AWS Mainframe Migration (Cloud)

Whitepaper

1. Abstract

Organizations worldwide have understood the importance of digital transformation as a key strategic objective. Modernization of the application & infrastructure is an essential tool that provides the fastest route to delivering business value. This modernization may be achieved through numerous ways, one of them being the migration of the mainframe to the cloud. Moving digital assets, such as data, applications, and workloads, to cloud infrastructure, is termed cloud migration. Migrating to the cloud from the mainframe gives your business enterprise a clear competitive edge with distinct advantages, such as scalability, cost reduction, automation, operational flexibility, rapid development, and faster time-to-market.

This whitepaper will walk you through the challenges & benefits of the mainframe migration to the cloud and provide an insight into the correct approach to kickstart your migration journey. A well-planned and smart migration strategy would help carry out a seamless shift without disrupting your organization's workflow. The key to a successful migration is soliciting an expert mainframe migration partner. Furthermore, the identification of the appropriate modernization approach is crucial for the success of your modernization engagements.

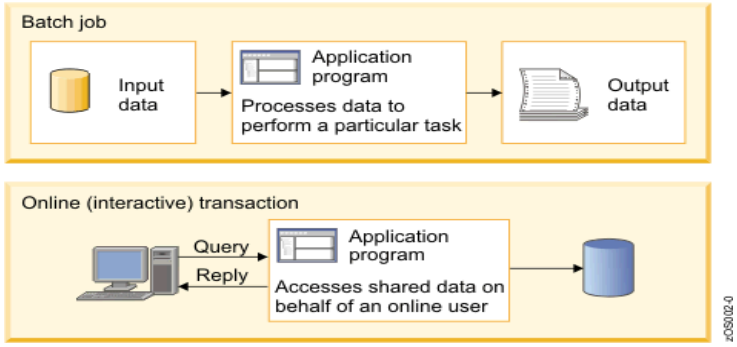
2. Introduction

Mainframe computers have been hugely popular for the past few decades as they can process terabytes of data from high-speed storage devices and produce valuable output. Despite the effectiveness and advantages of cloud-native development, the mainframe still remains a core and invaluable enterprise technology for large enterprise customers across Finance, Insurance, Manufacturing, Retail, and the public sector industries. The mainframe is still not dead, but with the advancement in technology, the mainframes are slowly outpaced by their more sophisticated counterparts. In this age of rapid digitization and fast-changing business, enterprises will have to embrace modernization to reap the benefits of advanced technologies.

The large mainframes run multiple workloads in parallel (such as programs, middleware, data stores, dependencies, and resources) that execute a cohesive set of business functions and are often supported by a transaction monitor.

Mainframe workloads majorly fall under one of the two categories mentioned below:

- **Batch Processing** – With mainframe systems, companies can generate & consolidate reports for review, and these applications producing such statements are batch applications.
- **Online Transaction Processing (OLTP)** – The transaction processing occurs interactively with the end-user. Mainframes here serve a large number of transaction systems which are often mission-critical applications that businesses depend on for their core functions.



Mainframe Workloads | Image Credit: IBM

a. Challenges with Mainframe Workloads - Drivers for Migration

Many companies have been running their software applications on mainframes for decades, and they have been running workloads with specific performance and security provisions that ensure smooth business operations. However, challenges with mainframes include workload complexity, high costs, skill shortage, inflexibility in the system, time to market, omnichannel support, modernized customer experience (UI), etc., to name a few.

- **Workload Complexity**: Mainframe systems have challenging non-functional requirements to process large volumes of data & users for core business workloads. The spectrum of complexity for workloads includes the virtualized, service-oriented architecture workloads at the low end of complexity and the monolithic mainframes at the high end.
- **The Cost Factor:** The costs of running mainframe systems can get sky high - the higher the transaction volume, the more expensive it gets. Moreover, the costs associated with storage, maintenance, operations, and facilities are also significant factors, including costs for real estate and infrastructures (such as power & cooling).

- **Shortage of Skills:** Companies also face an IT skills shortage as the experienced staff is exiting the workforce. Professionals with the required expertise to maintain & operate mainframe workloads are reaching the edge of retirement and ageing out (average age of COBOL and Mainframe experts being 50+ years).
- **Time to market & Customer experience**: Organizations globally are under immense pressure to create a culture of growth, and turn more competitive, efficient, and responsive to the rapidly changing business scenario. Mainframe systems are a significant barrier in accomplishing the modern business imperatives such as faster time-to-market and better employee & customer experience.

IT teams are looking forward to boosting agility as part of their Digital Transformation (DX) efforts, thus making the cloud a more logical option. Hence, migrating off mainframes has become imperative for enterprises because such legacy technology is generally unsuitable for ongoing digital transformation efforts.

b. How to Address these Challenges?

Cloud computing can address the challenges posed by mainframes, making it necessary to migrate:

- **Reducing workload complexity**
    - Migration to a cloud solution not only meets but often surpasses the challenging non-functional requirements, thereby increasing the quality of service for most critical business workloads.
    - Modernizing mainframe workloads with AWS modernizes core business, and companies gain the advantage of leveraging the mainframe data, containing decades of business transactions.
    - Further, cloud migration also offers on-demand access to compute and storage resources that can scale virtually without limit.
- **Adding cost Benefits**
    - It is costlier to run similar workloads in the mainframe than in the cloud and the added advantage is technology advancement in the cloud.
    - Migrating workloads to the cloud means avoiding mainframe hardware & software licensing fees and savings that can quickly pay for migration costs.
    - Moving to the cloud helps eliminate capital expenditure and millions of instructions per second (MIPS), shrinking independent software vendor (ISV) license costs, and leveraging elastic pricing models.

    - The cloud allows companies to trade capital expenses (such as data centres and physical servers) for variable costs, and they only pay for IT as they consume it.
    - Plus, the variable costs are much lower than they would pay to do it themselves because of the economies of scale
    - Companies thus can save costs by paying only for the compute time they use per millisecond instead of providing infrastructure upfront for peak capacity.

- **Addressing skills shortage**
    - According to a recent study, 23% of the mainframe workforce has been lost, and 63% have not been replaced.
    - Most of the new talents are gravitating towards the newer and more popular cloud technologies.

- **Better customer experience**:
    - More companies are finding that their business requirements are evolving faster than their ability to enhance their legacy applications in the digital world.
    - Cloud computing helps reduce development cycles via continuous integration and continuous delivery (CI/CD), and virtually unlimited infrastructure resources consumed on demand.
    - Companies also gain the advantage of leveraging the mainframe data; can feed data analytics or machine learning initiatives seeking competitive differentiators.
    - With the cloud, companies can expand to new geographic regions and deploy globally in minutes.
    - AWS has a global infrastructure, so companies can deploy their application in multiple physical locations with just a few clicks, making implementations several orders of magnitude faster than before.
    - Putting applications in closer proximity to end users reduces latency and improves their experience.
    - This gives companies the freedom to experiment, test new ideas to differentiate customer experiences and transform their business.

Role of AWS in Addressing the Challenges:

- With AWS, companies save a considerable amount of money compared to mainframe hardware upgrade costs. What makes the cloud-native approach **cost-effective** is the pay-as-you-go model (such as AWS Lambda) for all cloud services, whether it relates to infrastructure, platform, or software.
- AWS provides horizontal **scalability** and virtually unlimited **capacity** to enhance elasticity and manage workload peaks while minimizing unused capacity.

- Companies can unlock core business processes and data in their mainframes and **reduce risk** by removing vendor lock-in by taking advantage of the multiple protocols and interfaces available on AWS.
- AWS Cloud not only prioritizes **security**, but it also enables the companies (customers) to inherit the best practices of policies, architecture, and operational processes that satisfy the demands of security-sensitive customers.
- AWS cloud provides extensive **encryption of data** options both at-rest or in-transit, without application changes for data confidentiality, integrity, and compliance.
- Serverless computing platforms like AWS Lambda help upload code in the form of functions, and the platform runs those functions, making **infrastructure management** effortless.

Benefits that the cloud offers are usually outside the range of legacy applications running on mainframe systems, including greater agility, scalability, and cost-effectiveness. Modernizing the mainframe architecture would allow organizations to leverage the cloud and take advantage of these benefits.

Impact of Covid-19 on Mainframe Migration (Cloud)

The necessity for modernization of critical mainframe systems has become more eminent due to the Covid-19 pandemic forcing companies to adopt the "Work from Home" model. Before the pandemic outbreak, many organizations relied on a variety of outdated and inefficient technology to run their businesses. However, the overnight shift to the remote working model highlighted the drawbacks of the physical infrastructure and made organizations realize that digital transformation is imperative. There has thus been a significant rise in organizations modernizing their IT infrastructure and migrating their critical business workload to the cloud.

The annual 2021 Mainframe Modernization Business Barometer Report examines the current mainframe market and the impact Covid-19 has and will continue to have on modernization planning. The report states that:

- As a direct outcome of the Covid-19 outbreak, 78% of enterprises have started at least one modernization program
- In the next 12-24 months, 87% have scheduled at least one legacy system modernization program
- 60% of the enterprises agree that Covid-19 accelerated their cloud transition process.

As the global economy is on the path of recovery after the Covid-19 outbreak, many businesses are rethinking adapting to the new reality. While some companies collapsed, others learned tough lessons, and some emerged stronger during the pandemic. Further, the growing demand for online availability of information is escalating pressure on the operation of mainframe systems. On top of that, the end-users also have different expectations than before.

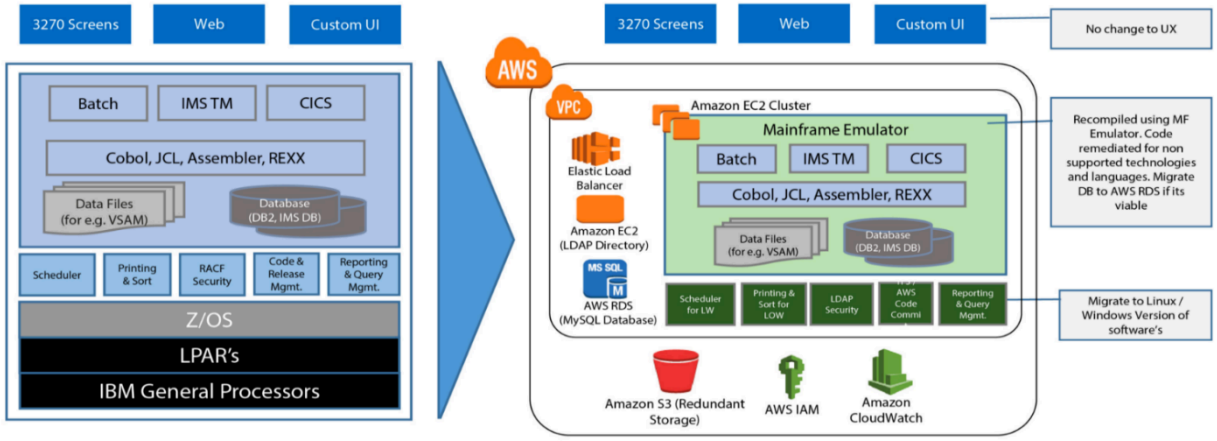
Our View
The necessity for modernization of critical mainframe systems has become more eminent due to the Covid-19 pandemic forcing companies to adopt the "Work from Home" model. For many organizations still using mainframes, the Covid-19 pandemic has demonstrated the urgent need for modernization. The pandemic has also intensified this shift, as, unlike mainframes, cloud applications can be managed remotely, even with IT staffers working from home. Most companies are thus moving mainframe workloads to proven robust cloud platforms such as AWS to take advantage of its benefits- including cost savings, security, scalability, and more advanced applications.

3. Mainframe Migration Options

With the modernization of the existing mainframe environment by migrating to the cloud, enterprises can reap this new system's benefits and capabilities that ensure increased business agility, operational flexibility, and cost-efficiency. A migration approach that's well planned is a must, and the ideal method should be aligned with the organization's workflow. Here is an overview of the three most effective and commonly used migration options:

a. **Re-hosting** (Software based Emulation)

Re-hosting, also known as the "**lift-and-shift**" approach, is the most commonly adopted strategy when migrating applications to the cloud and involves moving applications from the on-premise environment to the cloud without modification. This approach is widely used to migrate large-scale legacy applications to meet specific business objectives.



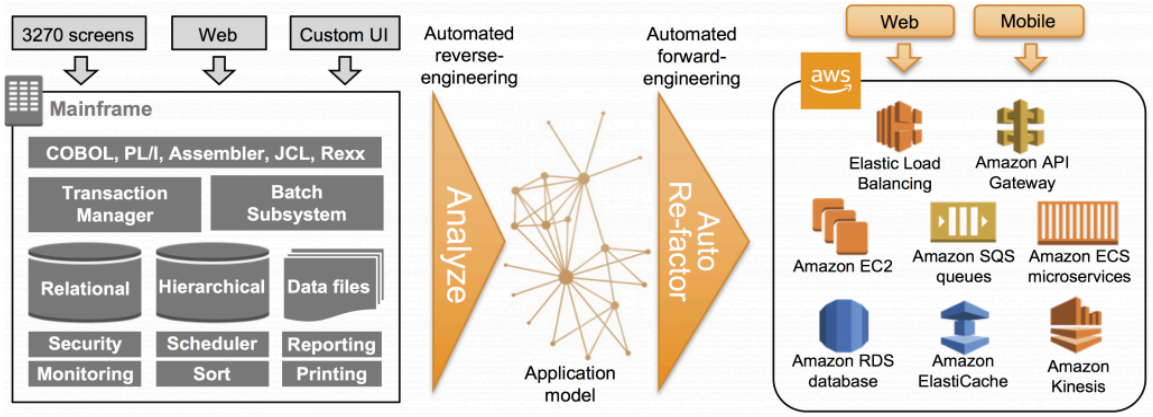
Mainframe Re-Host Migration to Cloud
Image Credit: AWS

Two Models of Re-Hosting:

- One is to re-host to another less expensive location to gain cost benefits without carrying the risk of programming language changes. The process typically begins with moving applications to a cloud-based emulator and then migrating the database to a cloud-based one.
- **Infrastructure Re-hosting**: Using a traditional hosting provider, this model may buy time, reduce vendor lock-in, and produce interim cost savings. Rehosting costs substantially less money and time, effectively minimizing risk for business logic errors. The applications will work as usual, with no change in user functionality or business logic.

b. **Re-factoring** (Automated)

The refactoring approach allows to "**re-architect**" existing applications to leverage the features & services offered by the cloud environments. This approach involves restructuring existing code or programming language to a modern one to reduce the risk of technical debt and several skill-related risks. There is a total refurbishment of an application to adapt it to the cloud, and it is helpful when the company has a strong business need for cloud-native features (such as improved development agility, scalability, or performance).

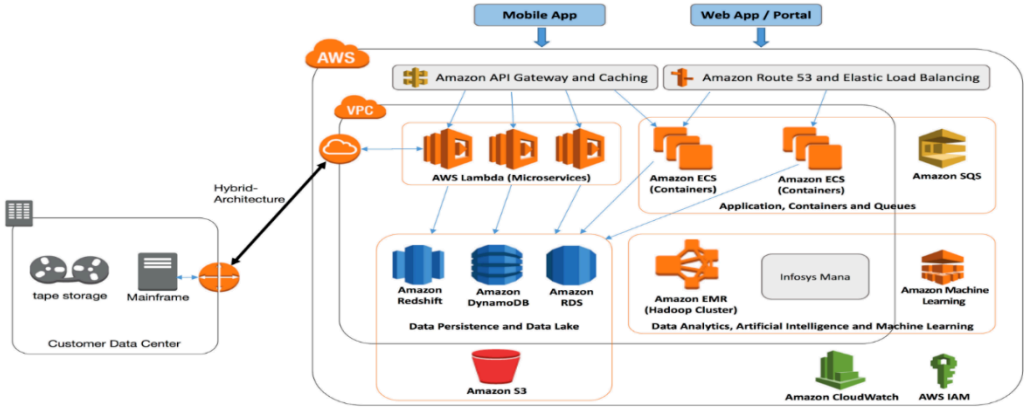


Short-Term Migration with Automated Refactoring
Image Credit: AWS

Automated Refactoring tools analyze and transform the complete legacy stack (such as COBOL-based), resulting in the automatic creation of a coherent and functionally equivalent target stack (such as Java-based or .Net based). Typically, the resulting application follows the best practices similar to cloud-native applications, which are service-oriented, service-enabled, and have packaged optimizations for AWS services. The Automated Refactoring tools' value & differentiators rely mainly on their automated forward-engineering capabilities. In this transformation, there is optimum automation for efficiency & quality but no manual re-write of code.

c. **Re-engineering** (Cloud-native)

This approach involves developing the application from scratch, that is, "**rebuild**" using all the cloud services & features and discarding any legacy components. This approach requires complete knowledge of the existing application processes & functionality and a good grasp of the cloud services. The rebuilding approach results in a completely new application with an improved feature set and capabilities.



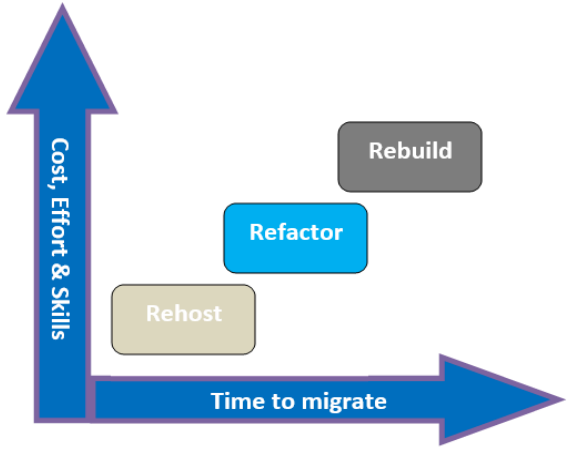
Mainframe Re-Engineering/Rebuilding for Cloud / Image Credit: AWS

This approach is recommended when the existing mainframe application can no longer meet future-state business requirements or agile target architecture. With rebuilding, the company can leverage a microservice-based architecture. This is done using cloud-native techniques, leveraging micro-services, containers & decoupling, data analytics, artificial intelligence and machine learning.

Key Takeaways

Each method or approach has its pros & cons, and ultimately migration partners like LTI assess and decide on the suitable option/approach based on risk tolerance, business case, and overall cloud strategy.

- **Rehost:** With no changes to the application, this approach has limited ability to take advantage of the cloud-native environment. It costs substantially less money and time, with practically minimal risk for business logic errors. However, some applications may be very complex to lift-and-shift and require a specialized set of tools and software.
- **Refactor:** This approach is an expensive option but can offer the best possible benefits of the cloud. It is a time-consuming strategy since more knowledge is required about the cloud platform itself and its services.
- **Rebuild:** Due to the added cost and complexity, it's not as common as a lift-and-shift approach. Having a new application interface and design can sometimes cause trouble for the users.



Time vs. Complexity (Cost, Effort & Skills) Illustration
for All Approaches

Regardless of the approach or strategy adopted, companies should consider the mainframe workloads in their cloud migration strategy, resulting in significant cost savings, increased agility, and a future-proofed architecture.

4. Mainframe Migration – Why LTI

For a successful mainframe migration to AWS cloud, businesses would want to choose a partner experienced in the best mainframe migration projects and possessing the most valuable tools & processes. With a great partner like LTI, you can seamlessly migrate your mainframe to the cloud.

a. LTIs Migration Approach

LTI's mainframe migration approach is an all-inclusive suite of contemporary tools and processes that offer application-readiness assessment, architecture design and blueprint, besides tool-led migration, testing, and operations management. The approach brings together several key constructs across the migration lifecycle to accelerate digital transformation.

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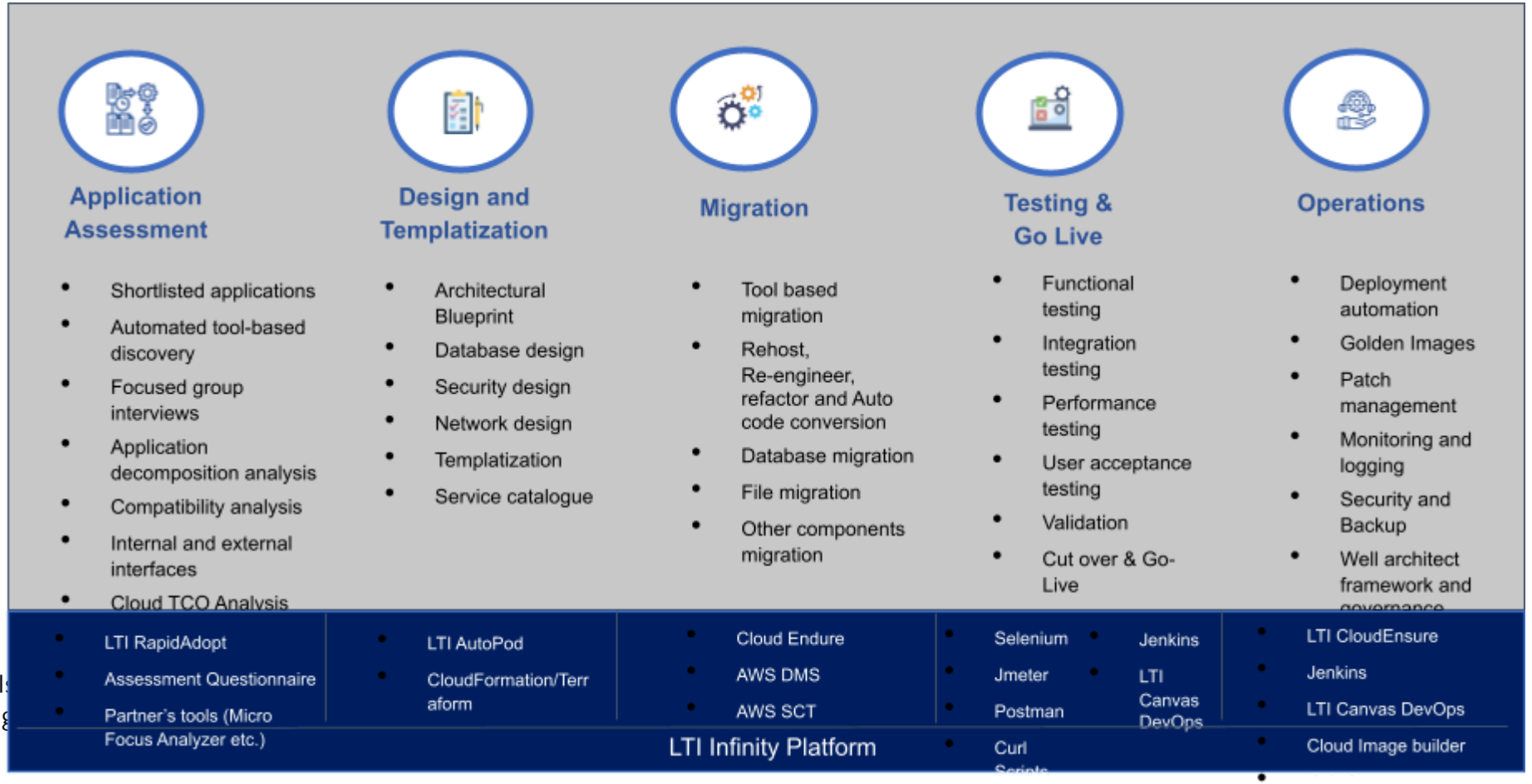
Application Assessment
Shortlisted applications
Automated tool-based discovery
Focused group interviews
Application decomposition analysis
Compatibility analysis
Internal and external interfaces
Cloud TCO Analysis
Design and Templatization
Architectural Blueprint
Database design
Security design
Network design
Templatization
Service catalogue
Migration
Tool based migration
Rehost, Re-engineer, refactor and Auto code conversion
Database migration
File migration
Other components migration
Testing & Go Live
Functional testing
Integration testing
Performance testing
User acceptance testing
Validation
Cut over & Go-Live
Operations
Deployment automation
Golden Images
Patch management
Monitoring and logging
Security and Backup
Well architect framework and
LTI RapidAdopt
Assessment Questionnaire
Partner's tools (Micro Focus Analyzer etc.)
LTI AutoPod
CloudFormation/Terraform
Cloud Endure
AWS DMS
AWS SCT
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LTI CloudEnsure
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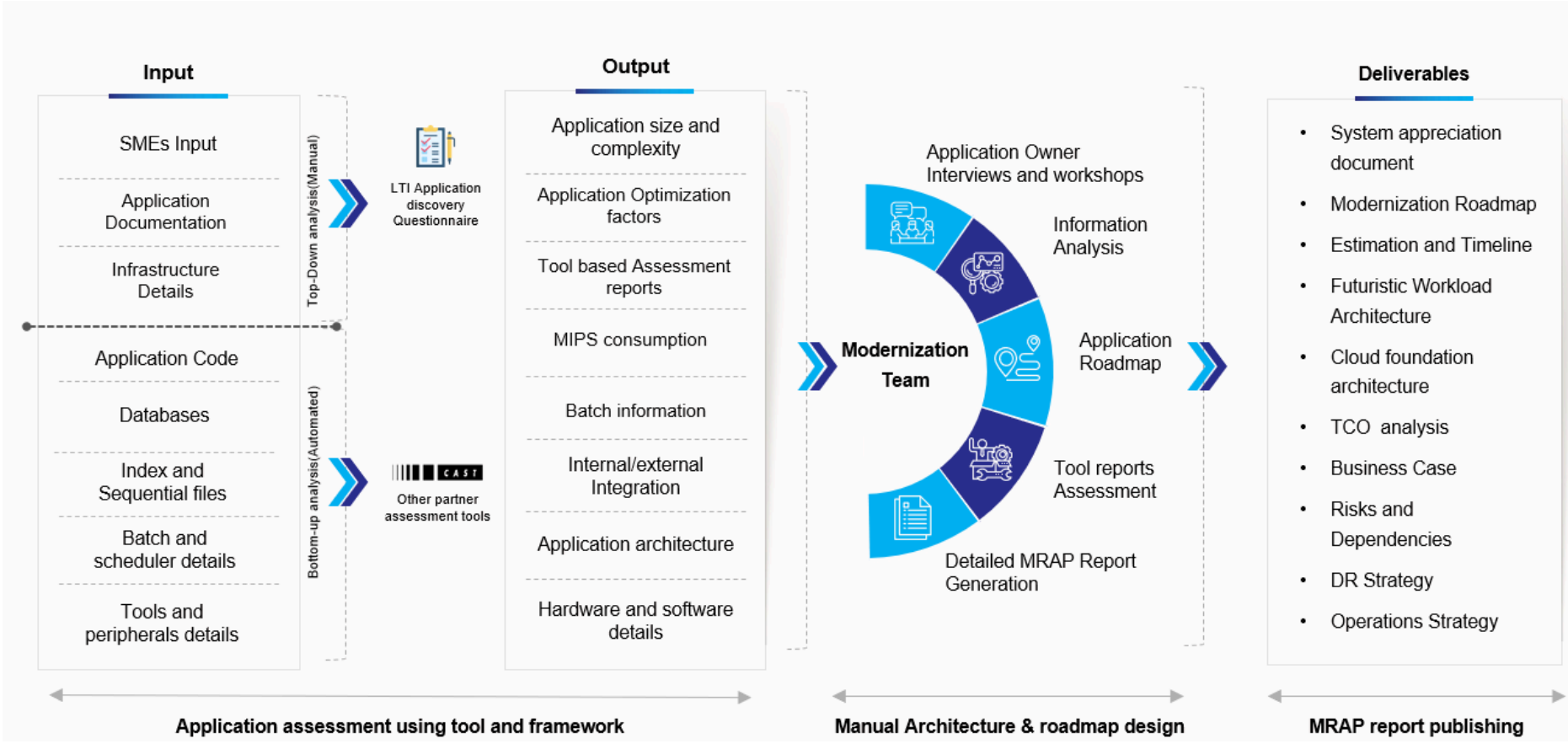
Cloud Image builder
LTI Infinity Platform



c. LTIs Migration Partners

We are partnered with modernization tool vendors to bring automation in order to accelerate the implementation of modernization solutions. The tools & software bring automation in each migration step including application analysis, rule mining, code-conversion, and rehosting.

5. Post-migration Benefits (Cloud-native)

Post-migration, the Mainframe migrated application should evolve into more cloud-native to get full advantage of the cloud.
Cloud-native is an approach to building and running applications that exploits the advantages of the cloud computing delivery model. This multidimensional approach represents a challenging change cycle where complete focus and attention are paid to the journey rather than the destination. Companies building and operating applications using a cloud-native architecture bring new ideas to market faster and respond sooner to customer demands. The key post-migration benefits of building next-gen cloud-native applications are the following:

Scalability & Elasticity: Auto-scalability is one of the vital features of cloud-native applications. To handle future needs by default, applications will scale automatically. Infrastructure automation at scale eliminates downtime due to human error, consistently applying the same set of rules across deployment of any magnitude. The importance of scalability is it helps to adjust the hardware and software capacity to the workload needs. Going by the highly fluctuating demands in today's world and the customers wanting to only pay for what they use, elasticity is crucial to dynamically and horizontally scale the number of instances processing a workload.

Reliability: Cloud-native applications are built as containerized microservices. As diverse business functions are built into independent microservices loosely coupled with each other, a failure in one does not cause the collapse of the whole application. This is what makes cloud-native applications more reliable & resilient.

Flexibility: Going cloud-native on AWS comes with much flexibility. The company can choose any combination of the operating system, programming language, web application platform, database, and other services, as per business needs. Therefore, teams have the advantage of working with the technology tools they are comfortable with, leaving them more time to build better applications.

Rapid Development: Cloud-native application development is an approach to rapidly developing new applications, optimizing existing ones, and connecting all of them. The concepts of DevOps, microservices, and containers are incorporated, thus quickening the process of development & deployment.

Faster Integration: As a result of new application development, it is imperative to integrate modern technologies to sustain businesses and drive business growth. For embracing new technologies (like IoT, Virtual Reality, etc.), cloud infrastructure is a must that offers platforms to implement these.

Competitive Advantage: Cloud-native applications enable businesses to get to market faster and offer improved customer experiences. Consequently, companies gain a competitive advantage that's hard to beat.

6. Conclusion

Migration helps eliminate capital expenditure and Millions of Instructions Per Second (MIPS), shrink Independent Software Vendor (ISV) license costs, and leverage elastic pricing models. Moving to consumption-based pricing (OpEx model) can reduce costs of capital expenditure (CapEx) significantly. The notable advantage is that there will be no change in the existing legacy program business logic, making it possible to effectively leverage critical data, enjoy a flexible, transparent, and modern environment, and save money on mainframe contracts.
A large number of companies are now looking to move mainframe workloads to proven robust cloud platforms such as AWS to take advantage of benefits, including cost savings, security, scalability, and more advanced applications. The global pandemic has further intensified all of these drivers, as, unlike mainframes, cloud applications can be managed remotely, even with IT staffers working from home.

When it comes to mainframe modernization, there is no magical approach or a 'one-size-fits-all' strategy. A well-thought-out and thorough approach to modernize the legacy mainframe systems is required, as each business case is unique. Many large enterprises still use the mainframe, but modernizing is a business-critical strategic imperative in today's technological environment.

Modernizing helps business houses cope with the ever-changing customer expectations and attain a more agile and straightforward architectural framework. The advantages of migrating to the cloud are not only limited to bringing down the operational costs and cutting down on the capital, but it also increases business flexibility and responsiveness to changing business requirements. The time to modernize mainframe systems is NOW. However, there is a need to plan well and understand the risks involved.

Next Steps

We would be happy to assist with multiple aspects of your mainframe modernization initiatives. Ensure accelerated migration to AWS Cloud with our robust Cloud platforms and solutions.

To learn more about our mainframe migration capabilities, please get in touch with us and review our value propositions.