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# Mainframe Modernization

## A Strategic Approach to Mainframe Modernization for the BFS Industry

WHITEPAPER

## Abstract

Mainframe modernization is talked about a lot but little understood. The financial services industry is by far the largest consumer of mainframe technology. Some estimates suggest about 40% of total consumption is driven by the financial services industry. While robust, fast, and reliable, mainframes slow down the digital transformation for organizations.[1]

A talent shortage, lack of business agility, and high operational costs are some of the key challenges. Hence, almost every organization wants to move away from the mainframe and embrace new digital technologies such as the cloud, APIs, microservices, and distributed data engines. However, the journey of mainframe modernization is complex and fraught with risks.

There is no one-size-fits-all solution for mainframe modernization. Different technologies have emerged in recent times, providing different options for organizations to choose from.

Decision makers from the BFS industry can use this whitepaper to get this technology-agnostic practitioner's viewpoint.


## Key Takeaways

- Latest approaches and technologies available for mainframe modernization
- Eight different approaches, ranging from relatively low-hanging fruit to complex overhauls
- Merits, limitations, pitfalls, and industry-maturity of each approach

# Introduction

The financial services industry was revolutionized with the introduction of commercial-scale mainframes in the 1960s and 1970s.

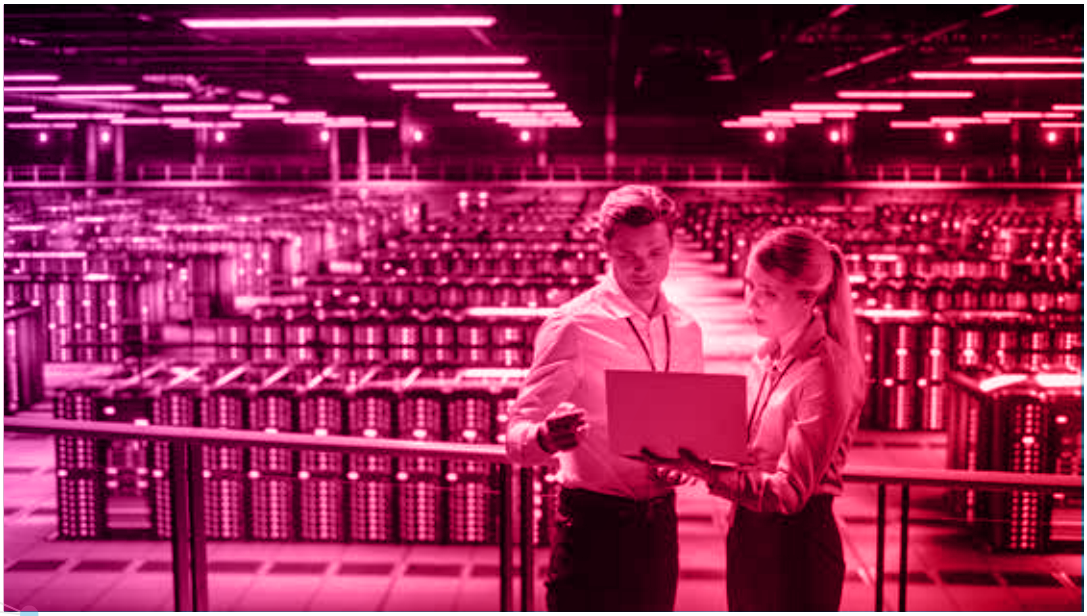
But in the last decade – especially with the advent of 'digital' technologies – the paradigm has completely changed. Mainframes, which transformed financial institutions earlier, have become an impediment to the digital-driven business transformation.

New organizations are eroding the market share of incumbents because of their nimble business models, agile mindset, and resilient/scalable technology platforms. Incumbents are aggressively looking for solutions to modernize their legacy mainframe platforms. It is no longer a wish, but an imperative. The pandemic has surely increased the need.

Mainframes are not easy to modernize.  The industry has been making attempts for more than two decades; but with extremely limited success. The solution landscape for modernization has become extremely complex with a spurt of new and innovative technologies However, the last few years have seen nnovative approaches and patterns in this field.

An independent survey from 2021 indicates that 78% of the organizations already have at least one modernization program in motion since the pandemic started. Without modernization, legacy systems are not portable or agile enough to integrate with modern technology platforms. Which makes them expensive to run and hold ups in problem solving.[2]

This thought paper takes a comprehensive scan of eight different approaches to modernizing mainframes. Apart from describing these approaches, the paper also discusses their industry-acceptability along with pros and cons from a business perspective. Moreover, the paper gives several real-life examples from the BFS industry where these approaches were adopted to usher in modernization benefits.



- More than **70%** of Fortune 500 companies
- **44** of the top 50 banks
- All **10** of the world's largest Insurers

Run their critical workloads on mainframes

# Challenges and Need for Modernization

The mainframe (i.e., consolidated data, storage, and compute) forms the backbone of the financial services industry. More than 70% of Fortune 500 companies run their critical workloads on mainframes. More than 90 of top 100 banks use mainframes. Financial Services consumes 40% of total million instructions per second (MIPS), indicating much stronger presence of mainframes as compared to other industries.[3]

The advent of new technologies, especially digital (such as cloud, channels, APIs, distributed data platforms, PaaS/SaaS models) have created a strong need to relook at the mainframe heritage assets. There are strong drivers to modernize mainframes as mentioned below.

**1. Business Agility Issues:**

a. Mainframes are monoliths, grown in complexity over a period.
b. Making a business change is difficult and time-consuming, due to unfriendly developer experience, software lifecycle processes, and talent shortage
c. Modernization practices can provide business agility, better TAT, and frequent releases

**2. Talent Shortage:**

a. Mainframe skills are dwindling as older staff is moving out of service
b. The old technology precludes younger IT professionals to take up mainframe skills
c. Patchwork and complexity of code/applications have increased the complexity of knowledge transition.

**3. High Cost of Operations:**

a. Mainframe transactions are going up rapidly due to proliferation of channels and increased digital operations.
b. Complexity of application portfolio leads to higher efforts for change, leading to high cost of professional services

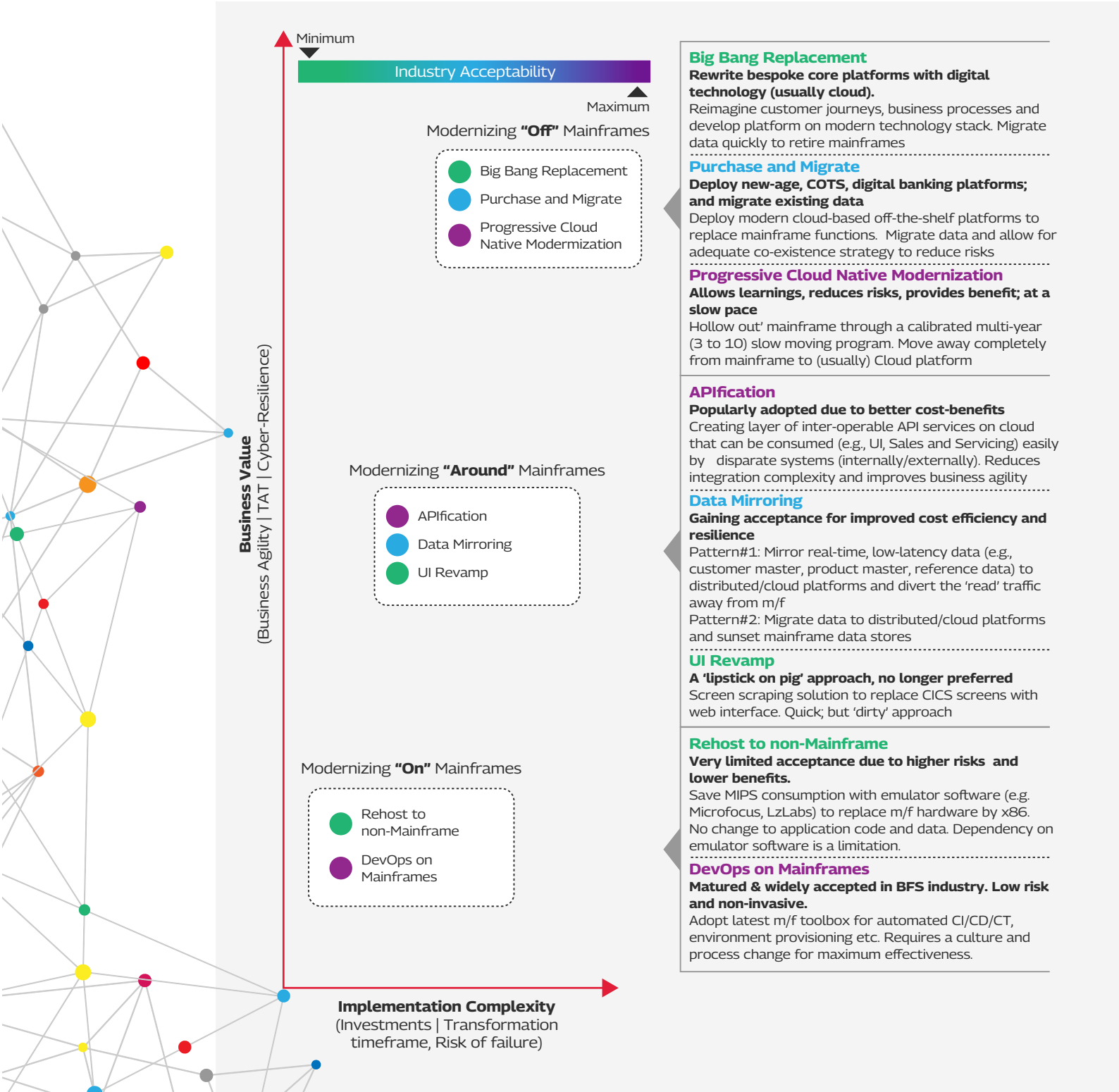
Despite these strong drivers for modernization, the global mainframe usage (measured in MIPS consumption) is going up. Acoording to a survey, 95% of respondents say the mainframe is a long-term platform that will grow and attract new workloads and 77% of extra-large shops report significantly higher MIPS growth over the last 12 months.

Why do we have this contradiction? The answer lies in the complexity of de-platforming mainframes. For a long time, it was believed that 'rip and replace' option (replacing mainframes by custom-built modern technology platforms) is the only possible option. The option is certainly valid; but it's very complex, risky, costly and time consuming.

In last few years, the space of mainframe modernization has evolved further. Today, 'rip and replace' is not the only option to modernize mainframe platforms. Innovative technologies, learnings from past failures and carefully calibrated modernization processes have given rise to new approaches of modernization. This broad bouquet of approaches balances the risk, cost, value, and time. Organizations can choose the right approach that is most appropriate for their context. In fact, large organizations need to choose combination of these approaches to achieve optimum results.

# Mainframe Modernization Patterns/ Approaches

As the adage goes, "no one size fits all", it is no different for financial services enterprises looking at modernizing their mainframes. Customers have diverse objectives when wanting to modernize mainframes which could be to optimize cost, faster launch of new offerings, to thwart competition from fintech's, move to cloud to offer edge services could be some of the reasons for banks. With deep implementation experience and matured practice, we at Tech Mahindra have envisaged below approaches for mainframe modernization. The efforts of modernization can be measured by business value and implementation complexity.




**Big Bang Replacement**
**Rewrite bespoke core platforms with digital technology (usually cloud).**
Reimagine customer journeys, business processes and develop platform on modern technology stack. Migrate data quickly to retire mainframes

**Purchase and Migrate**
**Deploy new-age, COTS, digital banking platforms; and migrate existing data**
Deploy modern cloud-based off-the-shelf platforms to replace mainframe functions. Migrate data and allow for adequate co-existence strategy to reduce risks

**Progressive Cloud Native Modernization**
**Allows learnings, reduces risks, provides benefit; at a slow pace**
Hollow out' mainframe through a calibrated multi-year (3 to 10) slow moving program. Move away completely from mainframe to (usually) Cloud platform

**APIfication**
**Popularly adopted due to better cost-benefits**
Creating layer of inter-operable API services on cloud that can be consumed (e.g., UI, Sales and Servicing) easily by disparate systems (internally/externally). Reduces integration complexity and improves business agility

**Data Mirroring**
**Gaining acceptance for improved cost efficiency and resilience**
Pattern#1: Mirror real-time, low-latency data (e.g., customer master, product master, reference data) to distributed/cloud platforms and divert the 'read' traffic away from m/f
Pattern#2: Migrate data to distributed/cloud platforms and sunset mainframe data stores

**UI Revamp**
**A 'lipstick on pig' approach, no longer preferred**
Screen scraping solution to replace CICS screens with web interface. Quick; but 'dirty' approach

**Rehost to non-Mainframe**
**Very limited acceptance due to higher risks and lower benefits.**
Save MIPS consumption with emulator software (e.g. Microfocus, LzLabs) to replace m/f hardware by x86. No change to application code and data. Dependency on emulator software is a limitation.

**DevOps on Mainframes**
**Matured & widely accepted in BFS industry. Low risk and non-invasive.**
Adopt latest m/f toolbox for automated CI/CD/CT, environment provisioning etc. Requires a culture and process change for maximum effectiveness.

# Merit and Demerit of Patterns/Approaches

## DevOps on mainframes

**Advantage**
Due to agile concepts and tool-driven automation, improvement in productivity and cost efficiency can be obtained.Also, velocity of change can be improved resulting in faster turnaround for change.
**Limitation**
Mainframes are retained. So, the advantages of cost and velocity are limited when compared to modern cloud platforms.The mainframe skillset challenge remains unaddressed.
**Implementation Challenges**
Work culture and mindset change is required for successful adoption of DevOps practices, processes, and tools. A paradigm shifts from command-and-control model to self-governing teams is difficult because of significant unlearning.
**Industry Acceptance**
Adopted widely by organizations as part of continuous modernization. The culture-shift is slow and complex; but even limited success can give benefits.

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## Rehost to non-mainframe

**Advantage**
Significant savings on operations costs because of elimination of hardware-based MIPS consumption platform. Relevant, if the MIPS consumption is concern area.
**Limitation**
The application technology remains unchanged (Cobol, Assembler, and DB2). So the skillset challenge remains unaddressed. No positive impact on business agility, integration, collaboration across heterogeneous technologies.
**Implementation Challenges**
Introduction of 'emulator' software as intermediate layer may impact robustness, performance, and reliability that mainframes are famous for. It also creates dependency on third-party software. Not all mainframe technologies are supported by emulator leading to limitations to rehosting possibilities.
**Industry Acceptance**
Not preferred by industry due to limited upside and significant challenges. But can be relevant for tactical use cases where MIPS consumption is high; but robustness is not the biggest consideration.

## UI Revamp

**Advantage**
End user experience is improved because of web/desktop GUI, instead of character-based green screens.
**Limitation**
Apart from limited gains of user experience, no real change to the platform in terms of cost, efficiency, skillset, and business agility.
**Implementation Challenges**
Third party tools used create dependencies.
**Industry Acceptance**
Largely out of favor due to very limited gains.

## Data Mirroring

**Advantage**
Cost optimization (reduction in MIPS) due to shift of 'read' transaction (which are bulk of overall transactions) away from mainframes.
Addition data store improves resilience.
The approach is 'stepping stone' for further modernization of moving away from mainframes.
**Limitation**
Since the application platforms remain on mainframes, the usual mainframe challenges of business agility and talent shortage remain unaddressed.
**Implementation Challenges**
Latency issue between the mainframe and cloud data stores may be a concern if the data is extremely volatile.
Also, cloud data platforms need to match the performance of mainframe data platforms. These are important design considerations to be managed.
**Industry Acceptance**
Has been gaining acceptance over last few years as a viable modernization pattern. For certain highly accessed data stores (e.g., customer information, reference/master data), cost optimization is significant.

## Apification

**Advantage**
Significant improvement in business agility due to ease of integration across heterogeneous platforms. Standardized API-driven collaboration fuel innovation possibilities for creating new revenue streams. Reduction of point-to-point interfaces simplify the complex mainframe landscape leading to efficiency and agility improvement. The approach is a stepping-stone for further modernization of moving away from mainframes.
**Limitation**
Operational costs of mainframes (MIPS consumption) is not favorably impacted. Also, the core remains on mainframe platforms, so talent issues are not addressed.
**Implementation Challenges**
Clear and thorough understanding of existing mainframe interfaces, functions and services is very important. It is important to achieve right balance between coarse-grained, data-heavy APIs and fine-grained, large-in-number APIs.
**Industry Acceptance**
Very high acceptance by industry. Almost every large organization is investing in this approach for multiple use cases such as payment transaction, customer information, order management.

## Repurchase and Migrate

**Advantage**
Elimination of mainframe platforms as the repurchased products are usually on latest technology stack.
**Limitation**
Not applicable, if the customization needs are significantly high or the business complexity doesn't justify 'buy' option. Also, future flexibility and agility is limited because of dependence on product/platform vendor. The bank/FS doesn't hold IP.
**Implementation Challenges**
Customization and configuration could be time consuming and costly, limiting applicability of the solution across all the use cases.
Coexistence strategy, along with data migration, parallel run etc. is critical to success.
The chosen platform needs to be carefully evaluated across non-functional characteristics.
Financial management (cost-benefit analysis, ROI calculations) and tracking is complex but important for the success of the program.
**Industry Acceptance**
Adopted widely for 'standardized' business processes for general ledger, human capital management, procurement and core transaction processing.

## Progressive Modernization

**Advantage**
When completed, complete elimination of mainframes and adoption of latest digital technology stack. Business is free from legacy.
**Limitation**
Very time consuming and costly journey with risks on the way. Possibility of failure is high. Managing risks is easier said than done.
**Implementation Challenges**
Understanding of existing legacy system is a challenge due to layers of patchwork and outdated documentation.
Due to long transition period, co-existence is complex. A careful strategy for coexistence and parallel run is required.
Also, multiple other dimensions (such as business enrichments, regulatory changes, and technology debt reduction) need to be handled during the modernization journey. These dimensions increase complexity and risk.
**Industry Acceptance**
In spite of risks, industry is slowly and surely adopting this approach to replace mainframes with latest technologies. But the speed of adoption is slow due to challenges mentioned.

## Big Bang Replacement

**Advantage**
Elimination of mainframe platforms in relatively short duration.
**Limitation**
Implementation risks are too high. In many cases beyond the reasonable levels.
**Implementation Challenges**
Crunching of timelines for a complex program leads to significant implementation issues, possibly failures. So, feasibility is low.
**Industry Acceptance**
Not preferred by the industry due to feasibility issues.

# Benefits of Mainframe Modernization

Benefits of mainframe modernization are immense. It is widely accepted that mainframes reduce the ability of the organizations to be nimble, collaborative and innovative. Modernizing mainframes remove these bottlenecks to varying degree. Besides these advantages, modernization also optimizes the costs, allows infusion of modern paradigm (such as hyper-automation, AI/ML adoption and self-healing).

Here's a quick view of possible benefits of mainframe modernization.

**Efficiency:**
Reduction in platform support

**Continuity:**
Downtime and a serverless promising model

**Speed:**
Improvement in release velocity

**Flexibility:**
Reduction in platform support

**Quality:**
Production code with defects

**Self-healing:**
Minutes average failure recovery

**Compatability:**
No cloud provider lock-in

**TCO Optimization:**
Legacy apps to get more out of existing investments

# Industry Proofpoints

### DevOps on Mainframes

A large Australian bank adopted a suite of mainframe tools to re-imagine the development and testing ecosystem. The tools such as RTC helped the bank for source code management, automated build and integration and continuous deployment. Integration with Eclipse based IDE tool (IDz) provided a whole new experience to the developer community. Importantly, zD&T was effectively used to create and manage dev and test environment. The critical aspect of change was not the introduction of tools; but the culture and mindset-shift for the teams. The bank provided special attention to training, reskilling, and shift to agile processes to make the transformation successful. All these steps resulted into 20-25% efficiency improvement in terms of engineering efforts as well as velocity.

### Apification

A large global bank had its entire commercial banking on mainframes. There were around 500 point2point interfaces, which drastically impacted the business agility, apart from increasing cost of change. The bank undertook APIfication to replace the interfaces with around 500 general purpose APIs. This overhaul of integration layer simplified the complex application landscape. It enabled the bank to quickly integrate services and processes across heterogeneous technology stack. It also enabled external collaboration to create innovative customer-focused services. Of course, business agility improved dramatically, making change management simpler.

### Data Mirroring

A large US based bank had its customer master data on mainframe DB2 database. This most accessed data increased MIPS consumption resulting into high annual costs. The costs kept going up, as data consumption kept increasing due to increased channels, reporting apps, dashboards etc. The bank decided to create a mirror in cloud using a cloud-native data platform (Single Store). Both the databases were kept identical with low-latency bridge for data synchronization. A data access layer was designed to provide easy, flexible, and optimized access to the cloud data. The applications consuming the customer data were diverted to access cloud-native data instead of mainframe DB2. This way, the MIPS consumption was reduced substantially. Equally importantly, the step paved way for further transformation of moving away from application layer from mainframe to cloud.

### Progressive Cloud Native Modernization

A large US based asset management firm embarked upon multi-year modernization journey for its order management and securities transactions platforms. In last 5 years, they have been able to decommission 60% of their 25 million LOC of mainframe code. They have adopted a carefully designed playbook for modernization, with several key features such as tool-enriched reverse engineering, clearly defined target architecture, roadmap that provides frequent value to business, clear approach to track and control cost-benefits, co-existence strategy for legacy and modernized platforms etc. The firm invested heavily in team reskilling and building agile mindset. The learnings from each phase were applied to the next. The progress has been slow - at times slower than expected - but the risks are managed well. The firm is confident to complete the journey in next two years.

# Experiential Learning and Best Practices

Despite strong drivers and availability of multitude of technology options, BFS organizations are very conservative about mainframe modernization. The transformation programs are fraught with uncertainties. Usually, the scale is remarkably high. Hence, it becomes imperative to step out of academic mindset and learn from the firsthand experiences. Some of the challenges and experiential learnings are given below:

| Challenges | Experiential learnings |
|---|---|
| **Sustaining executive interest and sponsorship**<br><br>Very often, sponsorship for the modernization program dwindles down because of limited perceived business value or cost escalations when the program is underway. This could be perception or reality, but in either case, the issue needs to be addressed. | • Setting realistic expectations through careful cost-benefit analysis and ROI calculations. The unknowns and assumptions should be clarified upfront and tracked for deviations during execution. The metrics to measure the value should be defined.<br>• Continuous delivery to production is important to realize business value. Timebox the release cycle and adjust the scope as per time and resources.<br>• Even planning needs to be agile. During the journey, changes may be required to the specifics of scope, resources, and technical decisions etc. Such changes to the roadmap should be analyzed and accepted. |
| **Over-reliance on tools and technology**<br><br>Very often, sponsorship for the moderniza-tion program dwindles down because of limited perceived business value or cost escalations when the program is underway. This could be perception or reality, but in either case, the issue needs to be addressed. | • The mainframe code is usually complex and patchworked over decades. So, the promise advocated by the technology-providers should be taken with a pinch of salt.<br>• Invest in 'proof of concept/value' to select the right tools.<br>• Realistically assess their efficacy and invest adequately into human/SME bandwidth. |
| **Culture Change**<br><br>The mainframe staff is typically not exposed to agile working and self-organizing teams.<br>While the transformation introduces new teams who are usually 'born in the digital world, it is important to get right culture-shift for the existing staff too | • Reskilling and retraining is the obvious first step.<br>• Software development processes need to be remodeled.<br>• Achieve synergies across the experienced and the new personnel.<br>• Appropriate confidence-building is required to onboard the heritage staff into the transformation |
| **Cost of failure**<br><br>The changeover from legacy to a new platform is complex. It may lead to unplanned downtime, teething troubles, or blackouts.<br>Such a risk, if materialized, may lead to a substantial business, financial, or reputation losses | • Important to plan for any eventuality during the transition and cut over<br>• Identify the levers to manage the risks and avoid the damages even if a release fails<br>• A suitable roll-out and decommission strategy should be crafted (e.g., Blue-green, Canary). |

# Tech Mahindra – Right Partner for Modernization Journey

Mainframe modernization remains hotly discussed, but sometimes poorly understood topic. With the increased digitalization, FS organizations are investing heavily in modernization initiatives. 72% of the organizations see modernization activity as key lever to improve carbon footprint.[4]

The technology and industry provide a large basket of possible approaches and patterns to modernize. But the key for the organizations is to look within and figure out the best path for modernization, which may consist of combination of multiple approaches. While risk management remains central to the success of modernization program, other key success factors are:

- Investments in developing detailed understanding of current portfolio, leveraging reverse engineering techniques as well as SME knowledge
- Ability to manage the risks without sacrificing the efficient and frequent value delivery to business
- Investments in people skills, agile processes culture shift
- Ability to provide efficient and frequent value delivery to business

Tech Mahindra has been helping its global clients to make the right decisions and execute them through the technology implementation. Tech Mahindra's holistic offering has been put into action for 30+ global clients. Tech Mahindra can help the clients to assess the current state and define the realistic roadmap for modernization. Tech Mahindra can implement the roadmap through its robust technology delivery capabilities leveraging several in-house enabler platforms and external partner products. Bringing experiential learnings and best practices has been the most important aspect of Tech Mahindra's mainframe modernization offering.

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