Guidehouse
Outwit *Complexity*

Future-Tech:

Are Mainframes Holding Your Agency Back?

Keys to Successful Modernization

The Key Question

Can agencies successfully migrate from these obsolete technologies to less expensive, more agile systems that can mitigate security risk, improve taxpayer services, and reduce support costs?

We Say Yes

Outdated systems continue to challenge government agencies – leaving them vulnerable to cyber-attacks, unable to address market changes, all while managing redundant processes, just to maintain business as usual. In this edition of GHFuture2030, we continue to dissect forward-looking challenges—here we discuss the significant upfront migration cost and the need to demonstrate long-term value to taxpayers. Agencies can no longer ignore the risks of staying on mainframe platforms. During recent Congressional testimony, the US Government Accountability Office (GAO) highlighted 10 out of the 15 federal agencies investigated had 249 systems vulnerabilities, of which 168 posed significant risk to the security of their operations. Additionally, the existing systems, some of which are more than 50 years old, use obsolete programming languages, as well as hardware and software that are no longer supported by the manufacturers.

The 10 Most Critical Federal Legacy Systems in Need of Modernization					
Agency	System name	Age of system in years	Age of oldest hardware in years	System Criticality (according to agency)	Security risk (according to agency)
Department of Defense	System 1	14	3	Moderately high	Moderate
Department of Education	System 2	46	3	High	High
Department of Health and Human Services	System 3	50	Unknown	High	High
Department of Homeland Security	System 4	8-11	11	High	High
Department of the Interior	System 5	18	18	High	Moderately high
Department of the Treasury	System 6	51	4	High	Moderately low
Department of Transportation	System 7	35	7	High	Moderately high
Office of Personnel Management	System 8	34	14	High	Moderately low
Small Business Administration	System 9	17	10	High	Moderately high
Social Security Administration	System 10	45	5	High	Moderate

Each year, Congress appropriates approximately $100 billion toward modernization and 80% is allocated to maintain these antiquated systems. Federal agencies continue to struggle with the proactive planning and budgeting needed to modernize legacy systems; upgrading underlying infrastructure; and investing in high quality, lower cost service delivery technology.

As a result, agencies continue to be exposed to security risks, unmet mission needs, staffing issues, and increased costs.

Mainframes Keep Agencies Running, but with Significant Risks

While mainframes run the most critical operations of several agencies, they have reached a point where the incremental benefit of maintaining them dwarfs the incremental costs. Failure to modernize these systems is likely causing chronic issues, including:

Security Risk

In many instances, mainframe systems are so old that they are no longer supported by their vendors, thereby creating security exposures and additional costs. As a result, these systems often operate with known vulnerabilities that are either technically difficult or prohibitively expensive to address.

Unmet Mission Needs

Many systems are too obsolete to support even basic mission functions and unable to flexibly respond to changing taxpayer demands and agency needs.

Staffing Issues

For their operations, mainframe systems need programmers experienced in older languages like COBOL and MUMPS, many of which have exited the market, resulting in a premium for these skills.

Increased Cost

The cost of maintaining these mainframe systems increases with time. The federal government's 10 legacy systems most in need of modernization cost about $337 million a year to operate and maintain, according to the Government Accountability Office.[1] Agencies also lose the opportunity to utilize taxpayer dollars toward modernizing their systems.

When coupled with constantly shifting regulations, increasing demands from the business teams to meet the agency's mission, advancement of latest technologies and tools to achieve faster time to market, and run a lean IT shop, the modernization of legacy systems, especially mainframes, needs a call to action immediately.

"While the risk of a mainframe migration to the cloud is substantial, the cost of standing pat is exponentially higher. A disciplined assessment and modernization plan with a measured approach can ease the burden."

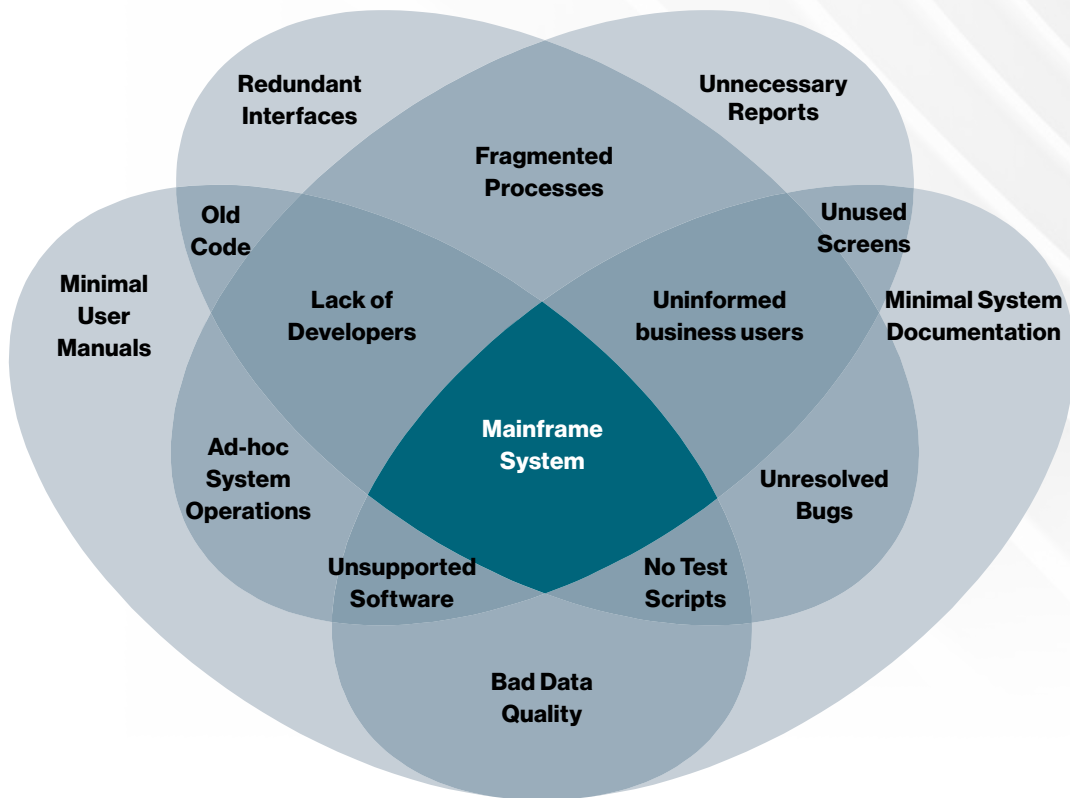**Paul Phaneuf**
Guidehouse Digital Leader

1. https://www.nextgov.com/it-modernization/2019/06/10-government-legacy-systems-cost-taxpayers-337-million-every-year/157682/

Migrating from Mainframes is Risky, but Not Doing so is Riskier

Mainframe modernization initiatives are risky for a variety of reasons. Our experience has found the highest risks stem from a few specific issues, based on the complexity and age of these systems.

Lack of documentation and limited understanding of the system at a business and technical level account for the most significant challenges for many agencies. In one of the system migrations performed by the Guidehouse team, the architecture was documented with sticky notes and unorganized papers that had not been updated in 10-plus years.

In many instances, the core team of developers, analysts, and business users have left the workforce, presenting a significant knowledge gap. The existing team is forced to run the system as-is, leaving the agency unable to make changes due to fear of breaking the existing programs. This leads to deterioration of the code and system components and increasing the level of effort required to modernize the system. Further, business users create "out-of-system" workarounds to fulfill their unmet requirements, leading to deterioration of data quality and program integrity.

Redundant Interfaces

Unnecessary Reports

Fragmented Processes

Old Code

Unused Screens

Minimal User Manuals

Lack of Developers

Uninformed business users

Minimal System Documentation

Mainframe System

Ad-hoc System Operations

Unresolved Bugs

Unsupported Software

No Test Scripts

Bad Data Quality

Complexities of migrating from mainframe systems

Due to aging systems, there are many unsupported software programs used by mainframes. As a result, there are no user manuals or online support forums to provide user guidance to operate or modernize these systems.
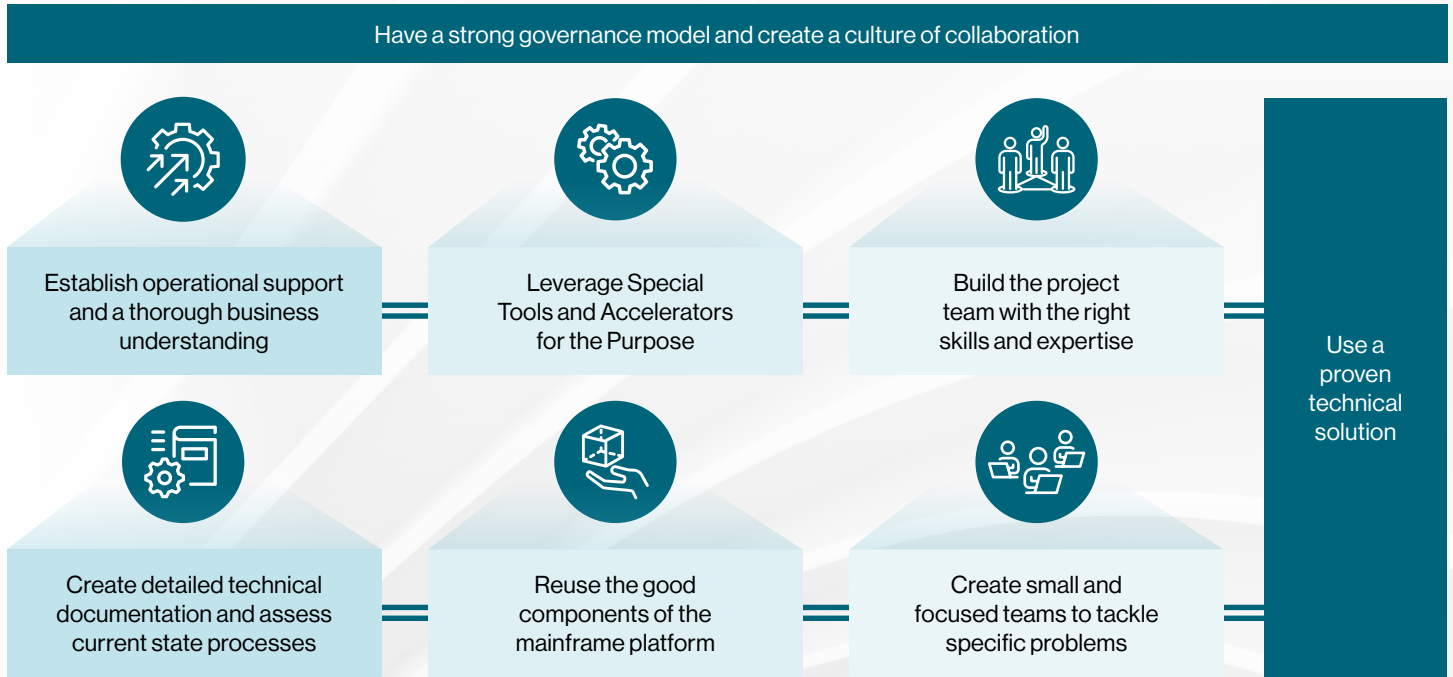
Lack of system controls and missing business validations lead to poor data quality in mainframes. Inconsistent formatting and input mechanisms for data in abstruse front-end user screens lead to unreliable data for reporting and operational functions. In fact, a recent migration performed by the Guidehouse team found 17 different calendar date formats across the mainframe data.

The inflexibility, lack of interoperability, and time to make changes to the mainframe architecture has forced technology teams to develop shadow and ancillary distributed systems to bypass the mainframe, increasing the number of interfaces and data exchanges. Some of these interfaces are redundant and may not be required. The distributed applications get a life of their own and increase the complexity of core operational processes, leading to a "spaghetti" technology environment that becomes messy to untangle. Guidehouse migrated a mainframe system that had 2,200 interfaces, files, and reports. Ultimately, only 60 of them were required after the modernization effort.

A Framework for Response

Based on our experience with several mainframe modernizations, we have developed a unique methodology to ensure the success of these failure-prone projects.

Our methodology delivers the right mix of technical and non-technical elements to ensure that a robust governance and team structure is built around a strong technical approach. This enables agencies to address the risks by leveraging the ideal operational, technical, communications, and training solutions. Not all issues need a technology solution and code build. Some problems can be managed through effective stakeholder management and prioritized needs of the business teams.

Have a strong governance model and create a culture of collaboration

Establish operational support and a thorough business understanding

Leverage Special Tools and Accelerators for the Purpose

Build the project team with the right skills and expertise

Use a proven technical solution

Create detailed technical documentation and assess current state processes

Reuse the good components of the mainframe platform

Create small and focused teams to tackle specific problems

Key Success Factors for Mainframe Migrations

Undoubtedly, agencies must have fundamentally sound project management techniques, a robust decision framework, and good technology skills as the backbone of any major transformation. However, based on our extensive experience, we have identified the following success factors across the Governance and Structure, People, Process, and Technology pillars of a project:

Governance and Structure

- Have a strong governance model and create a culture of collaboration. Mainframe modernizations are complex and involve large teams. Additionally, they have a lot of moving pieces and rarely go as planned. To prepare for this, a strong governance model with clear roles and responsibilities for each team member, and a nimble decision-making process to resolve risks and issues as soon as possible are critical to project success.

People

- Build the project team with the right skills and expertise. Assembling the right team with the skills required to analyze the mainframe system components like data, code, jobs, schedule, etc., is critical. Often, confusing requirements and- one-off scenarios are embedded in the code and even the operations team may not be aware of the specific use cases. A typical response during the requirements-gathering session often comes down to: "That is what the system does." These scenarios may seem innocuous, but should not be ignored, as they may impact the overall accuracy of the system functionality.

- Create small and focused teams to tackle specific problems. There will be numerous issues. ranging from technical to communications and training, that pop up during mainframe modernization projects. It is key to have agile teams to tackle the issues at hand and resolve them in an expeditious manner. These teams should be nimble, focused, and have the right mix of technical and non-technical skills. In a mainframe modernization Guidehouse recently completed, we created Tiger teams to test more than 200 user interface screens in just two months, helping the project meet the ultimate deadline.

Process

- Establish operational support and a thorough business understanding. A thorough understanding of the operations and business functions is the foundation for any modernization effort. With the passage of time, not only do the systems become obsolete, but also the processes become outdated and inflexible to meet the ever-changing business needs. As part of the modernization project, Guidehouse recommends the creation of a detailed concept of operations and Requirements Traceability Matrix to validate the system design and implementation requirements. Additionally, we suggest documenting detailed process flows (e.g., as-is and to-be), wireframes, and mock-ups to detail the page design elements, user interface requirements, and templates needed for data conversion. An agile approach to requirements gathering/definition by using epics, stories, story points, and burndown charts helps with new discovery and findings during the project.

- Create detailed technical documentation and assess current-state solutions. Using the concept of operations and detailed operational procedures, detailed technical requirements need to be developed as part of the overall discovery and analysis process. This should include the end-to-end-technology thread to support the operations: specific screens or web pages, data files, mainframe jobs, reports, and interfaces to tie the business and technology components together.

Technology

- Leverage special tools and accelerators for increasing the pace of modernization. Mainframes come with archaic software and data storage in formats that do not cooperate with modern distributed architecture. For each component, specific tools and a strong network of technology tool providers is critical to resolve these bespoke issues. For example, a mainframe stores data in EBCDIC (Extended Binary Coded Decimal Interchange Code) format whereas modern systems store data in ASCII (American Standard Code for Information Interchange) format. There are vendors who have tools to convert the data from EBCDIC to ASCII quickly, with high accuracy. Another example would be converting obsolete software like Easytrieve using well-established tools like IBM's Easytrieve converter. We recommend identifying and partnering with such vendors early in the project to ensure roadblocks are resolved timely.

- Reuse the good components of the mainframe platform. Not all the components and solutions embedded in a mainframe system are bad and disposable. A key element of success is to distill the useful pieces and reuse them in the modernized solution. This can range from simple modules of code, embedded business rules, and some external interfaces. While doing this involves reverse engineering pieces of the mainframe, it helps clarify requirements and expedites the delivery of the new system.

How Guidehouse's Proven Experience Untangles Technical Complexity in Mainframe Modernization

While there are many technical solutions to modernize mainframe platforms, agencies need to adopt a path that helps them assess the comparative and aggregate value (business, technical, and economic) of these legacy applications. More importantly, with limited money and time, agencies need an application portfolio management strategy that is efficient and delivers effective IT, both during and post-transition. A solution that aligns the IT investments to business value while enabling prioritization of key initiatives provides the best chances of success.

Guidehouse takes a business-focused, platform-agnostic application rationalization approach in modernizing applications, while reducing cost and complexity found in redundant systems. Our proven Application Rationalization methodology leverages business value (application to function mapping and user impact analysis) and technology health (technology lifecycle and platform redundancy) of each application. This approach enhances the modernization strategy (Rearchitect, Replatform, Rehost, Retire) for applications, enabling strategic initiatives and a long-term portfolio roadmap.

Operational Capability Alignment

User Impact

Functionality Alignment

Business value ↑

Rearchitect	Rehost
Applications (usually the mainframe system) that are critical for operations	Applications/ functionality that are required to sustaining future operations
Applications/ Functionality with redundancies and low risk profile	Applications/ functionality that provide some business value and easier to maintain
Retire	**Replatform**

Technical Health →

Technology Management

System Complexity

Platform Redundancy

Skills and Future Plans

Our solutions can methodically accelerate an agency's migration from mainframes, enabling faster return on investment. Our expertise helps mobilize agency operational and technical resources to develop and execute the modernization solution. This model has brought repeated implementation success for government agencies. Provided below is a detailed case study recently completed by the Guidehouse team.

Guidehouse helped the Small Business Administration (SBA) modernize a 35-year-old mainframe system and 50 associated distributed applications

Client Situation/Challenges:

The SBA selected Guidehouse to be the FTA for the 7(a) Loan Program and Secondary Market. With a portfolio of more than 400,000 loans and a balance of over $100 billion, the flagship 7(a) Loan Program provides access to capital for small businesses unable to secure financing on reasonable terms through conventional financing. The Secondary Market enables 7(a) lenders to sell the guaranteed portion of an SBA loan into the capital market. In support of the SBA's long-term modernization plan, Guidehouse supported the migration of the data and applications from the incumbent environment into the SBA's Capital Access Financial System architecture prior to taking over the day-to-day loan operations of the FTA. This engagement was a large-scale, complex technology migration and business transformation, and involved more than 200 team members across seven organizations.

Guidehouse Solution:

Phase 1 – Current State Discovery: Guidehouse performed a current state discovery of the FTA technology environment used to support the FTA operations.

The discovery revealed a large mainframe, several access databases, and many other disparate applications in various technologies running on legacy infrastructure. The overall architecture was tightly integrated with multiple file-based interfaces between these systems, poor design choices without query and performance optimization, and bad data quality due to years of missing controls and data validations. Additionally, there was no system documentation and user manual to lay out the business functionality, and all the knowledge was embedded in the code. Guidehouse and SBA quickly realized that a one-size-fits-all solution would not work to optimize the technology portfolio.

Phase 2 – Future State Solution and Target Operating Model: Based on the current state discovery, Guidehouse created the technology transformation roadmap based on business requirements, technology conversion solutions, and stakeholder priorities. The transformation roadmap included the conceptual future state architecture, modernization strategy (Rearchitect, Replatform, Rehost, Retire) for the applications, project team and governance structure, timelines, deliverables, milestones and dependencies, sign-off responsibilities, and decision framework with RACI (responsible, accountable, consulted, and informed) chart. Guidehouse's team process included assembling a multi-disciplinary team that included subject matter expertise in Program Management, Technology, e.g., solution architects, software developers adept in a variety of technologies, and business operations roles to work closely together across all phases of the program to enable SBA to successfully pivot from its current operating model to its target operating model.

Phase 3 – Modernization and Legacy Application Retirement Execution: Based on the Transformation Roadmap, Guidehouse executed the work through various workstreams. Based on their size and complexity, each application followed a migration path as detailed below.

Category 1 – Rearchitect Strategy: The IBM z/OS FTA Mainframe loan servicing application was modernized using a Rearchitect strategy—build on the current systems content/functionality, protection of existing capabilities and data, and creating the application using modern methods, technologies, and running on a modern platform rather than a legacy mainframe environment. The end product was a fully Rearchitected and modernized product running on a secure private cloud environment.

Category 2 – Replatform Strategy: The reporting applications were modernized using a Replatform strategy—convert from legacy infrastructure to a platform agnostic solution, and host on SBA's secure private cloud. Major components of the applications were analyzed and modified (remove hard-coded edits and rules, remove unstructured code remnants, and optimize the data models) resulting in easier-to-maintain and reliable applications.

Category 3 – Rehost Strategy: The secondary market applications for Pooling and Securitization were modernized using a Rehost strategy—Lift-and-Shift to SBA's private cloud using the same technology stack with upgraded versions. This solution enabled the applications to preserve the core business logic and data structures, thus leading to a low-risk technology modernization. Few modifications were performed to take advantage of the latest versions of the technology components. Guidehouse created the platform security baselines and hardened the environment to address any security and configuration related vulnerabilities.

Category 4 – Retire Strategy: Finally, the legacy Access databases and User Defined Tools were Retired—either by rebuilding the additional functionality into other FTA systems or by retiring the redundancies and unused functionality. While retiring the legacy applications, Guidehouse worked with the business users and technology SMEs to document the functionality, understand the application's architecture and design, and discover undocumented dependencies. Based on this assessment, our team developed the implementation plan to ensure that the functionality is covered in other systems, either through builds or commercial-off-the-shelf cloud products, removed the redundant processes, retired the reports that were no longer used, and performed the change management and training of stakeholders to ensure a smooth transition.

Client Benefits/Impacts:

The Guidehouse solution to transform the FTA technology environment streamlined the FTA business operations and modernized the technology environment. It helped reduce manual processes, improve data quality, retire 10 redundant applications, modernize 40 distributed applications, and migrate a 35-year-old mainframe system to a private cloud, greatly reducing the overhead of IT operations and application maintenance. It also helped the SBA address security vulnerabilities and audit concerns in running ancillary systems. Additionally, it has reduced SBA's dependency on older technologies and reduced the cost to operate an expensive mainframe. It has also dramatically reduced manual operational and maintenance activities by 50% and has enabled senior leadership to optimize spending and accelerate business change.

"The key to any successful migration is to conduct a robust discovery phase to uncover risks and limitations early – our proven methodology enables an agency to see and mitigate risks before they can negatively impact the broader program and associated stakeholders."

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