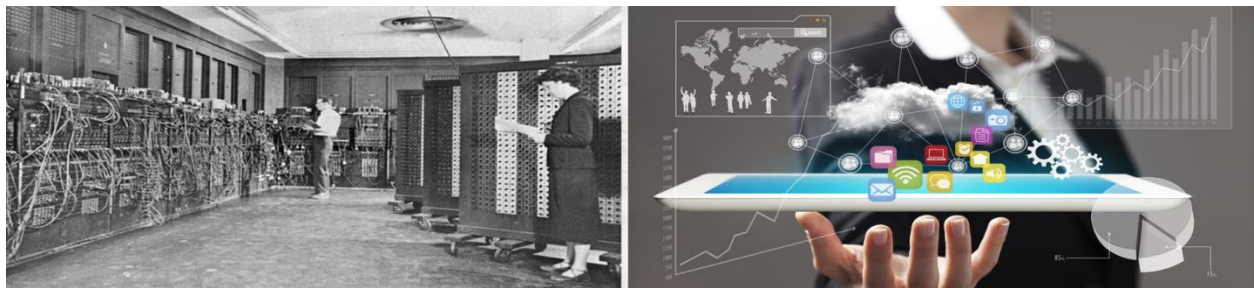




# **LEGACY SYSTEM MODERNIZATION**

## **Addressing Challenges on the Path to Success**

**October 2016**





October 07, 2016

Tony Scott  
Federal Chief Information Officer (CIO) and Chair, Federal CIO Council  
Office of Management and Budget  
725 17<sup>th</sup> Street, NW  
Washington, DC 20503

Dear Mr. Scott:

Subject: Modernizing Legacy Systems

It is my honor to provide you the attached report, “Legacy System Modernization, Addressing Challenges on the Path to Success”. ACT-IAC developed this report to help government agencies and their private sector partners address this important issue. The report was developed through the ACT-IAC collaborative process that engaged members with significant experience modernizing systems in both the government and private sectors.

We hope you and the members of the Federal CIO Council find the report useful to develop and implement sound modernization policies and procedures for the government. We established a new Community of Interest to continue this effort beyond the report. We would be happy to discuss the report with you and your staff, answer any questions, get your feedback, and discuss opportunities for ACT-IAC to continue to help address this important topic in the future.

KENNETH B. ALLEN  
Executive Director  
American Council for Technology–Industry Advisory Council

## TABLE OF CONTENTS

<b>Executive Summary .....</b>	<b>1</b>
<b>Introduction.....</b>	<b>4</b>
<b>Modernization Lifecycle .....</b>	<b>6</b>
Assessment and Roadmap.....	6
Modernization Readiness .....	8
Modernization Execution .....	10
Modernization Deployment .....	11
Post Modernization .....	11
Change Management and Communications.....	12
<b>Modernization Strategies .....</b>	<b>13</b>
Digitization through Modernization.....	17
<b>Making the Business Case for Modernization.....</b>	<b>18</b>
<b>Financing Modernization .....</b>	<b>19</b>
<b>Conclusion .....</b>	<b>21</b>
<b>Appendix A Examples of Modernization Projects.....</b>	<b>21</b>
<b>Authors, Contributors, and Affiliations.....</b>	<b>35</b>

## **American Council for Technology-Industry Advisory Council (ACT-IAC)**

ACT-IAC is a non-profit educational organization established to create a more effective and innovative government. ACT-IAC provides a unique, objective, and trusted forum where government and industry executives work together to improve public services and agency operations through the use of technology. ACT-IAC contributes to better communications between government and industry, collaborative and innovative problem solving, and a more professional and qualified workforce.

The information, conclusions, and recommendations contained in this publication were produced by volunteers from government and industry who share the ACT-IAC vision of a more effective and innovative government. ACT-IAC volunteers represent a wide diversity of organizations (public and private) and functions. These volunteers use the ACT-IAC collaborative process, refined over 30 years, to produce consensus-based outcomes. The findings and recommendations contained in this report are based on consensus and do not represent the views of any particular individual or organization.

To maintain the objectivity and integrity of its collaborative process, ACT-IAC does not accept government funding. This report and other ACT-IAC activities are underwritten by AT&T, ACT-IAC's strategic mission partner, and a number of private-sector organizations that share the ACT-IAC commitment to better government. A complete list of sponsors can be found on the ACT-IAC website – ACT-IAC greatly appreciates this support.

ACT-IAC welcomes the participation of all public and private organizations committed to improving the delivery of public services through the effective and efficient use of information technology. For additional information, visit the ACT-IAC website at [www.actiac.org](http://www.actiac.org).

### **Disclaimer**

This document has been prepared to contribute to a more effective, efficient, and innovative government. The information contained in this report is the result of a collaborative process in which a number of individuals participated. This document does not – nor is it intended to – endorse or recommend any specific technology, product, or vendor. Moreover, the views expressed in this document do not necessarily represent the official views of the individuals and organizations that participated in its development. Every effort has been made to present accurate and reliable information in this report. However, ACT-IAC assumes no responsibility for consequences resulting from the use of the information herein.

### **Copyright**

©American Council for Technology, 2016. This document may not be quoted, reproduced, and/or distributed unless credit is given to the American Council for Technology-Industry Advisory Council.

### **Further Information**

For further information, contact the American Council for Technology-Industry Advisory Council at 703-208-4800 or [www.actiac.org](http://www.actiac.org).

## **EXECUTIVE SUMMARY**

Many federal agencies rely on decades-old, obsolete technologies to support critical mission programs, essential functions, and daily operations. Collectively, agencies report spending about three quarters of their information technology budgets on operating and maintaining those systems. Costs are ever increasing, legacy systems are pervasive, security risks are growing, and new technologies are continually being introduced. Agencies are challenged to provide a secure environment as access becomes increasingly open and legacy systems potentially lack the flexibility to adapt to these changing needs. Even where they can adapt, the timeframe is long and the process is slow and inexact, often entailing risk-taking that can impact critical business functions. Modernizing onto newer technologies is critical to help agencies improve their services to citizens, enhance government operations, and strengthen cybersecurity. Modernizing legacy systems can be very challenging, risky, costly, and resource intensive; but, with the right strategic approach, the risks can be mitigated and costs lowered. This report provides a high-level, structured approach to help agencies successfully plan and manage their legacy system modernization efforts.

Many agencies have been consolidating their infrastructure, moving to cloud computing, adopting shared services, and adopting Agile development, DevOps, and modular contracting to modernize their legacy systems. However, these efforts are in the early stages and many legacy systems still need to be modernized. It would be rare for an agency to modernize all of its legacy systems at once. This means agencies will have to manage a complex mix of legacy and modernized systems for the foreseeable future. It also means they need to establish and maintain an ongoing modernization program. And it also means that agencies need to be strategic about which legacy systems they choose to modernize, in what order, and the approach they will use to maximize the benefit of those investments.

Once the decision has been made to modernize a legacy system, it is important to plan and manage the work in a disciplined manner that increases the likelihood of success. Integrating a security strategy into every modernization plan is paramount; robust security measures must be central to the modernization program. Given the rate of technology change, agencies also need to incorporate digitization strategies to better leverage advances such as analytics, mobility, social media, and smart embedded devices. First and foremost, organizing for success requires getting senior leaders, program managers, users, and essential support functions engaged, informed, and supporting the effort. Legacy system modernization efforts require sustained senior leadership attention, support, and effective management from inception through completion to succeed.

### **Modernization Lifecycle**

A successful legacy system modernization program combines business processes, people, and technology to reduce risks, promote adoption, and realize potential benefits. The following diagram shows important stages in the modernization lifecycle: Assessment and Roadmap, Readiness, Execution, Deployment, and Post-Modernization. It also includes the cross-cutting functions of Change Management and Communications throughout the lifecycle to provide the stakeholder support required for success.

Figure 1. Modernization Lifecycle



## Modernization Strategies

Various modernization strategies exist in today's market. Careful evaluation is required to identify the best one. Modernization strategies available to address legacy system challenges include Re-architecting, Remediating/Refactoring, Re-platforming/Re-hosting, Replacing, Retiring, and DevOps/Sustainment. Each strategy has unique business cases, business drivers, and strengths and weaknesses that may make it the best fit for a particular modernization effort.

## Modernization Business Case and Financing

This report addresses important considerations for making the business case for modernization including mission needs, return on investment, risks of the status quo, other accrued benefits, and the ability to manage the modernization initiative. It also provides guidance on funding options like requesting funding through the budget process, leveraging existing funding, and use of chargeback models.

## Keys to Successful Modernization

The following keys to legacy system modernization can help facilitate success. Executives can use these items as a checklist when planning and reviewing modernization programs.

### 1. Create Stakeholder Alignment

Make certain that the right stakeholders are involved and meet regularly in a formal governance model to promote information sharing, transparency, and collaboration.

### 2. Modernization is a Journey – Start with the Application Strategy/Portfolio Assessment

Thoroughly examine the application portfolio for redundancy and alignment with business strategy; develop an analysis of alternatives and “end-state strategy” for each system.

### 3. Include Risk Mitigation and New Agility in the Business Case

Be sure to incorporate risk mitigation and new agility in the business case. Legacy systems can include risks like unsupported technology that requires scarce skills to support. Modern technologies can dramatically increase agility and provide new digital capabilities.

### 4. Champion “Harvesting” over Replacing – Where Sensible

Legacy applications often contain valuable and time-tested business logic. With the right approach, this asset can be used effectively to reduce risk and cost.

### 5. Avoid Underestimating Impacts to Users and Minimize Functional Changes

User resistance is often the greatest barrier to successful modernization. Emphasize user acceptance to reduce program risk. When appropriate and possible, minimize functional changes that can introduce additional risk when moving to the new technology.

### 6. Make Sure IT can Support the New Architecture

Make sure the target architecture is well defined and understood by the organization and its support contractors. Verify that the technology infrastructure is adequate to support the target architecture and that IT personnel have the skills needed.

**7. Start Small, Begin with Agile, and Scale Fast**

Begin with a proof of concept to better understand legacy technology, uncover obstacles, and increase confidence. Use the Agile iterative approach to reduce risk and drive quality while incrementally delivering modernized components to transform the minimum capability necessary to enable faster deployment, getting early feedback from users and technical architecture validation.

**8. Modernization Testing is Unique – In a Good Way**

Test the new system against the working, proven baseline system to reduce risk, verify functionality, and assess fit to business needs.

**9. Measurement and Baselining are Key**

Establish a baseline of the legacy system for decision making and comparison. At each stage in delivery, define and track metrics.

**10. Remember Decommissioning**

Decommissioning legacy systems is often overlooked or lower priority. Plan ahead and develop a clear schedule of events for decommissioning to realize cost savings and other benefits.

## INTRODUCTION

Many Federal agencies rely on decades-old, obsolete technologies to support mission programs, essential functions, and daily operations. Collectively, they report spending about three quarters of their information technology budgets operating and maintaining those systems, limiting their ability to modernize their systems with newer technologies. Federal CIO Tony Scott raised multiple concerns about legacy systems, saying “We have a broad surface area of old, outdated technology that’s hard to secure, expensive to operate, and on top of all that, the skill sets needed to maintain those systems are disappearing rather rapidly.”<sup>1</sup> The Government Accountability Office (GAO) reported, “Federal legacy IT investments are becoming increasingly obsolete: many use outdated software languages and hardware parts that are unsupported.” and “...the government runs the risk of maintaining systems that have outlived their effectiveness.”<sup>2</sup> GAO recommended that the Office of Management and Budget (OMB) issue guidance on legacy system modernization and “...agency heads direct their respective agency CIOs to identify and plan to modernize or replace legacy systems as needed”.

New technologies that could help Federal agencies improve services to citizens and government operations continue to develop at a rapid rate. Many private sector companies use these technologies to provide their customers with goods and services in new and innovative ways. However, the gap between public and private sector services is increasing, and citizen trust in and satisfaction with the federal government is at an all-time low:

- The federal government ranks second-to-last out of more than 40 industries measured by the American Customer Satisfaction Index<sup>3</sup>. The government’s 2015 ACSI score is its lowest in nine years.
- Forrester’s Customer Experience Index<sup>4</sup> rates the federal government dead last in the 17 industries measured.
- According to a Gallup 2013 study<sup>5</sup>, trust and confidence in the federal government has steadily declined over the past 40 years. That decline was accompanied by a drop in citizens’ impressions that the government cares about them and that citizens can have a say in how government runs.
- A Pew Research study from 2015<sup>6</sup> reported “The public’s trust in the federal government continues to be at historically low levels. Only 19% of Americans today say they can trust

---

<sup>1</sup> “*White House Wants to Give Agencies a New Pot of Money to Upgrade Legacy IT*,” February 9, 2016, retrieved from <http://www.nextgov.com/cio-briefing/2016/02/white-house-wants-give-agencies-new-pot-money-upgrade-aging-it/125788/>, Nextgov.

<sup>2</sup> *Federal Agencies Need to Address Aging Legacy Systems*, May 25, 2016, <http://www.gao.gov/products/GAO-16-696T>.

<sup>3</sup> *ACSI Federal Government Report 2015*, January 26, 2015, retrieved from <http://www.theacsi.org/news-and-resources/customer-satisfaction-reports/reports-2015/acsi-federal-government-report-2015>, American Customer Satisfaction Index.

<sup>4</sup> “*The U.S. Federal Customer Experience Index, 2015*,” August 13, 2015, retrieved from <https://www.forrester.com/report/The+US+Federal+Customer+Experience+Index+2015/-/E-RES120202>, Forrester Research.

<sup>5</sup> “*Trust in Government*,” retrieved from <http://www.gallup.com/poll/5392/trust-government.aspx>, Gallup.

<sup>6</sup> “*Trust in government: 1958-2015*,” November 23, 2015, retrieved from <http://www.people-press.org/2015/11/23/1-trust-in-government-1958-2015/>, Pew Research Center.



the government in Washington to do what is right. Currently, slightly more than a quarter of Americans (27%) say they are satisfied in the country.”

The federal government’s information technology systems, together with the associated business processes and customer service, can affect citizens’ satisfaction and trust in government, either positively or negatively.

Modernizing legacy systems can be very challenging, risky, and resource intensive. The federal government has a spotty record of successfully acquiring and implementing new technologies. GAO added IT Acquisition and Operations to its High Risk List<sup>7</sup> in 2015 because “... federal IT investments too frequently fail to be completed or incur cost overruns and schedule slippages while contributing little to mission-related outcomes.”

Agencies report multiple reasons for not modernizing their legacy systems including lack of resources, lack of experience, risk of disruption to mission programs, organizational resistance to change, and risk of project failure. Key challenges include unclear project scope and manual project management processes. Some agencies have mitigated these challenges with Agile development methods coupled with modular contracting, resulting in significant product quality and productivity improvements.

Agencies should carefully assess the need for modernization of their legacy systems on a regular basis. The Federal budget cycle provides an annual opportunity to identify investments that need to be made and build them into future budgets. Modernization should not be undertaken solely because a system has been running for many years. Other factors like risks (e.g., cybersecurity and availability of support), costs, mission priority, customer demand, and the need for new capabilities should be considered.

Once the decision has been made to modernize a legacy system, it is important to plan and manage the work in a disciplined manner to increase the likelihood of success. Legacy system modernization efforts can require extensive time and resources to complete, seriously impact important programs, and can potentially fail in a myriad of ways. First and foremost, organizing for success requires getting senior leaders, program managers, users, and essential support functions engaged, informed, and supporting the effort. Legacy system modernization efforts require sustained senior leadership attention, support, and effective management from inception through completion to succeed.

### **IRS Modernized E-file System**

#### **Results:**

- Largest ever corporate e-filings in 2006
- All form 1040 processing moved in 2012 and legacy system was decommissioned
- Better quality forms, faster processing times, and integrated payments
- Over 120 million e-filed 1040 forms were processed in 2015 (87%+)

#### **Strategy:**

- Replace via digitization using distributed Agile development

#### **Enablers:**

- Top-level commitment
- Stakeholder alignment
- Agile implementation
- Engage with partners in government and industry

<sup>7</sup> HIGH-RISK SERIES An Update, GAO-15-290, February 2015, retrieved from <http://www.gao.gov/assets/670/668415.pdf>, Government Accountability Office.

ACT-IAC previously produced several reports, including the following, that could also help agencies with their legacy system modernization efforts:

- “KEY SUCCESS FACTORS FOR MAJOR PROGRAMS THAT LEVERAGE IT – The “7-S for Success” Framework”<sup>8</sup> and
- “Transforming the Way Government Builds Solutions”<sup>9</sup>

## MODERNIZATION LIFECYCLE

A successful legacy system modernization program combines business processes, people, and technology to reduce risks, promote adoption, and realize potential benefits. The modernization lifecycle addresses the changes required to bring business processes, software applications, data, and all associated information technology (IT) infrastructure to a desired state. It is essential for all agencies to become more efficient and more effective in performing the functions that support their missions. Revitalizing assets and aligning them, by applying the right enterprise architecture-based system modernization strategy, is important to preserve and structure the business knowledge and functions residing in legacy systems. The key is to retain current investments and expertise while driving toward the new environment.

It is critical to apply a robust modernization framework that is pre-built, pre-modeled, and pre-tested to accelerate transformation, reduce costs, and mitigate operational risks. The modernization framework should provide processes, tools, resources, and assets that reduce much of the risks of modernization. This approach provides for harvesting requirements and proactively generating demand for the enterprise architecture, which in turn aligns with long-term organizational objectives and enables managed adoption of enterprise architecture standards.

The following diagram shows important stages in the modernization lifecycle: Assessment and Roadmap, Readiness, Execution, Deployment, and Post-Modernization. It includes the cross-cutting functions of Change Management and Communications to provide the stakeholder support required for success. It is important to note that the process is best followed in an iterative manner to adapt as complexity is encountered at each stage.

Figure 2. Modernization Lifecycle



001 ACTIAC

### Assessment and Roadmap

This stage incorporates analysis of current and future business processes and capabilities to assess the extent to which the IT portfolio meets those needs. Based on this analysis, create a roadmap of application dispositions – to decommission/retire, remediate, re-platform, consolidate, or enhance applications. This will optimize the portfolio to align with the agency’s

<sup>8</sup> [https://www.actiac.org/system/files/7-S\\_for\\_Success\\_0.pdf](https://www.actiac.org/system/files/7-S_for_Success_0.pdf)

<sup>9</sup> <https://www.actiac.org/system/files/Transforming%20the%20Way%20Government%20Builds%20Solutions%20.pdf>, ACT-IAC Institute for Innovation, 2013.

constraints, dependencies, priorities, and budget profile. To determine appropriate dispositions, important application assessment topics include security, functional health, technical health, strategic alignment, and financial impact. Examining these topics provides the data-driven insight to make defensible application disposition decisions.

Based on short-term and long-term capabilities required, different modernization strategies are evaluated for each investment in the portfolio. If warranted, technology assessments and proofs of concepts are performed in this stage to aid decision making. A key step is to assess the agency's enterprise architecture, to make certain it is practical and usable and can support modernization initiatives.

A legacy system modernization project can be accomplished through a variety of methods. The first step is to understand the project scope and complexity. For example, suppose a system runs in one agency and provides data to a second agency for reporting. The first agency wants to modernize their system, but the receiving agency cannot accept the data in a new format – what happens then? Does the second agency have to modernize too? These types of questions illustrate why an assessment should be the first step in determining the correct modernization approach.

The assessment provides detailed understanding of the current environment, including individual application characteristics, and establishes a baseline scope and roadmap to reduce risk. The roadmap process should include an analysis of alternatives to make sure that a range of feasible options is considered and the best strategy selected prior to investment. The roadmap lays out the preferred option using multiple “waves” to plan, design, build, test, and implement smaller components of the application at a time (i.e., an incremental approach) rather than modernizing the entire system at once (known as the ‘big bang’ approach). Further, the modernization architecture should include defined performance measures and outcomes that, together with the agency's business architecture, support the overall strategic objectives of the organization. Those performance measures should provide the input required for the metrics ultimately used to gauge success.

Developing a modernization roadmap is critical. The detailed modernization roadmap presents a comprehensive view of the modernization strategies in the right sequence. The roadmap involves multiple dimensions, including the application modernization technical approach, governance and lifecycle management functions, and gap closure methods. The roadmap will highlight enterprise-level information requirements, cross-enterprise and business partners' integration needs, enterprise-level security, and operational support measures. The roadmap is further

### **Treasury Department Central Accounting and Reporting System**

#### **Results:**

- Eliminated multiple legacy systems
- Faster and more accurate reporting – daily rather than monthly
- Went from 12 days to process submissions until account statements were available to same day
- Improved remediation of material weaknesses in audit opinions

#### **Strategy:**

- Break into manageable chunks and replace via digitization using Agile development

#### **Enablers:**

- Top-level commitment
- Stakeholder alignment
- Agile implementation

reconciled with the expected enterprise architecture and the business case for undertaking the multiyear modernization, which provides the following:

- Analysis of functional process needs or problems posed by the current system with recommendations for improvement
- Proposed solutions based on the desired future state
- Assumptions and constraints
- Lifecycle costs and benefits of the modernization plans
- Investment risk analysis.

The roadmap provides both a timeline for the expected modernization to occur and estimated costs. It is important that cost and time estimates are based on a genuine assessment of the existing application and – simply a guess. The need for realistic estimates is a major reason for always conducting an assessment as the first step of any modernization project.

### Modernization Readiness

The modernization readiness phase includes preparations required to set the technology architecture and project management goals. It involves actions needed to plan, communicate, organize, and staff the modernization project. If an agency does not have a common, modern architecture stack, this is the right stage to define it. Otherwise an existing architecture framework needs to be evaluated for capabilities required for the modernized system. This is also the stage where development processes are identified and an infrastructure plan for development and final deployment is created. While the roadmap from the previous assessment phase is a high-level plan for the project, the readiness phase entails extending that plan to include the detailed steps needed to track and deliver the project at a more granular level.

Regarding staffing, it is critical to establish a team with key management oversight in each discipline. For any complex modernization effort, a skilled and experienced program manager is essential for success. In addition to the program manager, a strong government team to lead the modernization effort is the single most important ingredient for success. While leadership positions in a modernization effort will differ depending on the technology and solution, the following are typically key government roles needed for successful execution of a modernization program:

- **Business lead** – A senior official from the mission or business organization who has ultimate responsibility for making certain that the functional requirements are properly scoped and met by the delivered system.
- **System architect** – Someone who is both a technologist and an engineer, who can develop a technical solution to meet the requirements, and who fully understands the agency’s enterprise architecture and how the new system will interoperate with internal and external systems.

#### Customs and Border Protection Automated Commercial Environment

##### Results:

- Faster flow of legitimate trade into the U.S.
- Processes 97% of critical entry summary documentation
- Provides “single window” for business to transmit information, giving stakeholders earlier access

##### Strategy:

- Replace via Agile development

##### Enablers:

- Governance approach
- Agile implementation
- Engagement with partners in government and industry

- **Data architect** – An absolute must for any highly data-centric system to validate the proper integration of data from multiple, unrelated sources.
- **Security architect** – Someone who can verify there is a proper security design and integration with the agency's architecture.
- **Requirements manager** – Not the business lead but the individual who understands the lifecycle of managing requirements – from elicitation to the requirements change management process to test and evaluation.
- **Development and integration manager** – Too often missing from the team – if you are developing software or implementing a complex configuration of a commercial package, you need such an individual.
- **Test manager** – The individual who brings a solid, end-to-end view of the testing process.
- **Configuration manager** – The person who accounts for all project items and runs a tight change control process.
- **Operations manager** – The person who knows how to field and operate systems. This individual is always required and is even more critical as the government moves toward incremental delivery. It is not unusual for programs to simultaneously have a release in production, another in development and testing, and a third in requirements definition and design.
- **Contracting officer** – The leader from the procurement organization that handles the processes for procurements and resultant contracts.

## FCC IT Modernization

### Results:

- Reduced IT O&M spending from >85% to less than 50% of budget
- Reduced time to launch new prototype from 6-7 months to less than 48 hours

### Strategy:

- Stop custom coding and maintaining expensive legacy systems

### Enablers:

- Modelling positive change agents
- Engaging and linking government and industry partners
- Set and achieve goal of migrate to 100% public cloud and commercial services within two years

In addition to a strong modernization management team, it is also critical to have a way to drive alignment and proper decision making for stakeholders of the modernization effort. We have heard for decades that IT programs fail because of ill-defined requirements or poorly managed requirements scope throughout the program life cycle. While true, this is a symptom of a more fundamental underlying problem – namely, the inability of all key stakeholders in a modernization effort to agree to both desired outcomes and the approaches to meet those outcomes.

Change is inevitable in all IT programs, so achieving such alignment is not a one-time exercise at the start of a modernization effort. Alignment is an ongoing process that is critical throughout an investment's strategic planning, design and development, and its implementation – governance must be viewed as a full lifecycle process. For complex IT systems, there are at least a half-dozen stakeholder organizations that must be aligned, to include the strategy organization, business or mission owner of the system, IT, finance, procurement, legal, security, and privacy. Involving all key stakeholders in key decisions is an essential element to facilitate genuine alignment.

Modernization governance works best when there is a single, transparent reporting relationship for a program manager to an oversight governance board. The board of executives from key



stakeholder organizations must be empowered to make decisions binding their organizations and creating a partnership between the business, IT, procurement, finance, etc. The function of the modernization governance board is not to usurp the authorities of the program manager. Rather, it is to provide a forum where the program manager can take key issues and trade-off decisions. It should be an informed, empowered body that has a vested interest in the program's success that views the program manager as a trusted advisor and subject-matter specialist.

## Modernization Execution

Execution involves detailed design, building, and configuring the new environment and application, testing that all requirements have been met, and implementing the new infrastructure and/or application. Strategies, as defined in the Modernization Strategies section below, can have varied hardware- and software-based approaches. However, common threads that run across most of those implementations include the following:

- Compliance with the organization's System Development Life Cycle (SDLC) process to make sure that modernization efforts are subject to/enforced by the established rigor of any application development or maintenance activity.
- If the current SDLC does not map to the modernization process, then it should be modified and standardized across all modernization programs.
- Enforce compliance with the organization's architecture guidelines so that it is easier to maintain modernized applications.
- Incorporate early performance tests, especially in the case of a hardware re-platforming or re-hosting, to verify that the modernized application will deliver required performance in production.

The FCC IT Modernization represents a different approach that included stopping custom coding and maintaining expensive legacy systems by migrating to public cloud and commercial service provider solutions.

Testing for a modernization program is a complex activity. Many systems lack documented requirements and test cases for applications. The testing strategy needs to identify the test case sources and the environment in which it will be validated. The testing strategy also depends on the modernization strategy selected. For example, when software code is being transformed or rewritten, a functional equivalence strategy is appropriate. In complex systems, testing requirements generation, test plan generation, and testing execution may have to be executed in parallel with modernization execution as capabilities are modernized iteratively. Integrating security is critical for the modernization program. It is imperative to begin early in the lifecycle and use an architectural review of applications security measures to identify and address potential security vulnerabilities. This involves leveraging proven security strategies and using security testing processes, such as code testing, code reviews, and vulnerability/penetration

### FCC Consumer Help Desk

#### Results:

- Reduced \$3.2 million cost and 1-2 year timeframe to less than \$450,000 and less than 6 months.
- Reduced \$640,000 hardware and software maintenance costs to \$100,000.

#### Strategy:

- Migrate to public cloud solution eliminating expensive legacy system maintenance costs

#### Enablers:

- Public cloud solution
- Rapid prototyping using existing SaaS solution.
- Engagement with partners in government and industry

testing throughout the modernization program to proactively identify and remediate security vulnerabilities.

## Modernization Deployment

Deployment of new systems can be a moment of success, resulting in a smooth transition and satisfied users or fraught with mistakes leading to dissatisfied users and serious disruption to business. The difference between these possible outcomes depends on the quality and execution of deployment plans. Deployment can potentially affect personnel, business processes, IT infrastructure and operations, data, and support functions like finance and contracting. It can be a period of complex, interdependent, concurrent activities that need to be carefully orchestrated. It may involve coordination with and reliance on external third parties introducing new relationships, additional complexity, and potential risks. If anything is going to go wrong, the middle of a transition is when it is most likely to happen. There are several deployment strategies that can be applied to improve user adoption. Techniques that have been successful in both commercial and government sectors include A/B deployments to expose increments of capabilities to smaller sets of users and “dark launches” that deliver specific increments of functionality to the users.

### HUD New Core

#### Results:

- Overcame previous modernization failures
- Decommissioned outdated systems

#### Strategy:

- Phased replacement with Shared Services

#### Enablers:

- Governance approach
- Agile development methodology
- Communication

It is essential to carefully plan all of the steps required, anticipate what might go wrong, develop contingency plans and fallback strategies, and communicate with all affected parties for the duration of deployment activities. Importantly, this includes not only those involved in deployment activities but also the ultimate customers – the end users. User acceptance is critical to the success of modernization efforts. Users need to be informed about what to expect, what will change, and how it will affect the performance of their jobs. They also need to receive timely training, support, and assistance that is well-packaged, easily accessed and understood, and available when needed. Organizations need to plan in advance to provide a higher than average level of support during and immediately after deployment to facilitate a smooth transition and positive outcome.

## Post Modernization

Consider what is needed after the new system is implemented. Vendors may be required to provide post-implementation support while agency employees come up to speed on the new system or possibly continue supporting the system permanently depending on the agency approach. As the system moves into production, it is important to plan for user issues and the process to fix defects. Agencies should create a process to deal with issues related to functional equivalence or new business process incorporation. If there was specific tooling used during modernization, it is important to plan for that the tooling and team to be available for sufficient duration after product implementation so that post-modernization defects are dealt with efficiently.

Modernization involves new technology, infrastructure, and hosting options. In cases where the core technology language will be replaced (e.g., an application modernized from COBOL/VSAM to Java/Oracle), validate that the new skills required are in place. If a modernized application will be implemented in the cloud, private or public implementations will require changes in IT roles and responsibilities that will trigger organizational and cultural disruptions. Address this risk in advance to facilitate cloud adoption.

This stage includes decommissioning of hardware and software of the legacy system that occurs after the modernized system is deemed stable and the old system is no longer needed.

### Change Management and Communications

Change management and communications are required for a successful legacy system modernization. A large percentage of modernization efforts result in failure. One of the primary reasons is the lack of acceptance by end users. MeriTalk<sup>10</sup> reported that only 29% of agencies have established an application modernization change management team. The CIO, the senior IT management team, and senior business managers must consistently demonstrate commitment to the program. Without this leadership, the organization will withhold support or may actively oppose the effort.

While the IT organization is responsible for managing technology modernization efforts within existing business processes, it is important that the impact of change to the business and users be considered. The IT organization needs to engage the business organization to collectively drive modernization. It is imperative that the business drive the change with IT.

Change management for modernization is categorized in five important steps:

- **Define the Compelling Reason for Change:** This step involves explaining why the change is needed. It describes current limitations and how they are impacting performance. It is often the result of user or leader concerns about missing information, difficulty of use, lack of data breadth, bad or invalid data, poor system performance, and increasing operations and maintenance costs. The goal is to start telling a compelling story of why sponsors and users should support the change.
- **Quantify the Impact:** This step explains how the change fits into the overall strategy, who will be impacted, and how the change will affect the organization and the budget.
- **Build the Vision and Guiding Coalition:** This step explains how things will improve after the change has been implemented. The goal is to have an ending to the compelling story of why sponsors and users should support the change. Establish the leadership team and support across the organization required to implement the change.

### FCC.gov Refresh

Results:

- Overcame user frustration with previous website, >85% of new visitors like the new website

**Strategy:**

- Sought stakeholder input and feedback in all stages of project

**Enablers:**

- Frequent internal and external stakeholder engagement
- Rapid prototyping and engagement with government and industry partners

<sup>10</sup> *Future Ready Applications, The Modern Legacy*, November 18, 2015, retrieved from <https://www.meritalk.com/study/future-ready-applications/>, MeriTalk.



- **Communicate:** Implement a proper communication plan so end users are aware of the complete modernization process including when to expect regular communications (weekly, semi-weekly, etc.), when they will be required to take an action, and how they can appropriately provide feedback and ask questions.
- **Execute the Change:** If required, generate a detailed training plan to avoid issues with end-user acceptance. Along with the training plan, define how the training will take place – e.g., in-person, train-the-trainer, virtual, etc. Once training is complete, one or more leads within each user community should be identified as a coach that other users can go to if they have issues or concerns with the new system.

## MODERNIZATION STRATEGIES

Various modernization strategies exist today in the market. Many agencies have been consolidating their infrastructure, moving to cloud computing, adopting shared services, leveraging open data and Application Programming Interfaces (APIs), adopting Agile development and DevOps methodologies, and adopting modular/incremental contracting to modernize their legacy systems. Careful evaluation is required to identify the most suitable solution in each specific case. The proposed solution should address the legacy challenges, see that there is minimal culture conflict, be interoperable within the organization, and be aligned to the business investments. Understanding that each organization is unique and requires a tailored approach to modernization, the best modernization roadmaps often include several different strategies depending on the business issues being addressed. For example, business drivers such as cost reduction may suggest a Re-hosting while addressing security concerns may require fully Re-architecting the system. The need for flexibility may dictate replacing application reporting functions with a vendor package rather than rewriting custom code.

To develop a modernization strategy, an organization needs a clear understanding of the available modernization options. In determining which strategies to apply, it is important to consider some baseline assumptions and questions. The following questions provide an initial guideline to selecting strategies required for the modernization:

- Can certain functions of the application be replaced by a commercial off-the-shelf (COTS) product?
- To what extent is shared services an option?
- What are the business functions and rules written into the current application?
- How is the data accessed and used?
- How many external interfaces exist, and how are they impacted moving forward?
- What third-party products exist today that will need to be replaced in the future?
- How will the new application be tested?
- Are there any security implications for splitting the application?
- How much will it cost, and do those costs align with the business case?

Consider an open platform in the modernization strategy to future-proof the target technical and business architecture. Open source technologies offer foundational elements essential to a flexible, scalable, and proven platform for the future. The functional components required to implement transformation include cloud technologies, containerization technology, a container orchestration technology, service discovery tools, high throughput messaging technology, and an

API gateway. This platform should also be paired with data storage technologies to support both structured and unstructured data.

Many legacy applications were developed with minimal consideration for defending themselves or the data entrusted to them, making them a weak link in enterprise security. This leads to missed opportunities in the modernization program for data security and data management. Consciously addressing these weaknesses can help to identify specific actions to enhance the effectiveness of data security layers. This includes classification and categorization to help identify data owners close the data security gaps during modernization (e.g., storage, metadata management, and so forth).

In most organizations, modernization efforts will affect only a portion of the IT portfolio at any given time while the remaining legacy systems continue to operate. This duality led to the emergence of a concept known as “Bimodal IT,” defined by Gartner as “...the practice of managing two separate, coherent modes of IT delivery, one focused on stability and the other on agility. Mode 1 is traditional and sequential, emphasizing safety and accuracy. Mode 2 is exploratory and nonlinear, emphasizing agility and speed.”<sup>11</sup> Bimodal IT is more than just the fact that some systems will be modernized while others will not. It is an intentional strategy to separate systems into two categories and then intentionally manage them differently. The idea of Bimodal IT has generated a lot of controversy, with both strong advocates and detractors. This paper does not take either position. We introduce the concept so the reader can conduct their own research and make their own determination about the potential applicability and value of adopting a Bimodal IT approach in their organization.

The following modernization strategies are available to address legacy system challenges. Multiple strategies may apply to a modernization program; each strategy has unique business cases and business drivers that may make it the right fit for the agency. The table following defines the various modernization strategies and may help to determine where each approach might be used.

MODERNIZATION STRATEGIES	DEFINITION
Re-Architect	Re-architect the application and database to a modern framework retaining the existing business logic. This involves reverse-engineering the original application to understand the baseline requirements, then forward-engineering those business rules to a new IT environment based on a modern architecture. Benefits of a modern architecture include ease of implementing enhancements (e.g., mobility), ability to support real-time analytics, and increased availability of skilled resources. Re-architect legacy applications based on the modern architectural guidelines and design in shorter deployment time using automated or semi-automated modernization tools. Re-architecture programs can include an Agile approach that decomposes legacy systems into reuse-able components that can be addressed in incremental iterations of component reuse and/or reconstruction for iterative releases. Agile teams can undertake lean discovery of business context, requirements, and rules; enhance the common elements underpinning the business capabilities; and implement APIs and microservices supporting those capabilities. Business benefits of the Re-architecture approach can be achieved through automation of development, test, and production

<sup>11</sup> <http://www.gartner.com/it-glossary/bimodal/>

## MODERNIZATION STRATEGIES

## DEFINITION

	<p>operations by reducing the risk of the modernization through higher quality, rapid release cycles.</p> <p>Application characteristics suitable to Re-architect: Applications written in a legacy language that functionally meet (or mostly meet) the business need. Agency wants to remove/reduce legacy language due to reduced availability of skilled resources, slow speed, or inability to implement business changes and/or desire to migrate to modern technology.</p>
Remediate/Re-Factor	<p>Remediation or Re-factoring is used to optimize an application to improve poorly functioning areas or poor performance. It may include recoding inefficient programs or modifying data structures or data access to support the new target environment like cloud enablement. This is a low-cost modernization technique. More extensive modernization services can be deferred for later modernization efforts. Use to improve code quality, developer productivity, compliance to standards, and overall reliability of application.</p> <p>Application characteristics suitable to Remediate/Re-Factor: Legacy applications struggling to support performance requirement, changing functional requirements, and/or continued expansion required functionality. Agency seeks a low-cost modernization solution to extend the life of a legacy application.</p>
Re-platform/Re-Host	<p>Re-Platforming/Re-hosting involves moving the existing system to a different platform – for example, moving applications (e.g., Windows, Linux) into the cloud. This is frequently called a ‘lift and shift’, with the focus being to change as little of the application code and logic as possible. The benefits are that hardware and software licensing costs and maintenance may decrease significantly. This can also involve moving a mainframe into a lower-cost environment. It can involve porting an application from one technical platform to another by reusing (partially or fully) the code asset in the target platform. Key business drivers are high legacy infrastructure, operational, and license cost. Re-platforming requires less support and effort from the business.</p> <p>Application characteristics suitable to Re-platform/Re-Host: Legacy applications that, while meeting the business need, are expensive to support including high hardware costs. Agency seeks to reduce costs and/or reduce IT platforms.</p>
Reuse	<p>Reuse involves salvaging existing systems or components, leveraging a “touch once” approach in a series of releases that incorporate data and functionality from legacy applications into modernized applications, update to newer releases of underlying COTS software, and move to a new, componentized application architecture and standardized run-time environment. It involves rationalizing the applications and determining which applications to “reuse” and which to “turn off.” Rationalization can also be accomplished by moving to shared services. Progress has been made in this area as agencies move to human resources, acquisition, and financial management shared services in particular. Turning off applications through a rationalization process produces savings that can be used to fund future modernization work. Reuse fosters faster build-out of application capabilities by adopting the concept of open data and exposure of high-value APIs. Establishing such platforms and combining them with the API gateway to expose reusable services (e.g., APIs) for Government-wide use must be strongly considered as part of</p>

## MODERNIZATION STRATEGIES

## DEFINITION

	the modernization strategy.
	Application characteristics suitable to Reuse: Legacy application components that can be leveraged at the business domain level and are architecturally able to provide loosely coupled independent components into systems (e.g., web services) and provide a separation of concerns (user interface, business logics, data access layer).
Replace	<p>The legacy application is replaced with an entirely new solution – a custom or COTS application. A COTS product has the benefit of receiving vendor support for the software, and the agency may benefit from new capability provided by the vendor. To avoid issues during software updates, this requires the agency to adopt/configure the COTS system processes for the business. Agencies are free of custom development but dependent on software upgrades and subject to license fee increases. This could be a custom or COTS solution. Building a new system is often costly, slow, and risky.</p> <p>Application characteristics suitable to Replace: Applications written in a legacy language that fail to meet the business need. Applications supporting business processes that are being reengineered such that current capability will be obsolete.</p>
Retire	<p>Retiring involves the decommissioning of redundant or obsolete applications. This includes removing the application from production while retaining access to historical data. One critical item to consider is how data can be retrieved later. This usually involves migrating data to another repository or to an archive. Retirement is also used to shut down a legacy system post modernization.</p> <p>Application characteristics suitable to Retire: Applications are redundant or no longer needed by business. Agency is looking to Retire such applications to save costs.</p>
DevOps/Sustainment	<p>This strategy incorporates intelligent coding and continuous maintenance into the legacy system while continuing to use the existing code and platform. A DevOps framework supporting modernization extends Agile development by leveraging automated tools to enhance continuous integration throughout the lifecycle. This creates a legacy modernization process for a “continuous delivery pipeline” to plan, define, develop, test, release, and monitor releases, leveraging automation throughout the legacy modernization lifecycle. Developer-friendly Integrated Developer Environments (IDEs) and tools are used, which partially address the reduced availability of skilled resources for legacy languages. This solution introduces a collaborative working style between the development and operations teams. Changes are deployed faster and on an as-needed basis. Continuous delivery enables automated deployment and verification of an application across a set of environments.</p> <p>Application characteristics suitable to DevOps/Sustainment: Applications that functionally meet (or mostly meet) the business need. Agency is looking for ways to ease future enhancements and reduce release schedules while retaining the legacy language or platform.</p>

It is critical to complete a full assessment of the legacy systems to determine which strategy best applies, depending on the business objective. This analysis of the existing environment informs

an “operationally safe” modernization roadmap with a supporting business case for change. It focuses on aligning business and technology to base strategic and tactical decisions on business drivers, not technology constraints. Use of a variety of modernization tools and processes is critical to detailed understanding of the current-state system environment and to identify the best path to achieve the business goals. Additionally, it is critical to align the enterprise architecture (EA) with the long-term organizational objectives and for IT projects to adopt the EA standards. This EA strategy needs to integrate utilization and lifecycle management of various application, information, and infrastructure assets.

### **Digitization through Modernization**

Digitization focuses on digital touch-points with over-the-top customer experience, data, and analytics for the highest consistency and unprecedented knowledge of clients’ behaviors. The need for legacy systems to interact with digital applications is pushing them to process dramatically increased transaction volumes and operate at speeds greater than the systems were designed to handle. Online and mobile computing are straining legacy systems with increasing requests for data. A decade ago or more, only a few hundred dedicated users – such as an insurance adjustor or a travel agent – would access a system for data. Today organizations contend with millions of requests from outside users and data aggregators for that same information. This increased volume requires more computing resources to support the demand.

Agencies with legacy systems must seek ways to integrate new digital technologies, harvesting legacy technology to maximize their IT investments. In some cases, much of the legacy IT is still viable, and organizations simply need to enhance their systems with digital technology to meet their needs. To do so, they must establish an optimal mix of applications with digital touch-points, mapping out a logical, economic, and disciplined plan to accelerate their journey to digital via legacy by carefully considering all the latest modernization approaches at their disposal. When organizations assess how to bring their legacy systems into the digital era, their initial assumption often is they will have to ‘rip and replace’. Sometimes this method may make sense, but more often bringing IT systems into digital-ready mode is an iterative process – one that does not involve a start-from-scratch approach.

The key is creating flexibility to add new digital layers to supplement business functionality and support growth. Organizations can start by decomposing existing systems and breaking them into discrete components. This is far less disruptive than completely replacing an existing core legacy system, and it allows organizations to create new channels at scale. Additionally, gradual integration can be a less disruptive and easier approach to modernization than wholesale change.

#### **U.S. Army Total Ammunition Management Information System**

##### **Results:**

- Significant defect reduction
- Shorter test cycles
- Faster deployment using continuous delivery
- Improved response to cybersecurity threats

##### **Strategy:**

- Re-architect application
- Move to cloud using Agile development and DevOps

##### **Enablers:**

- Governance approach
- Agile implementation
- Engagement with partners in government and industry
- Communication

Selectively exposing legacy system capabilities and adding new digital layers enables this flexibility. There are modernization approaches to fit each application's needs. For example, organizations can move applications to a data acceleration or cloud-based layer during seasonal spikes in transactions; break down an application into a library of components for application reuse; or create an API management layer to facilitate access by other systems or external entities. By leveraging contemporary modernization options, enterprises can transform their legacy IT systems for the digital era without entirely replacing them.

An important first step, when considering how to integrate legacy and digital, is to understand the business requirements. Are you considering reopening backend systems as a result of growth in transactions because of digital channels? Are increased compute requirements still delivering value? What is your approach for keeping complex legacy systems up and running while also increasing efficiencies? Are your legacy applications able to keep up with changing compliance and cyber risk challenges? Discovery tools and cognitive agents can provide a clear view into legacy applications to determine which modernization approach will deliver the most value for each targeted application. Once you understand this optimal legacy landscape, it is beneficial to consult with your architecture staff or a systems integrator to determine how to approach modernization without disrupting the user experience. During this step, to select the applications that make the most sense to modernize, it is critical to determine which applications provide key functionality and have the biggest impact on programs. The final step is creating a modernization plan, incorporating both business and IT objectives, to transform traditional applications and help organizations operate in the digital era.

## MAKING THE BUSINESS CASE FOR MODERNIZATION

An ever-increasing percentage of government agency IT budgets are going to operations and maintenance of legacy systems. Of the \$52 billion in Federal civilian IT spending planned for fiscal year 2017, approximately 71% (\$37 billion) is classified as “legacy” IT spending – that is, spending dedicated to maintaining the existing IT portfolio, excluding provisioned services such as cloud.<sup>12</sup> Tight budgets have become the norm for most government agencies. Justifying modernization initiatives to obtain funding can be very difficult. It is critical that agencies develop a solid business case to convince agency leadership, OMB, and Congressional appropriation committees of the need for a modernization initiative. In preparing such a business case, agencies should address the following areas:

- **Mission Need** – All agencies want to operate more effectively and provide better services, whether for services to citizens or to support other mission objectives. One of the strongest arguments for the need to modernize is to describe the shortcomings of the legacy environment to effectively deliver mission services. Demonstrating that a legacy system cannot meet new requirements essential to the mission or that legacy costs are becoming unsustainable provides the basis to present a coherent, practical modernization initiative.
- **Financial Return on Investment (ROI)** – While not all modernization initiatives can provide a positive ROI based solely on financial returns, government agencies should strive to structure a modernization initiative to at least break even in a reasonable amount of time

---

<sup>12</sup> Agency FY 2017 IT Portfolio budget submissions to the Federal IT Dashboard, <https://itdashboard.gov>.

(i.e., within a couple of years). Upfront investment is expected, but a negative ROI or one that is not positive for many years has a very low probability of being funded.

- **Risk of the Status Quo** – Many legacy systems are old; support staff is retiring and no one else knows how to maintain the application when they leave or the vendors no longer support the hardware and software. Large, complex legacy systems that took many years to develop cannot be replaced in just a few months. Such systems can take years to replace because they literally perform hundreds or thousands of functions that impact thousands or millions of people. If the system fails and no one can support it, then how many people are impacted, how many laws are broken, and is an emergency fix even possible? One of these items can sometimes trigger the need for modernization even if the financial justification is not present.
- **Other Accrued Benefits** – In addition to mission need, there are typically other accrued benefits to the agency in implementing modernized systems. One is improving the agency's cybersecurity posture because modern architectures and products are designed with security in mind versus many legacy systems that were often designed and built even before the Internet existed. Other accrued benefits can include (1) the ability to maintain and upgrade the modernized system and the ability to use, adapt, and upgrade modern IT infrastructure over time; and (2) the use of modern data management to enable data from the modernized system to be leveraged for other uses – e.g., better operational efficiencies or to feed other processes and systems to enhance other agency operations.
- **Ability to Manage the Modernization Initiative** – Given the track record of modernization initiatives in the federal government and the inherent risk in implementing large-scale change, agencies need to demonstrate their readiness and ability to successfully execute the initiative. In particular, completing proper planning (as outlined in the section on Assessment and Roadmap) and having a dedicated, experienced program team and appropriate governance model (as outlined in the section on Modernization Readiness) not only show agency commitment but demonstrate organizational maturity to successfully manage a complex modernization initiative.

While a solid business case does not guarantee success in financing a modernization initiative, an agency that properly prepares a business case to address the five items above not only gives itself a chance for success but, perhaps most importantly, demonstrates the organizational readiness to embark on a modernization initiative.

## FINANCING MODERNIZATION

Financing is one of the biggest challenges agencies face in modernizing their legacy systems. Many legacy systems were developed incrementally, with development, enhancement, and operating costs spread over many years. It can be difficult for agencies to muster the resources it takes to modernize them over a short period of time while continuing to operate and maintain the legacy systems. The annual budget process does not naturally align with the need to balance long-term modernization goals, which are achieved over a period of years, against short-term, iterative steps needed to implement modernization in a modular and agile manner.

It is essential to thoroughly analyze options, costs, and benefits and to make a compelling business- and mission performance-based justification for modernization investments. The full costs of modernization and the means to fund them should be a strong consideration in selecting the modernization strategy to use (described earlier in this paper). A number of currently available funding options are described below. Additional funding options – such as establishing



a new IT modernization fund or allowing agencies more flexibility in managing and using appropriated funds – are possible in the future, but those options are outside the scope of this paper. Potential existing sources of financing for legacy system modernization include the following:

**Requesting Funding Through the Budget Process.** This involves submitting a budget request and justification to OMB and the Congress through the annual budget development process, in accordance with budget development and IT capital planning guidance. The advantages of this approach is that it can provide additional resources to enable agencies to modernize their systems, and agencies can use the budget process to link IT costs to the mission activities they support. The disadvantage is that this approach can be unreliable, especially in times of constrained or declining budgets; the requested funding may be delayed, reduced, or disapproved; and, even if approved, the money will not be spendable for 18 to 30 months after the initial request.

**Leveraging Existing Funding.** This can occur at multiple stages of the budget development and execution processes. Costs can be planned into a subsequent year during budget development (usually requires an offsetting reduction elsewhere in the budget). Funds can be reallocated within the current year (which may trigger a formal Congressional reprogramming request, depending on the amount of funding involved). And funding may become available during the fiscal year – e.g., year-end unobligated balances or recoveries of unobligated balances from prior obligations. Comprehensive visibility into all IT spending and fund sources and establishment of enterprise IT funding mechanisms are important foundational capabilities. Cost-cutting efficiency efforts – e.g., data center consolidation or migration to cloud platforms or shared services – can generate savings that can be reallocated to legacy modernization investments, though capturing those savings within a fiscal year presents challenges because the IT savings do not necessarily align with the fiscal year calendar.

Funding options that convert large capital investments into smaller periodic payments – e.g., leasing vs. owning or managed services – may help make modernization efforts more affordable. Some commercial IT vendors offer a variety of financing services and options along these lines that agencies may want to explore. Additional innovative options that work within existing authorities – e.g., share in savings approaches – may be worth pursuing.

The advantage of this option is that agencies have more control and flexibility over funding decisions. The disadvantages are that it does not provide any additional resources, and agencies may not be able to retain and repurpose savings they generate to fund modernization.

**Use of Chargeback Models.** A variety of options are available to federal agencies to charge users – both from within and from outside their agencies – to pay for modernization including shared services models, fee-for-service models, working capital funds, and franchise funds. It is important for these approaches to use cost allocation methods that are as equitable, understood, and transparent as possible to be accepted by paying customers. While it is possible to finance modernization within these approaches, those costs often have not been included in the past. It can be challenging to get the user communities to agree to increase their fees to finance modernization efforts. There may also be policy or other structural obstacles to these approaches that need to be carefully investigated in coordination with agency CFOs before they are adopted, including rules for what kinds of activities can be supported by particular funds (e.g., service



provision is a generally accepted use, but introducing new lines of business is not). The advantage of this approach is that it spreads the costs across the benefiting user community. The disadvantages are that users may be unwilling or unable to pay their share of the costs, jeopardizing the modernization effort; and it takes additional overhead to establish and operate these financing mechanisms.

In summary, there are a variety of different approaches to finance modernization efforts. There may be other options not identified in this report. Agencies could benefit from examining financing mechanisms used by other federal agencies, in other public sector organizations, and the private sector to identify additional financing models that may be of use to them.

## **CONCLUSION**

Modernizing legacy systems is an increasing imperative for Federal departments and agencies to deliver services to citizens and support mission programs securely, efficiently, and effectively. Avoiding modernization will only worsen problems and make challenges more difficult over time. A well planned, disciplined approach to modernization can increase the likelihood of success and reduce the risk of failure. However, there is no simple, “cookbook” solution to modernization. Every situation is unique and different, so modernization plans need to be tailored to each specific case. This report provides a flexible framework that can be adapted by Federal departments and agencies to help support their legacy system modernization efforts.

## APPENDIX A. EXAMPLES OF MODERNIZATION PROJECTS

### IRS Modernized E-File System

In the 1970s, the IRS created the first version of the e-file system, enabling individual taxpayers' form 1040s to be filed electronically. Rather than dealing directly with individual taxpayers for e-filing, the IRS decided to work through intermediaries who served individual taxpayers, electronically collected their returns, and forwarded them to the IRS for final processing and posting to the individual master file. This approach proved to be a very good decision that created a market for companies to innovate, develop software solutions (e.g., TurboTax), and provide value for the taxpayer in creating his or her return. This approach has enabled the market to continue to innovate and provide increasingly sophisticated capabilities for the taxpayer.

By the late 1990s, it was clear that the original e-file system would not serve the agency well in the future. There were scalability issues in the design, it was difficult to add other form types (such as business returns), there were security issues, and the system was getting more difficult to maintain. IRS decided to create a new, modernized e-File system to replace the original system as part of the Business System Modernization (BSM) program. The IRS decided to start with corporate returns (form 1120) and tax-exempt organization returns (form 990), as the legacy e-file system could not process them.

Modernized E-File has been a remarkable success, beginning with processing form 1120 and form 990 returns in 2004 and mandating the largest corporations' e-file beginning in 2006. In 2010, form 1040 returns were processed for the first time, and all 1040 return processing moved to the new platform in 2012, enabling retirement of the legacy e-file system. In 2014, form 1041 (estate and trust returns) was added to the Modernized E-File platform.

This new platform enabled the IRS to provide significantly enhanced capabilities, including more explicit error checks to help make sure returns are correct as they are filed; faster acknowledgment of receipt of returns (moving to near real time), and incorporating an integrated payment option. In 2015, more than 120 million 1040 returns were processed by the Modernized E-File system, representing more than 87% of all 1040 returns filed.

#### Keys to Success

- **Senior-level Commitment** –There was very senior-level commitment to complete the program on time including the personal commitment of the Commissioner of the IRS. This visible commitment at the top drove the organization to success.
- **Governance Approach** – A governance body was formed that oversaw the design, development, and rollout of the system. It was jointly chaired by the Director of Large and Medium-Sized Business Unit and the IRS CIO. This shared partnership model of governance enabled appropriate decision making to occur in a transparent and informed manner.
- **Use Proven Program Management Techniques** – As the BSM program matured, it developed a suite of management practices that supported each of its projects including the development of Modernized E-File. The maturation of these program management practices enabled IRS to move off the GAO High Risk List for its modernization initiatives.
- **Engage with Industry** – IRS conducted extensive outreach and collaboration with the tax preparation industry to make certain that Modernized E-File would serve their needs.

- **Partner with Vendors** – Modernized E-File was a good example of government and vendor collaboration to develop a complex IT system. Each vendor played its role well, with proper oversight and management from the government project office. It was a model for how good projects should operate.

### **Treasury Department Central Accounting and Reporting System (CARS)**

The Department of the Treasury Bureau of Fiscal Service is responsible for maintaining the federal government's set of accounts, managing execution of the budget, and providing information about the federal government's financial position. To perform these duties, Fiscal Service's Government-wide Accounting (GWA) department used information systems that were deployed in the 1980s that had increasing risks of failure due to aging technology. Those systems' primary focus was on operational requirements with minimal focus on customer needs and ease of use.

To modernize the government's accounting processes and the delivery of financial information, GWA established the Central Accounting and Reporting System (CARS) project with the following objectives:

- Eliminating aging technologies that were becoming obsolete and increasingly difficult to support due to the dwindling number of individuals with the expertise to operate and maintain them
- Re-engineering business processes to support more efficient and effective mechanisms for exchanging and delivering financial data across the government
- Providing a user-centric system with greater agency access to their data and self-service capabilities
- Helping ongoing remediation efforts to address material weaknesses identified in audit opinions.

CARS used an incremental development approach, with phased production releases, to deliver a multi-tiered web solution comprised of service-oriented modules that work together to provide a single integrated accounting system. GWA partnered with the Administrative Resource Center (ARC), a shared services provider, to implement and operate GWA's General Ledger (GL).

By partnering with ARC for GL services and breaking the development and deployment of this large-scale financial accounting system into smaller, more manageable phases, GWA successfully delivered incremental business value, kept users engaged, and sustained momentum for the duration of the project. In March 2015, CARS replaced the legacy accounting system and became Fiscal Service's accounting system-of-record. CARS achieved the following accomplishments:

- Eliminated three legacy applications with significant reductions in operations and maintenance costs and operational technology risks
- Implemented business changes to provide more timely and accurate reporting of accounting information by shifting agency reporting from monthly to daily
- Reduced the elapsed time between agency submission of accounting data and the availability of updated account statements from 12 days to the same day, providing greater management and control over Fund Balances with Treasury

- Replaced manually intensive agency and Fiscal Service processes used to enter and verify transactions with automated workflow capabilities, allowing transactions to be originated, reviewed, and approved online
- Implemented a U.S. Standard General Ledger-compliant set of accounts and established the General Fund entity, assisting ongoing remediation efforts to address material weaknesses identified in audit opinions.

### **Keys to Success**

- **Senior Level Commitment** – The CARS project had the full support and commitment of the highest levels of Fiscal Service management. Fiscal Service’s Commissioner was kept well informed on the progress of the effort and championed the project, including reaching out to agency CIOs to support CARS-required agency changes.
- **Use Proven Program Management Techniques** – Partnering with the Federal Reserve, GWA matured its program and project management processes. Using disciplined project management practices facilitated the day-to-day management of the project and provided better data and transparency to senior-level decision makers.
- **Use a Phased Release Approach** – Adopting a phased approach for software development and deployment enabled incremental delivery of business value and the opportunity to continually evaluate, adapt, and refine processes to facilitate project success.
- **Early and Ongoing Engagement with Federal Program Agencies (FPA)** – Implementing an extensive outreach program and collaborating with FPAs helped to make sure CARS would serve its customers’ needs. Conducting FPA work sessions at various locations throughout the country, with mock-ups of user-centric functions, allowed the project team to gather and incorporate agency feedback into the CARS solution. In addition, providing CARS information and updates at Financial Accounting Conferences helped keep agencies engaged.

### **U.S. Customs and Border Protection (CBP) Automated Commercial Environment (ACE)**

ACE was intended to “...form a comprehensive system that enables Customs and Border Protection (CBP) to interact, manage, and oversee the import and export data, enforcement systems, and cargo related financial management in order to provide end-to-end visibility of the entire trade cycle.” In April 2001, the U.S. Customs Service (now CBP) announced its intention to replace a number of legacy systems, most notably the Automated Commercial System (ACS) and the Automated Export System (AES), with a modernized system named ACE.

During ACE’s first decade, there were significant delays, cost overruns, and criticisms of mismanagement. While some progress was made, by 2011 neither AES nor ACS had been retired and there was concern about the viability of continuing ACE as a stand-alone program. At that time, CBP revamped the program approach, taking on more management responsibility itself and moving to an Agile development approach for creating new modules of ACE with the goal of retiring AES and ACS in as soon as possible.

Over the past 5 years, key functionality on ACE has been implemented much faster, and AES was retired in 2014. All remaining functionality in ACS is being phased out in 2016, with the plan to fully decommission ACS in mid-2017. Michael Mullen, executive director of the Express Association of America, recently stated: “CBP’s effort on this has been astounding at every level. The team that is working on this project has just been expending enormous effort and it’s

clear that a really first rate job has been done on this program and that we are very close to success.”

Since April, 2016, more than 75% of all cargo imported into the United States – approximately 81,000 of the total 108,000 daily transactions – has been processed electronically through ACE. ACE is processing 97% of entry summary documentation – critical information needed to correctly assess duties, collect statistics, and provide compliance with U.S. trade law. ACE is the “Single Window” through which businesses electronically transmit required information to the U.S. Government, giving trade stakeholders earlier access to shipment data while speeding the flow of legitimate trade. CBP is on track to deliver all core trade processing capabilities by the end of 2016 to meet the goal of the President’s 2014 Single Window Executive Order.

### **Keys to Success**

- **Governance Approach** – In 2011 a governance body was formed that oversaw the design, development, and rollout of the system. It consisted of senior-level stakeholders from across CBP, including mission leaders, IT, and acquisition. This shared partnership model of governance enabled appropriate decision making to occur in a transparent and informed manner.
- **Use Proven Program Management Techniques** – As the ACE program matured, it worked to mature its program and project management processes, leveraging support from the IT and Acquisition organizations in CBP. The use of such practices supported day-to-day management of the program and provided better data and transparency to senior-level decision makers.
- **Move to an Agile Development Methodology** – Previously, ACE modules were developed using a traditional waterfall development model, resulting in releases that failed to meet trade industry and internal government users’ expectations and causing significant rework, schedule delays, and cost overruns. Moving to an Agile methodology provided earlier and more frequent feedback from users, enabling CBP to deploy capabilities that were fully vetted with users more quickly. Confidence in the program’s ability to deliver and trust in the program has grown over the past 5 years.
- **Engage with Industry** – CBP has always had extensive outreach and collaboration with the trade industry to make certain that ACE can meet their needs.

### **Treasury Department, Bureau of the Fiscal Service Administrative Resource Center (ARC) Oracle Release 12 Migration**

Since 1996, ARC has provided a full range of financial management accounting services, including a comprehensive, integrated financial management system platform and system administration, user training, and business process operational support to other federal customer agencies. The customer agencies share the use of a single instance of the core financial management system, which includes feeder systems and interfaces. The core financial management system platform and the feeder systems interfaces support the basic financial management functions required of most Federal agencies. ARC’s success in supporting customers in financial management has been foundational to its growth and development as a premier shared services provider in the Federal marketplace.

ARC has a positive track record with financial management system implementations, including most recently its first Cabinet-level agency customer implementation, the U.S. Department of

Housing and Urban Development (HUD). Prior to that effort, ARC completed its most challenging modernization project to date with the migration to Oracle Release 12(R12).

As a shared services provider, ARC updates and improves its systems to facilitate their viability and reliability, support their customers' needs, and maintain a competitive edge for future customer needs. The Oracle R12 project was initiated to provide a supported federal version of the Oracle platform in the future and meet compliance and contractual commitments.

The R12 Upgrade was ARC's most complex system implementation to date, demanding the expertise of more than 230 technical and functional personnel during the project lifecycle. More than 5,000 requirements were identified and tested, more than 70 interfaces were rewritten, 22,000 cutover plan steps were executed, and 2,800 systems users were affected.

Beyond facilitating continued support for the platform, Oracle R12 provided three major improvements to the functionality of ARC's core financial management system: an accounting structure based on the Common Government-wide Accounting Code; an improved posting logic design and process; and the project's Costing and Billing modules. It also provided a stronger foundation for future customer implementations such as HUD.

The project began in April 2010 with the gathering of requirements and concluded in May 2014 with deployment of R12 for more than 40 financial management agencies on ARC's shared instance at a total cost of approximately \$13 million. It was a success for both ARC and its customers, who benefited from functional enhancements made available through this migration and from a major technological advancement at minimal cost. This major upgrade averaged about \$330,000 per customer – a fraction of the cost they would have incurred to upgrade their own system independently.

The success of this project, the benefit provided to customers at minimal cost, and the foundation this modernization provided in advance of the HUD project – all serve to substantiate the effectiveness of the business model in the shared services environment.

### **Keys to Success**

- **Manage Expectations** – ARC set very specific expectations about what the implementation would (and would not) entail, such as not adding any new functionality that was not inherent or absolutely necessary, and then used a disciplined approach to make sure they met those expectations.
- **Focus on Requirements** – ARC conducted a thorough analysis of requirements well in advance of the project to maximize success.
- **Project Management** – ARC made strong project management on this project a priority from the beginning.
- **Resource Appropriately** – ARC assembled a strong team, using experienced staff to provide a solid foundation to support the system after deployment and to reduce costs.
- **Communicate Often** – With a wide customer base and varied customer expectations, ARC had a robust communications strategy to gain customer input (especially regarding rollout scheduling), providing customers with regular status reports, and involving them in testing.

### **U.S. Department of Housing and Urban Development's (HUD) "New Core" Program**

The U.S. Department of Housing and Urban Development (HUD) manages general ledgers, time and attendance, travel, procurement, and financial reports. These activities, critical to HUD's mission programs, were performed by systems mostly deployed before 2000. These systems were at increasing risk of failure due to the aging technology, no longer supported by vendors, making HUD susceptible to increasing Operations and Maintenance costs and material weaknesses identified in audit opinions.

To modernize these systems, HUD conducted the Financial Systems Integration project from 1991 to 2000 and then the HUD Integrated Financial Management Improvement Project from 2003 to 2012. When these efforts failed to produce the required results, HUD chose to migrate its financial management systems to a Federal Shared Services Provider – the Administrative Resource Center (ARC) operated by the U.S. Department of the Treasury Bureau of the Fiscal Service – in a project known as “New Core.” The New Core program began in 2013 with the goal of modernizing legacy systems through shared services by October 2014. However, in early 2014, program team leaders and stakeholders recognized a reconfiguration of the program was needed to drive success.

HUD and ARC developed a phased release structure for New Core that introduced new functionality throughout the program's lifecycle. The first release, in October 2014, migrated HUD's Travel and Relocation system and functions to ARC's shared services environment. The second release migrated HUD's Time and Attendance system and functions in February 2015. The third release, completed in October 2015, migrated HUD's Core Accounting and Procurement system and functions to ARC.

By moving to a shared services solution and breaking the migration into smaller, more manageable phases and releases, HUD was able to successfully modernize its systems after two earlier, unsuccessful attempts. In the process, HUD became the first Cabinet-level agency to move its financial operations to a shared services provider.

### **Keys to Success**

- **Senior-level Commitment** – The New Core program had the full support and commitment of the highest levels of both HUD and Treasury. HUD's Deputy Secretary, Treasury's Fiscal Assistant Secretary, and Fiscal Service's Commissioner kept well informed on progress and communicated the importance of the program to their respective organizations. HUD's New Core Program Management Office was headed by a member of the Senior Executive Service (SES). This high-level involvement was critical to gain the staff cooperation needed to meet tight project deadlines.
- **Project Management Team Integration and Use of Proven Program Management Techniques** – HUD and ARC merged project management activities into a single project management office (PMO). Both HUD and ARC worked from a single Integrated Master Schedule and Work Breakdown Structure for each release/project. They implemented a risk management approach that enabled them to identify risks and quickly develop mitigation strategies. ARC embedded staff in the PMO, located at HUD, and had additional staff travel to HUD weekly. This helped create a single project identity that built team cohesion, reduced misunderstandings, and minimized conflict between the two organizations.
- **Move to a Phased Release Approach** – Moving from a single, “Big Bang” release to a phased-release approach enabled the implementation team to reduce project complexity,

constantly evaluate and adapt to issues that arose, and apply lessons learned to subsequent, more complex phases and releases.

- **Implement a Coherent Change and Communication Strategy** – The shared services approach required business process changes that directly impacted HUD staff. Communicating the impacts of these changes was as important as management of the program itself. Successful implementation required cooperation of many program areas within HUD as well as the union. HUD designated an SES-level official to develop and execute a change management and communication plan to address this important issue.

### **Commonwealth of Virginia, Department of Planning and Budget (DPB), Performance Budgeting Systems**

The Virginia Department of Planning and Budget (DPB) launched “Public Budgeting Version 2.0,” the nation’s first enterprise-wide state performance budgeting system, in 2010. DPB’s highest-level business needs, replacing a system that had not been significantly altered in 25 years, involved replacing five disparate but interrelated systems – BudgetNet, Allotments, BudgetTool, BATS, and Horizon – with a solution that addressed the functions these systems performed while alleviating the challenges the environment presented. The project goal was to replace the variety of systems, databases, spreadsheets, and documents that supported the Commonwealth’s strategic planning and budgeting with a commercial software product to automate and integrate those functions. Challenges included the following:

- Numerous heterogeneous application infrastructures that required operational training and technical support expertise for each, which increased staff time and costs.
- Siloed databases that resulted in redundant data and increased the work needed for data quality, reconciliation, and cleansing.
- Lack of uniformity among applications in functionality, navigation, security, and reporting that negatively affected user experience, increased potential for insider threat or security vulnerabilities, and limited ability to publish data consistently and with integrity.
- Difficulty providing new functionality that integrated with all systems, impeding modernization.

States’ budget systems are critical in formulating annual budgets, with inputs from multiple agencies, policy constraints, and scrutiny from legislators and the public. The replacement and modernization of a budget system must be accomplished with proven technologies and reliable methodologies. Critical success factors DPB considered in its choice of a new budgeting tool included the following:

- The ability to meet and mitigate existing challenges.
- Flexibility to meet existing business rules and workflows rather than changing business rules/processes to fit a pre-defined structure.
- Use of a modern and flexible architecture conducive to changes over time to accommodate technology advancements.
- A system that supports decision making, including financial and strategic planning.
- The ability to incorporate changes to the base code in newer versions of the budgeting software code.

The new system – called Performance Budgeting (PB) – successfully consolidated previous data structures, offered practitioners new insights and a view of budget dimensions previously



unavailable, and increased budget transparency. The PB system incorporates multiple data inputs from various state agencies and provides real-time reports and interactive, drill-down budget presentations through a web interface. The system increases government accountability by combining budget, performance management, and strategic planning measures into a single software solution.

Within 3 months of going live, Virginia Secretary of Finance Richard Brown recognized the PB system as a superior, cost-saving solution. Secretary Brown said, “The new Performance Budgeting system increases the efficiency and effectiveness of the Commonwealth’s budgeting processes and the accessibility of budget data and report. The Performance Budgeting Project team met the challenges of an aggressive schedule, sourcing issues, and infrastructure delays in an effort to deliver the system for this year’s budgeting cycle.” Virginia’s DPB won the 2014 Excellence in Virginia Government Award for Innovation in Government, recognized for “innovative reforms that have resulted in increased efficiency, effectiveness.” And the system was referred to in a case study in a National Association of State Budget Officers (NASBO) publication on state performance budgeting system successes (“Investing in Results: Using Performance Data to Inform State Budgeting; State Experiences and Lessons Learned,” Summer 2014).

#### **Keys to Success:**

- **Senior Management Commitment** – From conceptualization of the program through its execution, it received support from DPB’s Director up to the Governor’s office. Regular meetings were held with these senior-level staff to brief them on progress and receive guidance.
- **Governance Approach** – Early in the project, prior to selection of a vendor, a Steering Committee – headed by DPB’s Director and composed of users, budget operations analyst, budget functional analysts, and IT – was formed to guide the overall project and report to senior management.
- **Program Management/Client-Vendor Partnership** – The program was managed jointly using standard Commonwealth processes adapted to the specific needs of the program. By jointly managing the effort, an integrated team provided an environment conducive to high levels of interaction and cooperation between those with budget expertise and those with technical expertise.
- **Innovative Technology** – The technology selected to implement the system was the only solution that provided all the functionality out of the box or through plug-ins, requiring no custom coding to the base software platform to meet system requirements.

#### **Federal Communication Commission (FCC) IT Modernization**

In 2013, listening sessions with the FCC’s 18 different Bureaus and Offices determined that the Commission’s information technology was not sustainable since more than eighty five percent of its IT budget was allocated to maintaining legacy systems. The FCC successfully undertook “Operation Server Lift” in 2015 to modernize its infrastructure and reduce operating costs. Legacy systems would become cloud based, be retired, or be moved to a commercial provider that would take over operating and maintaining those systems.

Beginning in January 2014, the FCC deployed Virtual Desktop to the entire Commission, enabling the FCC to stop patching and maintaining individual PCs and refocus its resources on

the planned Server Lift. In February, the FCC awarded a contract to move its email and documents to the cloud, reducing the FCC's email server footprint, internal operations and maintenance costs, and contractor overhead.

Operation Server Lift needed to power down, physically move, and power back up the remaining servers at the commercial service provider's site. In March 2015, a Request for Proposal was issued for data center consolidation, optimization, and the actual move of FCC's servers; 2 months later, a contract was awarded. In August 2015, the FCC initiated a full storage area network replication of its 400 terabytes of data. The SAN replica and non-essential applications were physically shipped to a leased data center. After they arrived safely and were successfully powered back up, the team began an orderly shutdown of the FCC's systems.

On September 3, the servers were disconnected and shipped to the commercial provider's site. By September 10, all of FCC's external applications were available, and a day later Operation Server Lift was completed. In all, 200 servers, 400 applications, and 400 TB of data were moved from FCC's two Washington, D.C., data centers to a commercial service provider. The move helped consolidate and eliminate infrastructure and reduce ongoing operations and maintenance costs from more than 85% of the IT budget to less than 50%. In addition, the successful effort reduced the time it takes to launch a new prototype from 6-7 months to now less than 48 hours. The effort also provided the FCC a more accurate inventory of applications, unique configurations, and software in their environment.

### **Keys to FCC IT Modernization's Success**

- **Empowerment and Commitment** – The FCC embraced a 'change agent' model linking government personnel with industry experts and empowering them to modernize the FCC. The FCC Chairman and the Managing Director fully supported the CIO and the IT team. This approach and support was critical to the success of this initiative.
- **Focused Goals and Planning Approach** – A goal was established for 100% public cloud and commercial service provision for the entire Commission within two years. An Integrated Project Team was formed among the FCC government and contractor staffs to develop and execute a comprehensive master schedule of move activities and dependencies. Regular meetings provided risk assessment and mitigation. This shared partnership model of governance enabled appropriate decision making in a transparent and informed manner.
- **Partnership with Vendors** – Operation Server Lift was a good example of government and vendor collaboration to execute a complex IT modernization. FCC worked closely with its existing vendors and new vendor partners supporting move, hosting, and telecommunication to facilitate virtually seamless integration across multiple work streams.

### **FCC Consumer Help Desk**

Launched in January 2015, after less than six months of development, the FCC's new Consumer Help Desk replaced the Commission's previous paper-based system with an easier-to-use, more consumer-friendly portal for filing and monitoring complaints online. The solution is Section 508-complaint ensuring accessibility by all individuals, with telephone service provided for individuals who need to log a complaint but lack internet access.

The Consumer Help Center makes the FCC more user-friendly, accessible, and transparent to consumers need to file complaints associated with wired or wireless telecommunication services.

FCC has been monitoring telecommunication providers for “cramming” unauthorized charges onto consumer phone bills, and information collected by this new solution is more smoothly integrated with FCC’s policymaking and enforcement processes compared to the legacy paper-based process. The system provides faster responses to consumer concerns as well as better information to the agency on consumer issues with providers.

Key business results include 18 different paper-based forms for logging telecommunication concerns with the FCC were replaced with one online, interactive portal. In addition, the portal supported a greater-than-50% increase in the number of complaints filed and completed by consumers. This shows that the ease-of-use for the web solution makes consumers more likely to log a concern for remedy by a provider or potential investigation by the FCC. Also, instead of taking days to fill out a paper form, mail it to the FCC, have the form scanned, and then route it to provider – the new system is immediate: once a concern is filed, the new system routes electronically to the provider for potential remedy. A routing delay of days was reduced to milliseconds. This resulted in a Forbes article attributing the new system to saving one consumer \$1,800 by a much faster turn-around time via the new system.

#### **Keys to FCC’s Consumer Help Desk Success:**

- **Rapid prototyping** – Previous estimates of \$3.2 million over 1-2 years were reduced to actual costs of less than \$450,000 and less than 6 months to completion.
- **Move to Cloud** – On-premise hardware and software maintenance costs of \$640,000 were reduced to \$100,000.
- **Partnership with Vendors** – The solution integrated Zendesk with AudioEye to provide cloud-based accessibility to the public, and greater scalability should increase demand occur with filling concerns by the public.

As a result, the U.S. public got a better, more agile, more resilient solution at a substantial cost and time saving. And the FCC took a step forward in modernizing its legacy IT in a proven, cost-effective, sustainable way for both the present and the future.

#### **FCC.gov Redesign**

Changing the usability and functionality of FCC.gov could have been daunting. More than a million unique monthly visitors use FCC.gov to research telecommunications issues and voice their opinions. These visitors were accustomed to certain forms. It did not matter that the forms were over 15 years old and hard to navigate. Any changes would have to compete against the comfort of the familiar.

Refreshing FCC.gov posed additional challenges – the website was updated in 2010-2011 and it was not well received. The previous redesign effort was led by a “new media” team kept separate from the main IT team. The new media team was not encouraged to engage the offices or IT team at FCC to gain a better understanding of stakeholders’ usage and receptivity to changes. In the recent project, the new media team was re-integrated with the broader IT team so they could work collaboratively on a shared stakeholder engagement, change management strategy, and project plan.

In 2013, the FCC recognized the need to refresh FCC.gov and overcome the users' frustration with the previous website efforts by seeking input and feedback in all stages of the website refresh process. FCC first launched a static prototype that allowed people to give feedback. After a few months, they moved to a working, functional prototype so people could see the design. An agile process was adopted with 2-week sprints between feedback, data collection, and a new rollout.

These efforts were successful, with more than 85% of new visitors reporting they preferred the new design over the previous one. The team received thank-you letters from multiple stakeholders recognizing the successful update and expressing appreciation for involving and listening to the various stakeholders.

### **Keys to FCC.gov Refresh's Success**

- **Communication internally and externally to multiple stakeholders** – The FCC team conducted extensive outreach and collaboration with the communications industry and citizen advocate groups to make certain that the redesigned FCC.gov would serve their needs.
- **Rapid prototyping** – FCC embraced a 'change agent' model for the entire IT Team, linking government personnel with industry experts and empowering them to modernize the FCC. The FCC Chairman and the Managing Director fully supported the CIO and the IT team. This approach and support was critical to the success of this initiative.
- **Move to Cloud** – The FCC is using world-class cloud providers to host the new FCC.gov, making it agile, secure, scalable, and responsive worldwide.

### **U.S. Army Total Ammunitions Management Information System (TAMIS)**

As part of the Department of Defense (DoD) strategic plan for data center consolidation and modernization, the U.S. Army embarked on a modernization of a mission-critical system – Total Ammunition Management Information System (TAMIS). The U.S. Army Headquarters selected the TAMIS to transform the application to a cloud environment to develop a repeatable process for migrating Army applications to the cloud and to develop a strategy for applications that were required to comply with Federal Risk and Authorization Management Program (FedRAMP) and CSM (Cloud Security Model) impact level 4 requirements.

TAMIS is a U.S. Army system for developing, prioritizing, and managing training, combat, and test munitions requirements. A web-based unclassified enterprise application, TAMIS tracks over 1.3 billion rounds of ammunition and interfaces with 11 other systems, including the Standard Army Ammunition System and National Level Ammunition Capability. Over 7,000 DoD users log in daily, averaging 575,000 average monthly transactions.

The U.S. Army was seeking a modernized system that provided an agile and repeatable deployment pattern, providing a cloud native architecture for future mission-critical needs as part of an applications modernization effort. In addition, a mobile front end was required to meet the demands of field users equipped with tablets and smart phones.

Due to frequent DoD command stakeholders' requirements changes, the team assessed the application, migrated into the cloud, and implemented a DevOps method to improve the development and test cycles and accelerate the release time to production, including end-to-end

automation of the DevOps lifecycle, 2-week sprints using Agile scrum, continuous delivery best practices, and automated testing using a variety of tools.

The application modernization effort comprised three major components: transformation to the cloud, modernization to a new architecture, and employment of an Agile approach using DevOps methodology. With a tight deadline of only 6 months, the team started by using a sequence of steps to make the application cloud ready:

- **Assessment of applications for transformation.** Multiple mission and technical characteristics were analyzed to determine suitability for migration. For characteristics that were not cloud ready, recommendations were created to mitigate the issue.
- **A target architecture and migration plan/roadmap.** To minimize risk and get TAMIS operational as soon as possible, the plan included two phases: a Re-host phase that migrated the TAMIS training environment from its legacy environment to AWS as proof of basic cloud services and a Re-architecture/optimization phase to take advantage of cloud capabilities.
- **Modernize the application and implement a DevOps approach.** With the successful migration to the AWS GovCloud, the application was refactored and re-architected to include reusing components, implementing key services, and optimizing for the cloud environment. Through the modernization, DevOps concepts and tools were incorporated into the TAMIS program including automated testing, infrastructure-as-code, and continuous integration. The results included improved test cycles including improved quality and reduced regression cycle from 3 weeks to 3 hours. Additionally, the program saw improved product quality, demonstrated by a significant defect reduction due to implementation of automated DevOps processes, scrum metrics, and automated testing.

The TAMIS migration is a key example of how a government agency can heed the call to action to modernize without putting a mission-critical environment at risk. The U.S. Army embraced the cultural change of a DevOps approach to produce some substantial results: Improved quality and reduced regression cycle from days to hours; significant defect reduction due to automated testing tools; faster deployment of new functionality through continuous integration and continuous delivery capabilities; and quick response to regulatory changes such as security.

### **Keys to Success:**

- **Change the culture** – Cutting development time from months to days and slashing regression testing from weeks to hours constitutes a massive cultural change. The U.S. Army was able to unify teams representing development, quality assurance, and testing to knock down walls through a DevOps approach. Engaging all parties was crucial.
- **Have a Plan** – The use of roadmaps and planning made sure that the project could move forward quickly – but not so recklessly that the project would be put at risk.
- **Understand the Architectural Decisions** – Make sure that the architectural decisions that are made are fully analyzed not only from a technical prospective but from a cloud financial and software license prospective.
- **Employ the Cloud to Full Advantage** – The team was able to reap the benefits of a scalable computing platform and realize immediate cost savings as well as creating the foundation for a mobile application.

- **Partner with Vendors** – The U.S. Army worked closely with key vendors, who collaborated extensively on transformation and migration of the TAMIS application.

## **AUTHORS, CONTRIBUTORS, AND AFFILIATIONS**

### **Principal Authors**

Eric Stogoski, Accenture Federal Services

Kartik Mecheri, Karsun Solutions, LLC

Stu Hammer, Hewlett Packard Enterprise

### **Contributors**

Christopher Heath, Robbins-Gioia

Dan Gahafer, Hewlett Packard Enterprise

Michael Preis, IBM

Rod Fonticella, Unisys

Susie Adams, Microsoft

### **Senior Advisors**

Bob Suda, Suda and Associates, LLC

Dan Chenok, IBM Center for the Business of Government

Dave McClure, Veris Group

Richard Spires, Learning Tree International, Inc.

### **ACT-IAC Staff**

Michael Howell