also established that, contrary to some industry messaging, the mainframe is a modern platform with characteristics that make it not just the starting point, but also the best destination for some modernized applications and data.

But the mainframe is only one potential best-for-purpose destination.

Selecting the right platform for each application is the exercise of aligning business and technical requirements inherent in the application with a technology platform's unique capabilities, attributes, and strengths while avoiding the weaknesses.

The point-of-view paper was mostly about the infrastructure, but what about the next step for modernized applications and data on the mainframe infrastructure? And what about applications or workloads that are best placed on other platforms, either as part of an overall strategy to get them off the mainframe or integrated with applications hosted by public cloud providers as part of an overall hybrid cloud strategy?

Three key modernization motions

There are three high-level motions or patterns for mainframe application modernization.

- 1 Modernize applications on the mainframe
- 2 Modernize and move applications off the mainframe
- 3 Modernize applications while keeping some on the mainframe, moving some off the mainframe, and integrating them—typically hosted on the public cloud providers like Microsoft Azure, Amazon Web Services (AWS), or Google Cloud

Each of these motions must address the data requirements of the existing applications and take advantage of opportunities created through new and expanded use of the data.

Most enterprises will use a combination of these motions as part of their mainframe transformation for different application suites, or even on an application-by-application basis. Sometimes, corporate or business strategy will impact the choice, as will other challenges such as:

- Changes in availability of skills for specific platforms, programming languages, and more
- The prospect of requirements for capital or expense costs outlays for upgrades to back-level hardware and software
- A requirement to integrate the mainframe as a component of the existing IT ecosystem, rather than manage it as an island
- A requirement to increase the flexibility, velocity, and agility of application enhancement and development
- Previous attempts to migrate applications and data between platforms, with limited or no success
- Familiarity with specific service, cloud, software, and hardware providers
- Increasing requirements for broader data access
- Short-term or long-term cost considerations

The challenge becomes even more difficult when faced with conflicting requirements or requirements that lead to conflicting goals. This is not new to the IT industry, but it seems to be accelerating and each motion has advantages based on customer requirements.



Modernize applications on the mainframe

The mainframe can do virtually anything that can be done on an x86 platform. The modern mainframe is cloud-native ready and massively vertically scalable, often without adding hardware. It provides exceptional performance and availability. It can host new or changed workloads, but also traditional, mission-critical workloads. There are virtually no viruses on mainframes, with security features like Encryption Everywhere built into the platform. DevOps and DevSecOps can be implemented for mainframe using most of the common, standard open tools available on other platforms.

There are, however, some drawbacks to hosting all workloads on the mainframe. The mainframe is nearly as open as any other platform, especially when running Linux®, but there are only a limited number of independent software vendors (ISVs) who provide tools that support the traditional IBM Z environment. This scarcity reduces options as well as leverage over these providers for more traditional IBM Z operating systems, and locks traditional mainframe applications and data to a single hardware provider.

Although DevOps can be implemented, it typically has not been. Development and operations are usually done using traditional methods that are less agile, slowing the time to market for applications.

Advances in the use of AI and other automation solutions can provide immediate improvements for some mainframe enterprises, even for already automated functions like batch management. Many of these functions have not been examined in years, particularly in the context of how to improve them.

There is attrition of mainframe application development skills fluent in older languages like COBOL. Modernization on the platform can somewhat alleviate the impact of this attrition. Enterprises can implement tools such as Zowe™ to mask the complexity, convert code to newer languages like Java, and implement application programming interfaces (APIs) on the mainframe to enable development of programs on other platforms to connect to the mainframe.

Most mainframe data is locked on the mainframe or made available to other platforms through less-than-optimal transfer, replication, or duplication processes.

Cost is often cited as a challenge for the mainframe, but cost is a matter of perspective. Short-term versus long-term, CapEx versus OpEx, hard costs, opportunity costs, and more are all factors that should be considered.

The total cost of ownership (TCO) depends on what is included and what isn't, as well as the timeframe chosen. Any change to applications and data on or off the platform generates some up-front cost and changes ongoing operating and maintenance costs.

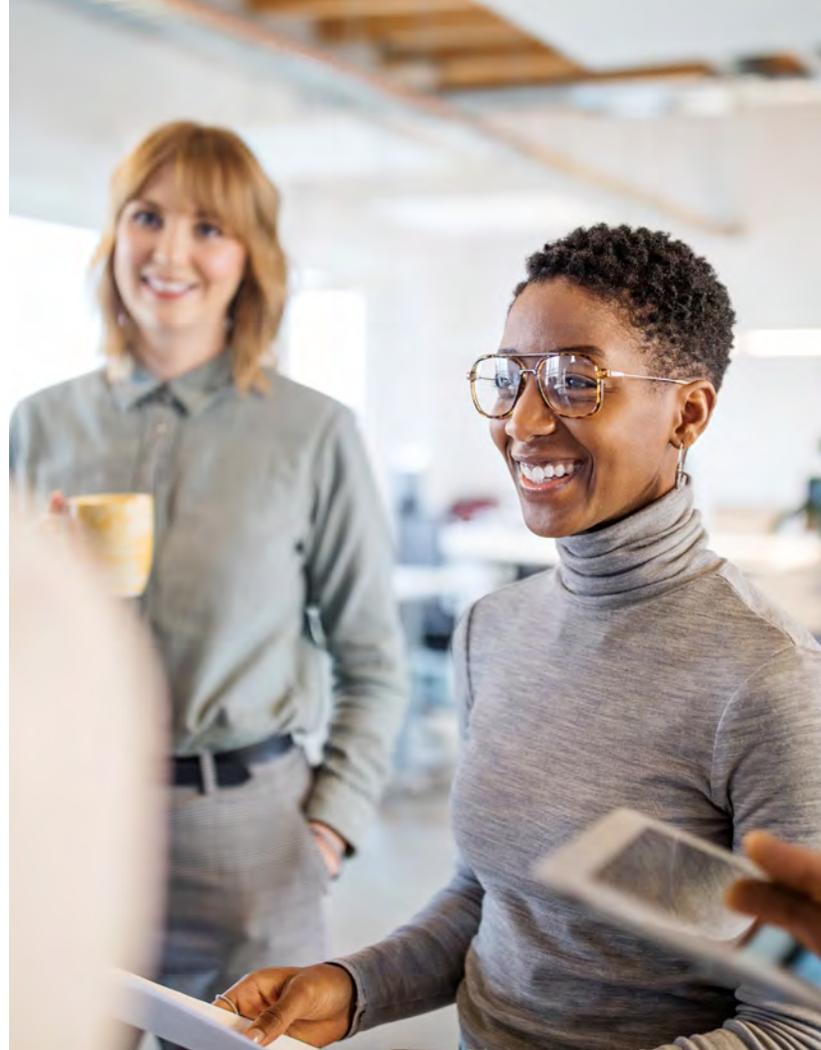
Move applications off the mainframe

Applications hosted on the public cloud, or on x86 in general, are typically developed, maintained, and enhanced using the most current programming languages and agile processes. In general, cloud applications can be changed very quickly. Although there is an overall global shortage of technical skills for all platforms, there are more skilled people for development and management of these applications and data. Applications scale horizontally by adding vCPUs or servers. This is particularly good for new application development because it can be done on a very small footprint and then scaled up with hosting charges on a consumption basis.

The mainframe has traditionally hosted the systems of record for an organization, which includes hosting critical customer information and customer transaction databases. A major challenge that must be addressed when moving off the mainframe is the transformation and movement of existing data to the new platform, as well as the storage, capture, processing, backup, and restore strategy going forward.

Most of the security features can be designed or built into a cloud solution, but not all. Additional effort is required to detect and manage threats that do not occur on the mainframe. The mainframe was designed and optimized to be a very secure, highly available, high-volume transaction processor, so applications in need of that power may not be good candidates to move off the mainframe.

Moving applications and data off the mainframe includes one-time cost and changes both operating complexity and ongoing costs. TCO for modernization off the mainframe needs to be broad enough to provide an accurate view for decision makers. Changes always come with risk, which should be considered when analyzing cost. This is not to say, "if it isn't broken, don't fix it." There may still be a need, but decades-old code has typically been tested and hardened through debugging or enhancements to maintain production environments. Even worse, the code and documentation may have been lost creating a requirement to reverse engineer the code or wrapping the current object code to run in emulators. The latter approach avoids needing to change code but can also reduce execution speed. It does not solve the challenge of maintaining the codeless applications going forward.



A major challenge of moving off the mainframe is the transfer of existing data to a new platform and defining the storage, capture, processing, backup, and restore strategy going forward.

Modernization of mainframe applications through integration with the public cloud

This motion may be appropriate for some applications or application suites. By taking this approach, the strengths of each platform can be exploited, and the weaknesses can be avoided—allowing you to realize the benefits of application modernization both on and off the mainframe. The mainframe can do what it does best for mission-critical systems of record, including supporting very high transaction volumes with near-perfect availability.

Data on the mainframe can stay on the mainframe but be made available to cloud applications. The cloud can provide the flexibility and speed to market needed for systems of engagement.

Taking this approach does create additional complexity over either of the other approaches taken on their own, but in many cases the benefits outweigh the risks. As with each monolithic platform approach (off mainframe or on mainframe), TCO must be examined very carefully.

Modernization is a journey that takes several steps. The implementation roadmap must address the infrastructure, the applications, the data, and the future-state operating environment.

Beginning with the end in mind is critical regardless of the motion. Mainframe transformation and application modernization needs to be driven by a well-defined strategy.

Elements of a mainframe transformation strategy

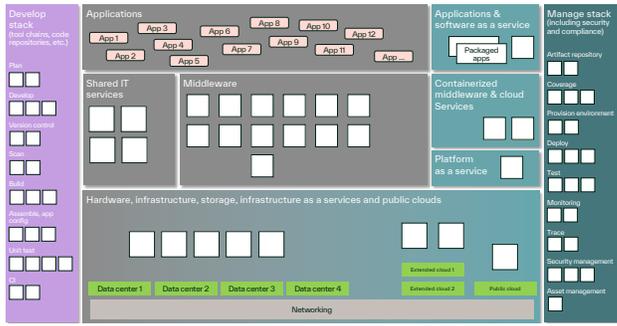
Mainframe transformation and application modernization is a journey that can take several years depending on the volume and complexity of the applications and data. It is important to lay out where you want to go during that journey.

A strategy that will enhance your chances of success should include the following elements as a minimum:

- Define a vision
- Establish the target architecture and operating model
- Identify a systematic approach to making data, application, and workload placement decisions including when to:
 - Modernize applications on the mainframe
 - Move applications off the mainframe to private cloud or public cloud
 - Integrate applications across platforms with applications hosted off the mainframe
- Evaluate gaps between the current and target architecture
- Create a cross-enterprise communications approach that ensures stakeholder buy-in to changes, with C-level executive sponsorship
- Create a cross-enterprise skills program to ensure the target state has sufficient skilled resources to enable future development and management
- Define a prioritized roadmap for transformation



Current operating model



Target operating model

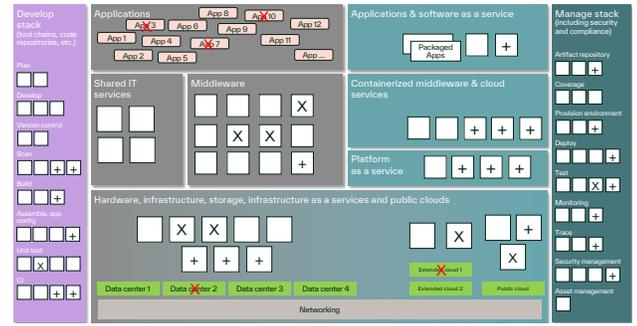


Figure 1: Current architecture versus target architecture

The whole strategy must be aligned to business requirements and establish valued outcomes with a focus on how the target architecture and operating model can enable business results.

A good starting vision is to put the right workload on the right platform, but different enterprises may have different visions for many reasons. In any event, the vision must be defined at a lower level than just a starting point so that lower-level plans can be validated as being aligned to the vision.

A great strategy is not static. Conditions, business requirements, technology, and other factors that impact the ability to realize a strategy can change, so the strategy itself needs to be reviewed on a regular basis.

Commitment to the strategy by stakeholders is required for it to be successfully implemented. This commitment is especially critical for any technology transformation campaign because it touches so many parts of the enterprise beyond the technology. For mainframe transformation and application modernization, this fact is magnified even more because skills and cultural changes are often necessary to implement newer agile processes and procedures.

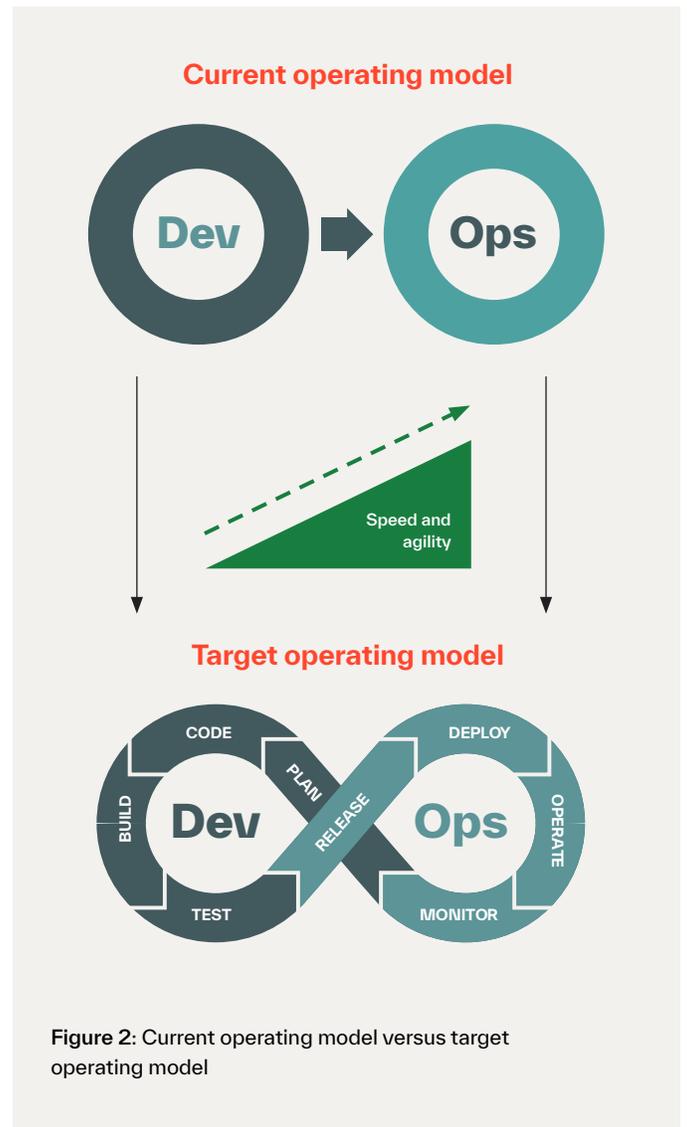


Figure 2: Current operating model versus target operating model

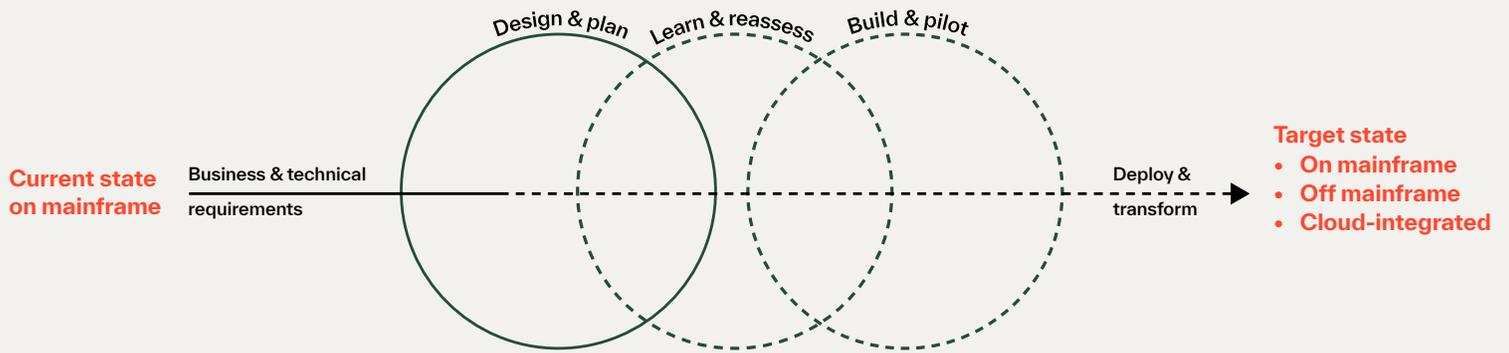


Figure 3: Phases of mainframe transformation

A successful, comprehensive strategy takes a holistic approach. The term holistic is often overused, but in this case, it fits because the strategy must address business, technology, process, communications, skills, and the operating model, as well as lay out criteria and steps to take to evaluate applications for ultimate disposition. It takes an understanding of the current and target environments through all these perspectives. In most cases, it is good to start with the critical, high-level pieces of the strategy and then iterate through building it out as more is learned.

Building momentum through iteratively capturing value and learning is perhaps the most critical key to success.

Destinations for mainframe applications

Regardless of which of the three motions an enterprise chooses, there are a limited number of approaches that can be taken to modernizing mainframe applications and transforming the infrastructure on which the modernized applications and data run.

In December 2010, Gartner defined guidance for moving applications to cloud.² This guidance was widely adopted as a de facto standard in the industry. However, this guidance was limited by focusing only on migrating applications and data to the cloud.

By 2018, Forrester outlined key patterns for handling the future of mainframes.³ By this point in time, it was recognized that the mainframe was not going away. Forrester took a broader perspective, including both technical and business approaches to mainframe modernization and what to do with applications and data that remained on the mainframe.

Since Gartner first coined some of the terms, the technology and the platforms have advanced. Tactics that were only suitable for moving applications and data off the mainframe became possible modernization options on the mainframe as well.

Taking the holistic view across the infrastructure and applications, the approaches to mainframe application modernization can be grouped into three broad categories.



Modernization approaches that require major changes to the code



Migration approaches focused on migration with minimal changes to the code



Traditional approaches

Both modernization and migration also require transformation and major changes to the data.

Application modernization approaches

Containerize

Containerize applications and middleware using Kubernetes platforms provided by a public cloud provider such as Amazon Elastic Kubernetes Service (EKS), Azure Kubernetes Service (AKS), or Google Kubernetes Engine (GKS), or a more general-purpose, cross-platform environment such as Red Hat® OpenShift®, and VMWare Tanzu.

Replatform

Use code conversion tools, emulators, and more common, cross-platform languages, as well as new middleware and platforms to migrate the application to a new platform.

Refactor

Rebuild code and data using new programming and recovery models. The code is typically refactored into microservices.

Externalize

Expose critical elements like database or specific transaction processors through APIs using a variety of available mainframe tools. This exposure facilitates integration with applications on multiple platforms without major changes to some of the original code or middleware.

Enrich

Add new value through implementing chatbots, artificial intelligence, and data analytics.

Optimize

Common optimization journeys include upgrades, DevSecOps modernization, recompiling, and various migration paths. Optimization should almost always be performed as part of any mainframe modernization journey.

Application migration approaches

UNIX to Linux

UNIX can be replaced by Linux, which is supported on multiple platforms, to provide greater interoperability and to facilitate movement of applications between platforms.

Modernize storage

The newest storage has capabilities that greatly increase throughput and resiliency.

Virtual to virtual

Server images enabled through virtualization can be migrated between different platforms, including from the mainframe to the public cloud or from distributed systems in general to the mainframe.

Physical to virtual

Migrating to a virtual model from a physical server model provides the benefit of scalability without hardware expense and facilitates the movement from a CapEx model to an OpEx model in general.

Physical to bare metal

The benefits of moving from individual physical servers to a consumption-based model where bare-metal capacity is used provides benefits similar to the physical to virtual approach.

Container to container

Some container platforms are more open than others. Migration from one container platform to another may enable more portability of applications.

Traditional approaches

Retire

For code that has reached end-of-life and has no more value, the best approach is to decommission the code.

Replace

The functionality provided by the application, middleware, and infrastructure is replaced with an equivalent common off the shelf (COTS) or software as a service (SaaS) solution.

Retain

Leave the application in the source environment. The decision to retain is generally based on TCO, complexity, lack of source code or documentation, and latency concerns. This approach can be used in conjunction with the externalize approach.

As previously mentioned, it's best to take an iterative approach where business value increases with each iteration. Based on the strategy and criteria defined for selecting the best-for-purpose destination for each application, each iteration should start with an assessment of an application or an application suite. An initial, higher-level assessment of a broader range of applications can also be done to provide initial targets and prioritization for each iteration.

During each iteration, the applications and data are examined to determine dependencies, technical debt, limitations like missing code, cost of ownership, skills required to maintain the code, and more, as well as how the application and data can best move to a landing zone in the defined, target architecture. Based on the assessment, you can develop wave plans that identify the approaches to take for each application and determine the projected financial impact before any costly changes are made.

Throughout each iterative assessment, there may be changes or other lessons learned that force a reassessment. Since one focus of modernization is flexibility, it should not be a surprise that successful modernization must also be driven by a flexible process.

With the appropriate approval and commitment from stakeholders, the applications, data, and infrastructure can be modernized, transformed, and enabled on the architecture. If the new, agile DevOps or DevSecOps processes have not been enabled for the mainframe, implementation of those processes is critical to facilitate any of the motions and to support the enterprise in ongoing technology management success.

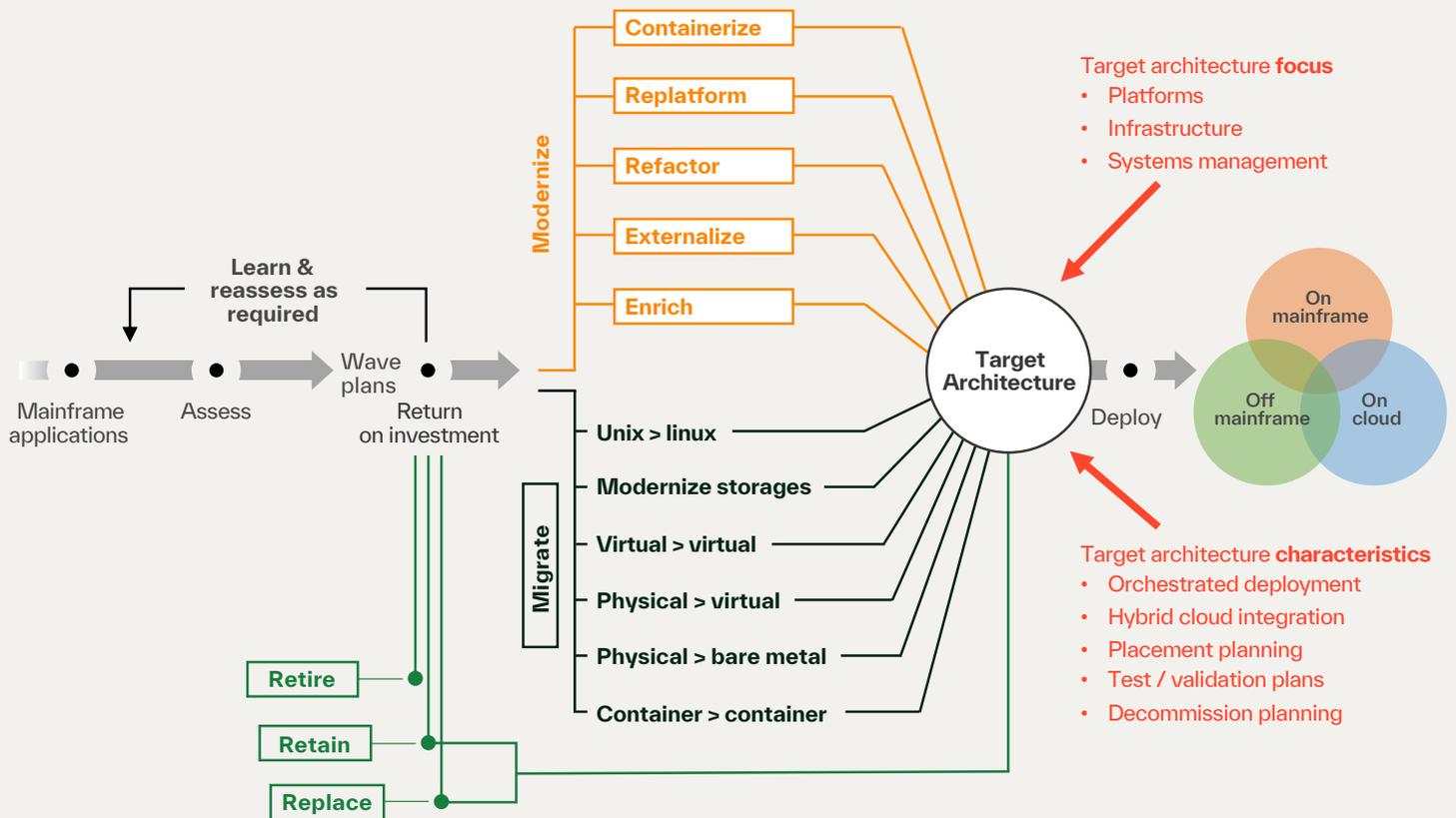


Figure 4: A systematic approach to workload and application placement, modernizing on mainframe, moving off mainframe, or integrating with private and public cloud



Another good starting point

There have been multiple studies that indicate that enterprises continue to invest in IBM Z. One recent study completed after the first waves of COVID-19 indicates that the overall global mainframe market is projected to grow at a compound annual growth rate (CAGR) of 7.5% between 2022 and 2027.⁴

There are many good reasons for the continued growth of the platform. Modernization of mainframe applications is not as easy as was thought—or sold—several years ago. There is widespread recognition that the mainframe continues to provide value, but modernization challenges can be daunting or even overwhelming. For some industries, the regulatory, security, and transaction-processing requirements make rapid migration from the platform to a monolithic cloud model even more difficult and expensive.

It is most likely that some of an enterprise's mainframe applications and associated data will continue to be hosted on the mainframe for some time, even for journeys that are intended to move all applications completely off the mainframe. These are often mission-critical applications that would require the business to stop to allow migration. Such applications may even need to run in parallel with new applications through a transition period.

A good starting point is often to begin by optimizing the mainframe environment to ensure the business is getting the maximum value from current investments. Advancements in the IBM Z platform and middleware can help to increase speed, reduce consumption, and be a critical accelerator of mainframe application modernization. DevOps or DevSecOps can be deployed for the existing mainframe domain, bringing the benefits of the agile processes. When integrated with enterprise or cloud management, this further accelerates any future movement off the platform.

“The new IBM z16 platform brings AI and cyber resiliency to your hybrid cloud using innovative on-chip AI inferencing and industry-first, quantum-safe technologies. With advances in hybrid cloud that make modernization less risky, it's an essential platform for any digital transformation. Accelerate decision velocity and get the agility to move your business forward.”

– IBM⁵

Regardless of which approach you take for each application, an incremental approach increases value while protecting your investment. Infrastructure transformation can be a step toward integration with public cloud or a stop along the way to migrating off the platform. For applications that will remain, an optimized mainframe will provide maximum value.



Improve what is already in your enterprise

Technology modernization helps to:

- Drive hardware currency
- Ensure software currency
- Deploy more modern programming languages
- Realize process improvement
- Automate
- Use multiple hosting models
- Realize improvements through recompiling existing applications



Put your most robust technology forward

Consolidating workloads helps to:

- Rationalize your footprint and reduce complexity
- Exploit all the modern capabilities of the platform
- Improve security and availability
- Reduce software license costs through consolidation
- Remove requirements for capital through mainframe cloud
- Co-locate Linux and z/OS when appropriate



Enable your journey to hybrid cloud

Unleash the power of IBM Z to:

- Modernize in place
- Expose legacy applications for integration through APIs
- Deploy containers
- Develop cloud-native applications
- Institute a DevOps model
- Enable greater agility for future transformation

Even businesses that do not want to invest in the current model can still optimize what they have. There are often opportunities to tune, refine, and improve your own environment, or accelerate optimization through working with a trusted partner.

Kyndryl services

Kyndryl has the skills and expertise to help with your transformation. As a trusted mainframe infrastructure, applications, and data management services provider and integrator, we are here to meet you wherever you are on your mainframe transformation journey.

If we are fortunate enough to have already gained your trust by managing your infrastructure, our familiarity with your environment and business challenges further accelerates modernization. If we do not manage your mainframe environments, we would like to. Our mainframe experts can provide onsite support on your own equipment, on dedicated equipment in one of our purpose-built data centers, or on our right-size, consumption-based zCloud infrastructure—an OpEx alternative that unlocks the modern capabilities of the mainframe.

If we provide you with infrastructure management but not application management services, you can also accelerate your journey further by engaging Kyndryl services for your mainframe or cloud applications. This approach allows you to focus on your core business instead of modernization challenges. We'll manage all the necessary upskilling or right-skilling, fill staffing gaps, and manage changes in the staffing footprint during and after transformation.

For new infrastructure or application management customers, we can help accelerate your transformation and application modernization in parallel with your transition to our services.

Kyndryl continues to be a global leader in mainframe managed services. In 2022, we scored the highest out of 19 vendors analyzed by Gartner, receiving the score of 4.45 out of 5 for our use case in legacy data center outsourcing deals. Kyndryl was also recognized by ISG as a leader in mainframe modernization services, mainframe as a service and mainframe operations.⁶

Our experience as a mainframe leader across all industries and major countries also provides us with the business and technical expertise to serve customers who do not wish to use our managed services. Through our ecosystem of alliances, partners, suppliers, and our own experts, we can drive your transformation while integrating all the services necessary for application assessments, building wave plans, financial analysis, modernizing the code, and implementing the changes. As a full-scope, multi-platform service provider and integrator, we can also manage the resulting target environment regardless of platform.

Whether you have yet to define a modernization strategy or are looking to refine an existing strategy, Kyndryl can help you define it through consulting engagements. Our cloud consulting portfolio is focused on four groups of capabilities, which we can mix and match to create a solution tailored to your specific needs:



Cloud strategy and optimization: Align your platforms and services to your business strategy with a unifying hybrid, public cloud, or multi-cloud strategy and roadmap.



Cloud and landing zone design: Design a unifying cloud solution architecture that meets the requirements for your target hybrid, cloud, or multi-cloud estate.



Platform and infrastructure modernization: Create the blueprint for your platform and infrastructure modernization that aligns to your value chains and transformation goals.



Modern operations and management: Establish a solid foundation for management of cloud platforms through DevOps or DevSecOps, automation, and AI operations (AIOps) initiatives.

The iterative approach that can be used for each of the three modernization motions presented at a high level in this document is the Kyndryl approach. Regardless of your target state, we can work with your staff to provide assessments, pilot projects, project management, and implementation for you on a project basis. We have specific, integrated offerings and capabilities that can help make each of the motions successful either as part of a comprehensive engagement or engaged to meet individual challenges.

Transformation and modernization on the mainframe

Our services specifically focused on transformation and modernization on the mainframe include:

- Providing a **Z transformation experience workshop** to help arm you and your staff with high-level knowledge to enable better modernization decisions at both the strategy level and the detail level
- Doing a **technical health assessment** of your entire mainframe environment, or individual components such as DB/2, CICS, or other middleware to help drive optimization

We provide strategy and implementation capabilities for:

- Mainframe DevOps transformation
- API deployment using z/OS Connect and other solutions
- Data virtualization
- Open frameworks, including solutions like Zowe and z/OSMF
- Linux consolidation
- Containerization on the mainframe with zCX and Red Hat OpenShift
- Data center migration
- Site reliability engineering (SRE) transformation
- Batch standardization, optimization, and improved automation
- Extended mainframe analytics and improved overall automation

Integration with public cloud

Kyndryl addresses four of the key challenges with mainframe to public cloud integration through offerings designed to satisfy the following use cases:

- **Physical proximity:** Empower customers with the ability to connect mainframe systems to the public cloud through a security-rich connection that has highly available, high-speed dedicated bandwidth.
- **Application integration:** Leverage the power of public cloud DevOps stacks along with mainframe-specific and open-source tools to enable engineers to plan work, collaborate, build code, and release applications. Manage the entire infrastructure as code and open the mainframe to integration through the implementation of APIs.
- **Data integration:** Address the need for data integration between cloud services and on-premises mainframe platforms to enable actionable insights from data and mitigate security risks associated with mishandled data movement off the mainframe.
- **Management and automation integration:** Provide consolidated monitoring and automation across the entire infrastructure stack through integration of capabilities from the public cloud provider and Kyndryl's standard mainframe management platform.

Move off the mainframe

The major focuses of moving off the mainframe are the applications, data, and future-state operations model. Kyndryl offerings are designed to guide our customers through each step, including:

Discovery

- Application and data inventory and dependency mapping
- Assessment
- Analysis, including ROI

Design

- Target architecture
- Target operation model
- Technical design plan

Build

- Conversions as required
- May include pilots and proof of concept

Test

- Unit testing
- Service integration testing
- User acceptance testing
- Performance testing

Migrate

- Deployment and hand-over to production

Manage and run

- We meet you where you are, with the tools you need to get you to where you want to go

Why Kyndryl?

Kyndryl has deep expertise in designing, running, and managing the most modern, efficient, and reliable technology that the world depends on every day. We are deeply committed to advancing the critical infrastructure that powers human progress. We're building on our foundation of excellence by creating systems in new ways: bringing in the right partners, investing in our business, and working side by side with our customers to unlock potential.

For more information

To learn more about Kyndryl advisory, implementation, application, infrastructure, and management services for IBM Z, IBM i, and cloud, please contact your Kyndryl representative or visit kyndryl.com/us/en/services/core-enterprise-zcloud



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The performance data and client examples cited are presented for illustrative purposes only. Actual performance results may vary depending on specific configurations and operating conditions.

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