TREASURY INSPECTOR GENERAL FOR TAX ADMINISTRATION

Some Next Generation Information Technology Infrastructure Capabilities Were Implemented, but Program Management Improvements Are Needed

November 29, 2021

Report Number: 2022-20-001

HIGHLIGHTS: Some Next Generation Information Technology Infrastructure Capabilities Were Implemented, but Program Management Improvements Are Needed

Final Audit Report issued on November 29, 2021   Report Number 2022-20-001

Why TIGTA Did This Audit

The Next Generation Infrastructure program is part of the *IRS Integrated Modernization Business Plan* that emphasizes modernizing core tax administration systems, operations, and cybersecurity to improve the taxpayer experience.

The Plan is a road map for achieving necessary modernization of systems and taxpayer services in two three-year phases that are comprised of a series of discrete projects and programs.

This audit was initiated to determine the progress of the Next Generation Infrastructure program.

Impact on Taxpayers

Effective program management helps the IRS coordinate information technology investments in a cost-effective and efficient manner. Once implemented, the Next Generation Infrastructure capabilities will support a more efficient, scalable, and flexible architecture to support more interactive relationships between taxpayers and IRS employees.

What TIGTA Found

In Calendar Years 2019 and 2020, the IRS implemented several Next Generation Infrastructure capabilities. These capabilities included standard stack projects, continuous integration and continuous delivery pipeline, containerization, and central code repository projects. However, no clear or comprehensive program management structure was established for the Next Generation Infrastructure program because the program relies upon five Information Technology functions to implement and manage capabilities.

This decentralized approach makes it difficult to determine ultimate responsibility and accountability over the Next Generation Infrastructure program. For example, a formal program charter was not developed, and charters for the related Next Generation Infrastructure capabilities also were not developed. While the *IRS Integrated Modernization Business Plan* monthly reports include outcomes for the implemented capabilities, the program did not consistently monitor the performance of all of the implemented capabilities.

In addition, the Next Generation Infrastructure program did not link performance metrics to overall performance measures. For example, the IRS used a combination of expert opinion estimates and automated tools to provide information on internal processes for some capabilities, but the Next Generation Infrastructure program is not using this information as a performance metric.

In December 2020, the Information Technology organization's Strategy and Planning Office issued a stop-work order for the Next Generation Infrastructure program. The program office lacked contingency plans or processes to address any potential funding shutdown even though the Next Generation Infrastructure program had its funding cut in the prior years. As of August 2021, the Next Generation Infrastructure program funding had not been restored.

What TIGTA Recommended

The Chief Information Officer should ensure that the Next Generation Infrastructure program executive has centralized operational authority to manage program capabilities, and that the program establishes and links performance metrics to the *IRS Integrated Modernization Business Plan* to monitor and report on progress.

The IRS agreed with our recommendations. The Chief Information Officer plans to ensure that the Next Generation Infrastructure program executive has centralized operational authority to manage capability implementation and to develop and report on Next Generation Infrastructure metrics that align with the *IRS Integrated Modernization Business Plan*.

**TREASURY INSPECTOR GENERAL
FOR TAX ADMINISTRATION**

U.S. DEPARTMENT OF THE TREASURY

WASHINGTON, D.C. 20220

November 29, 2021

MEMORANDUM FOR: COMMISSIONER OF INTERNAL REVENUE

FROM: Michael E. McKenney
Deputy Inspector General for Audit

SUBJECT: Final Audit Report – Some Next Generation Information Technology
Infrastructure Capabilities Were Implemented, but Program
Management Improvements Are Needed (Audit # 202120019)

This report presents the results of our review to determine the progress of the Internal Revenue
Service's (IRS) Next Generation Infrastructure program. This review is part of our Fiscal Year
2022 Annual Audit Plan and addresses the major management and performance challenge of
Modernizing IRS Operations.

Management's complete response to the draft report is included as Appendix II.

Copies of this report are also being sent to the IRS managers affected by the report
recommendations. If you have any questions, please contact me or Danny R. Verneuille,
Assistant Inspector General for Audit (Security and Information Technology Services).

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Background

In April 2019, the Internal Revenue Service (IRS) published the *IRS Integrated Modernization Business Plan* that emphasized modernizing core tax administration systems, operations, and cybersecurity to improve the taxpayer experience. The IRS divided this six-year road map for achieving necessary modernization of systems and taxpayer services into two three-year phases that are comprised of a series of discrete projects and programs. The IRS recognizes that it should retire and decommission legacy systems and replace them with more sustainable infrastructure.[1] Three goals will help the IRS achieve a sustainable infrastructure:

- Reduce the complexity of the technical environment.

- Leverage data to deliver secure, agile, and efficient applications and services.

- Strengthen organizational agility through automation and streamlining processes.

The Next Generation Infrastructure (NGI) program is part of the *IRS Integrated Modernization Business Plan*. NGI is a series of packaged initiatives to support a more efficient, scalable, and flexible architecture implemented through advanced information technology infrastructure tools and technologies. The NGI program is comprised of multiple capabilities, including continuous integration/continuous delivery pipeline, the centralized code repository, the standard stack methodology, the container solution architecture, and the legacy code conversion strategy. The technology is planned to allow more interactive relationships between taxpayers and IRS employees. The NGI program relies on five Information Technology functions to help meet its goal to support the modernization of IRS operations. The five functions responsible for the daily operations of NGI capabilities are Enterprise Architecture, Server Services and Support, Development Operations (*i.e.*, DevOps), Technology Strategy Management, and Technical Integration Operations.

Results of Review

Some Next Generation Infrastructure Capabilities Were Implemented

In February 2020, the IRS redefined the NGI program from the 2019 *IRS Integrated Modernization Business Plan* as an overarching, collaborative effort to explore, select, and implement relevant modern technologies to attain the Future State Computing Infrastructure. The Future State Computing Infrastructure envisions the use of technology to provide a more proactive and interactive relationship between taxpayers and IRS employees that will improve taxpayer service, enforcement, and operations. The IRS modified the NGI program's capabilities to reflect the new definition and redefined the capabilities with new milestones to achieve the goals of the new NGI definition. The IRS adjusted priorities and eliminated certain capabilities. Some of the adjustments to the NGI program included:

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[1] See Appendix III for a glossary of terms.

- In April 2020, the IRS removed the automated desktop performance assurance and automated network provisioning (software-defined networks) capabilities from the modernization business plan because they did not fit the new definition. According to the Fiscal Year 2019 Key Insights report, automating desktop performance assurance will provide insights into the computing performance of desktops and workstations and more quickly resolve issues that might otherwise disrupt taxpayer service operations. The Key Insights report also provided that, by automating the provisioning of software-defined networks, the IRS can further modernize its technology operations.

- The IRS aligned both Enterprise Online Storage and the Tapeless Backup Solution requirements to the Managed Infrastructure and Data Services Acquisition.

Figure 1 shows NGI capabilities in the *IRS Integrated Modernization Business Plan* that were implemented in Calendar Years 2019 and 2020.

Figure 1: Implemented NGI Capabilities

Capability	Implementation Date
Centralized code repository: onboard initial 10 projects	May 2019
Centralized code repository: onboard additional 15 projects	July 2020
Continuous integration/continuous delivery pipeline: onboard initial 40 projects	May 2019
Continuous integration/continuous delivery pipeline: onboard additional projects	July 2020
Converting legacy code and reducing the application footprint: strategy on legacy code conversion	December 2019
Develop containerization solution architecture	May 2019
Standard stack: develop and validate 3 to 5 stack solutions	September 2019
Standard stack: deploy 3 to 5 standard stacks via automation	November 2019
Standard stack: develop and deploy additional standard stacks	April 2020

Source: Treasury Inspector General for Tax Administration's analysis of the IRS Integrated Modernization Business Plan and project documentation for NGI capabilities.

In December 2020, management in the Information Technology organization's Strategy and Planning Office instructed the NGI program to stop all work and take steps to perform an orderly shutdown. Programs were directed to assess the status of their in-progress capabilities to conduct an orderly shutdown or request additional resources to deliver a capability already significantly underway. The IRS deemed the containerization program important enough to continue on its own regardless of the existing shutdown of other NGI capabilities. As of August 2021, NGI program funding had not been restored. If funding is allocated to implement Phase 2 of the *IRS Integrated Modernization Business Plan* road map, NGI program capabilities planned to deploy include:

- Expand use of Development Operations to automate software delivery and infrastructure changes.

- Continue converting legacy code to modern languages.

Program Management Was Decentralized

No clear or comprehensive program management structure was established for the NGI program because the program relies upon five Information Technology functions to implement and manage capabilities. This decentralized approach makes it difficult to determine ultimate responsibility and accountability over the NGI program. The Internal Revenue Manual[2] defines an information technology program as a group of organizational or functionally related projects managed in a coordinated way to obtain benefits and control not available from managing them individually. A project is an information technology endeavor following a defined software development life cycle or an implementation schedule that has approved funding and staffing resources; can be planned, monitored, measured, and controlled; and directly results in a unique product for business functionality. Projects are responsible for regular performance reporting.

We found the NGI capabilities are managed and controlled by the following organizations:

- The Enterprise Program Management Office's Development and Operations team is responsible for the continuous integration/continuous delivery pipeline capability and the centralized code repository.

- The Enterprise Operations function's Server Support and Services Division is responsible for the standard stack capability.

- The Enterprise Operations function's Server Support and Services Division and the Enterprise Services function's Enterprise Architecture Office are responsible for developing the containerization solution architecture.

- The Applications Development function's Technical Integration Office is responsible for the legacy code conversion strategy.

The Internal Revenue Manual[3] states that each Program Management Office or equivalent function shall ensure that programs and projects within their organizations ensure that all metrics for their organizations are collected to determine the effectiveness of the items and contingency management activities. The Internal Revenue Manual states that the process will be reviewed regularly to ensure that it continues to support the business requirements of the enterprise. Process metrics will be focused on providing relevant information as opposed to merely presenting raw data. Roles and responsibilities for the process must be clearly defined and appropriately staffed with people having the required skills and training.

The management of NGI capabilities was inconsistent. Each of the capabilities were at different stages in developing and validating metrics. Formal charters clearly defining the executive sponsor role for the NGI program or the related NGI capabilities were not yet completed when funding was cut in Fiscal Year 2020. Because there was no formally defined NGI program charter, the metrics were not properly collected for the entire NGI program. Even when metrics were collected and reported, the metrics were not used for management decision making. In addition, the metrics for each of the capabilities did not tie into the overall objectives of the NGI program.

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[2] Internal Revenue Manual 2.172.1.6, *Enterprise Control Authority and Operations* (Apr. 21, 2021).

[3] Internal Revenue Manual 2.109.1.1.3, *Risk, Issue, and Action Item Management Practices, Risk, Issue, and Action Item Management Policy, Mandate* (Apr. 15, 2020).

The NGI program office did not monitor the implementation of all the capabilities. The decentralized structure of the program contributed to this issue. For example, NGI capabilities do not maintain formal risk registers, and NGI capabilities' project schedules are not reviewed or approved by the NGI program office. During our audit work, we notified NGI management that the continuous integration/continuous delivery pipeline project management plan did not follow the standardized project management template. The IRS acknowledged that the project plan was not in compliance and stated it would make necessary revisions.

While the *IRS Integrated Modernization Business Plan* monthly progress reports identified outcomes for NGI capabilities, the NGI program did not consistently monitor the performance of all of the implemented NGI capabilities. For example:

- The NGI program office was unable to provide supporting evidence to validate the implementation of NGI capabilities in a specific month and year for seven of the nine implemented NGI tasks. While the NGI program reports monthly according to the Information Technology Strategy and Planning Office template for the *IRS Integrated Modernization Business Plan*, maintaining historical implementation documentation was not a requirement. Therefore, the NGI program was unable to provide sufficient support to show specific implementation dates. The NGI program provided data files, screen shots, and user-prepared files to confirm the implemented capabilities; however, the IRS did not maintain evidence for when these capabilities were implemented.

- In December 2019, the IRS reported the legacy code conversion strategy[4] as complete; however, the legacy code conversion effort currently reports its progress outside of the NGI program on an annual basis for inclusion in the *Key Insights Report*. The Fiscal Year 2019 *Key Insights Report* dated February 2020 reported the legacy code conversion strategy as "On Track."

- In May 2019, the IRS reported the containerization solution architecture as complete. However, the containerization solution architecture we received in August 2021 was a draft version and was last updated in September 2018.

Effective program management helps the IRS to coordinate technology investments in a cost-effective and efficient manner and facilitates current accurate reporting.

Recommendation 1: The Chief Information Officer should ensure that the NGI program executive has centralized operational authority to manage capability implementation.

> **Management's Response:** The IRS agreed with this recommendation. The Chief Information Officer will ensure that the NGI program executive has centralized operational authority to manage capability implementation.

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[4] The *IRS Integrated Modernization Business Plan* provides the modernization strategy through Fiscal Year 2024. It also includes the Modernization Metric to retire 75 percent of legacy code.

Performance Metrics Were Not Linked to Overall Performance Measures

In the *Fiscal Year 2019 Key Insights Report,*[5] the IRS stated that performance objectives and outcomes aligned to modernization pillars will be reported annually to include baselines, interim progress, and targets. The report also stated that performance measures will continue to evolve as the modernization portfolio progresses and the IRS's performance management process matures. The categories for performance measures included cost containment, reliability and security, operational agility, and speed and efficiency. The *IRS Integrated Modernization Business Plan* also describes overall performance measures that include a definition, baseline, target, actual progress, and explanations for plans and potential shortfalls. The November 2020 *IRS Integrated Modernization Business Plan* monthly report states that clear outcomes and deliverables as well as timely progress reporting could help justify funding decisions.

The NGI program reports the progress of the implemented capabilities in the *IRS Integrated Modernization Business Plan* monthly reports, but the NGI program has not established performance metrics for all NGI capabilities and did not link the existing performance metrics with the overall modernization performance measures. For example, the IRS used a combination of expert opinion estimates and automated tools to provide information on internal processes for the continuous integration/continuous delivery pipeline and standard stack capabilities, but the NGI program is not using this information as a performance metric. In addition, the IRS is still in the process of developing return on investment measures for one of the NGI capabilities.

In its Fiscal Year 2019 funding request, the IRS requested $10.5 million and spent $9.8 million for the NGI program. In Fiscal Year 2020, the IRS requested $10 million for the NGI program, but received only $300,000. In Fiscal Year 2021, the IRS requested $16 million for the NGI program but received no direct funding. In Fiscal Year 2021, the funding source changed from Business Systems Modernization to Operations Support. The lack of a connection between the broader performance measures and the program performance metrics potentially contributed to this reduction in funding. Without consistent performance reporting, the IRS may be unable to deliver planned capabilities on schedule.

Recommendation 2: The Chief Information Officer should ensure that the NGI program establishes and links performance metrics to the *IRS Integrated Modernization Business Plan* in order to monitor and report on progress.

> **Management's Response:** The IRS agreed with this recommendation. The Chief Information Officer will develop and report on NGI metrics that align with the *IRS Integrated Modernization Business Plan*.

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[5] IRS, *Integrated Modernization Business Plan Fiscal Year 2019 Key Insights Report* (Feb. 2020).

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Appendix I

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Detailed Objective, Scope, and Methodology

The overall audit objective was to determine the progress of the NGI program. To accomplish our objective, we:

- Reviewed applicable Internal Revenue Manual, Enterprise Life Cycle, and Agile criteria for relevant information associated with metrics and performance identified in the NGI program.

- Interviewed Information Technology organization personnel and reviewed program documentation to evaluate NGI program implementation efforts against Federal Government criteria and agency requirements.

- Interviewed Information Technology organization personnel and reviewed program documentation to determine what has been added, deleted, or changed from the original *IRS Integrated Modernization Business Plan* for NGI program objectives and validated the status of the implemented NGI capabilities.

Performance of This Review

This review was performed with information obtained from the Office of the Chief Information Officer located in Lanham, Maryland, during the period October 2020 through August 2021. We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objective. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective.

Major contributors to the report were Danny Verneuille, Assistant Inspector General for Audit (Security and Information Technology Services); Jena Whitley, Director; Myron Gulley, Audit Manager; Charlene Elliston, Lead Auditor; and Benedict Kim, Senior Auditor.

Internal Controls Methodology

Internal controls relate to management's plans, methods, and procedures used to meet their mission, goals, and objectives. Internal controls include the processes and procedures for planning, organizing, directing, and controlling program operations. They include the systems for measuring, reporting, and monitoring program performance. We determined that the following internal controls were relevant to our audit objective: the IRS's policies and procedures for measuring and documenting NGI program performance and metrics and the *IRS Integrated Modernization Business Plan*. We evaluated these controls by interviewing IRS management and staff, reviewing data obtained from IRS systems supporting the completion of NGI program capabilities, and reviewing program documentation and metrics.

Appendix II

Management's Response to the Draft Report

DEPARTMENT OF THE TREASURY
INTERNAL REVENUE SERVICE
WASHINGTON, DC 20224

CHIEF INFORMATION OFFICER

November 4, 2021

MEMORANDUM FOR DEPUTY INSPECTOR GENERAL FOR AUDIT

FROM: Nancy A. Sieger   Nancy A. Sieger   Digitally signed by Nancy A. Sieger
               Chief Information Officer   Date: 2021.11.04 06:44:50 -04'00'
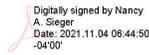
SUBJECT: Response to Draft Audit Report – Some Next Generation Information
               Technology Infrastructure Capabilities Were Implemented, but Program
               Management Improvements Are Needed (Audit# 202120019)

Thank you for the opportunity to review the draft audit report and meet with the audit
team to discuss early report observations. The Next Generation Infrastructure (NGI)
program has accelerated the implementation of new technologies that enable the IRS to
modernize its infrastructure and operations, including moving more quickly to the cloud
and more rapidly delivering new services.

We have delivered numerous improvements in recent years as part of the NGI program.
The implementation of DevOps Continuous Integration and Continuous Delivery
(CI/CD) Pipeline, Enterprise Container Platform and Standard Stack technology enable
the IRS to deploy applications to the cloud or on-premises more efficiently using the
same technology, which saves tens of thousands of hours of work time. In addition, we
are successfully transitioning to the Managed Infrastructure and Data Services (MIDS)
program, which provides vendor managed cloud-based and on-premises solutions for
storage and computing and enables the IRS to use the appropriate infrastructure based
on customer needs. We are also in the process of implementing the Virtual Desktop
Environment project, which will enable the IRS to support fewer laptops, as well as
repeatable and simpler deployments.

We agree with TIGTA's two recommendations and will continue to ensure that
governance and oversight are followed in accordance with the IRM and ELC processes.
Our corrective action plan is attached.

The IRS values TIGTA's continued support and assistance. If you have any questions,
please contact me at (202) 317-5000 or a member of your staff may contact Marci
Weiskott, Director, Technology Strategy Management, at (301) 452-8056.

Attachment

Attachment

Draft Audit Report – Some Next Generation Information Technology Infrastructure
Capabilities Were Implemented, but Program Management Improvements Are Needed
(Audit #202120019)

Recommendation 1: The Chief Information Officer should ensure that the NGI program
executive has centralized operational authority to manage capability implementation.

CORRECTIVE ACTION #1: The IRS agrees with the recommendation. The Chief
Information Officer will ensure that the NGI program executive has centralized
operational authority to manage capability implementation.

IMPLEMENTATION DATE:
March 15, 2022

RESPONSIBLE OFFICIAL(S): Associate Chief Information Officer, Enterprise Services

CORRECTIVE ACTION MONITORING PLAN:
The IRS will monitor this corrective action as part of our internal management system of
controls.

Recommendation 2: The Chief Information Officer should ensure that the NGI program
establishes and links performance metrics to the IRS Integrated Modernization
Business Plan in order to monitor and report on progress.

CORRECTIVE ACTION #1: The IRS agrees with the recommendation. The CIO will
develop and report on NGI metrics that align with the IRS Integrated Modernization
Business Plan.

IMPLEMENTATION DATE:
February 15, 2022

RESPONSIBLE OFFICIAL(S): Associate Chief Information Officer, Enterprise Services

CORRECTIVE ACTION MONITORING PLAN:
The IRS will monitor this corrective action as part of our internal management system of
controls.

Appendix III

Glossary of Terms

Term	Definition
Agile	An incremental process to build software that is characterized by the division of tasks into small batches of work and frequent reassessment and adaptation of plans developed in close collaboration with the customer.
Code Repository	A repository for active builds that have traceability from source code to deployed artifacts in controlled environments that also supports staging for testing and contains build artifacts destined for controlled environments.
Containerization	When an application is "containerized," the application is segregated or isolated from the underlying operating system. The container that holds the application only uses a few libraries from the underlying operating system. This isolation of the application now allows that application to run on any standard container platform, no matter the underlying operating systems being used.
Continuous Delivery	The ability to make changes of all types (including new features, configuration changes, or bug fixes) safely and quickly, in a sustainable way; aims to build, test, and release software faster and more frequently via team practices and delivery automation. Automates the entire software release process. Every revision that is committed triggers an automated flow that builds, tests, and then stages the update. The user triggers the deployment to a specific environment following the final decision to deploy.
Continuous Integration	The regular practice of merging all developers' working copies into a shared mainline once a day (or more). Continuous integration practices drive the pipeline, and the automated build (compile) verifies integrations (check-in) to detect integration errors and provide feedback as quickly as possible, reducing integration problems and speeding development of more cohesive software.
Enterprise Life Cycle	A standard approach to manage and implement business change through information systems initiatives. The Enterprise Life Cycle provides the direction, processes, tools, and assets necessary to accomplish business change in a consistent and repeatable manner.
Future State Computing	The envisioned long-range technology environment supporting the strategic IRS business direction and based on the IRS Enterprise Technology Blueprint. The Future State Computing Infrastructure envisions a more proactive and interactive relationship between taxpayers and IRS employees to improve taxpayer service, enforcement, and operations.
Legacy System	An information system that may be based on outdated technologies but is critical to day-to-day operations. In the context of computing, it refers to outdated computer systems, programming languages, or application software that are used instead of more modern alternatives.

Modernization Pillars	The strategies in the *IRS Integrated Modernization Business Plan* that are critical to the agency's mission and future development: taxpayer experience, core taxpayer services and enforcement, modernized IRS operations, and cybersecurity and data protection.
Next Generation Infrastructure	A series of packaged initiatives to support a more efficient, scalable, and flexible architecture implemented through advanced infrastructure tools and technologies, *e.g.*, standard stacks, enterprise storage solution.
Onboard	The process whereby the continuous integration/continuous delivery pipeline runs the code through a series of validations for security, code quality, and unit tests to make sure it meets all standards. At least once each day, all newly developed code is deployed to the development environment.
Standard Stack	A set of standardized software and server configurations used in the provisioning of systems, applications, and services in a rapid, repeatable fashion.

Appendix IV

Abbreviations

IRS	Internal Revenue Service
NGI	Next Generation Infrastructure

**To report fraud, waste, or abuse,
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By Web:

www.treasury.gov/tigta/

Or Write:

Treasury Inspector General for Tax Administration

P.O. Box 589

Ben Franklin Station

Washington, D.C. 20044-0589

Information you provide is confidential, and you may remain anonymous.