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Report to the Subcommittee on Transportation, and Housing and Urban Development, and Related Agencies, Committee on Appropriations, House of Representatives

September 2021

IT MODERNIZATION

HUD Needs to Improve Its Estimation and Oversight Practices for Single-Family Housing

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GAO Highlight

Highlights of GAO-21-459, a report to the Subcommittee on Transportation, and Housing and Urban Development, and Related Agencies, Committee on Appropriations, House of Representatives

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IT MODERNIZATION

HUD Needs to Improve Its Estimation and Oversight Practices for Single-Family Housing

Why GAO Did This Study

For many years, HUD has insured a portfolio of single-family mortgages worth over $1 trillion, relying on an outdated IT infrastructure and manual processes. HUD has made several unsuccessful attempts to modernize IT in the past, leaving it dependent on legacy systems. In April 2019, FHA and HUD's Office of the Chief Information Officer (OCIO), initiated FHA Catalyst.

GAO was requested to review HUD's single-family housing modernization program. This report examines (1) the extent to which HUD has implemented leading practices for managing requirements and identifying and mitigating risks for FHA Catalyst, (2) the reliability of the program's estimated costs and schedule, and (3) the extent to which HUD has established effective oversight for the program.

GAO compared FHA Catalyst documentation on requirements, risk, cost, schedule, and oversight to leading practices identified in the Capability Maturity Model Integration, and GAO's guides on cost, schedule, and investment management. GAO also interviewed FHA and OCIO officials.

What GAO Recommends

GAO is making eight recommendations to HUD to fully implement leading practices for managing requirements and mitigating risks, estimating cost and schedule, and conducting oversight. HUD concurred with the recommendations.

View GAO-21-459. For more information, contact Kevin Walsh at (202) 512-6151 or walshk@gao.gov.

What GAO Found

For the Federal Housing Administration (FHA) Catalyst program, the Department of Housing and Urban Development (HUD) substantially implemented leading practices for managing information technology (IT) requirements and risk management. The Catalyst program is intended to modernize the single-family housing loan life cycle and associated IT systems. Specifically, the department fully implemented two of four requirements management leading practices, and partially implemented the other two. For example, HUD established requirements and performed testing on all FHA Catalyst modules. However, the department did not document agreements among the project managers responsible for managing requirements or subject FHA Catalyst to an independent review to ensure modules were performing as expected. As a result, the FHA Catalyst program is at risk of not performing as intended or of not meeting requirements.

In addition, HUD established a risk management plan, and identified and analyzed risks to FHA Catalyst. However, HUD did not develop contingency plans for the identified risks. Without established contingency plans, the department could be unprepared to handle a critical risk, should one occur.

HUD developed cost and schedule estimates for the FHA Catalyst program that exhibited significant weaknesses in addressing leading practices for cost and schedule estimation and, therefore, were unreliable.

- According to GAO's *Cost Estimating and Assessment Guide*, the characteristics of a high-quality, reliable cost estimate are that it is comprehensive, well-documented, accurate, and credible. The FHA Catalyst cost estimate was unreliable because it partially addressed the "comprehensive" characteristic, minimally addressed the "well-documented" and "accurate" characteristics, and did not address the "credible" characteristic. For example, although the estimate included life-cycle costs, it did not include the cost of full-time government employees and infrastructure. Without a reliable cost estimate, the department faces an increased risk that the program will cost more than the planned $91.9 million.
- GAO's *Schedule Assessment Guide* states that a sound schedule estimate is comprehensive, well-constructed, credible, and controlled. The FHA Catalyst schedule was unreliable because it partially addressed the comprehensive, credible, and controlled characteristics, and did not address the well-constructed characteristic found in the guide. The absence of a reliable schedule estimate raises increased doubt that HUD will be able to complete the modernization by December 2023 as planned.

Although HUD took early action to establish FHA Catalyst oversight and partially implemented four related categories of leading practices, gaps exist in the established processes to oversee the program. These gaps include a lack of fully defined roles and responsibilities, and the absence of measures to assess performance. Accordingly, HUD lacks assurance that oversight will be performed and that decision makers have the information needed to monitor the program.

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Abbreviations

CMMI-DEV	Capability Maturity Model Integration–Development
ESC	Executive Steering Committee
HITM	Housing IT Modernization
HUD	U.S. Department of Housing and Urban Development
FHA	Federal Housing Administration
IT	information technology
ITIM	Information Technology Investment Management
IV&V	independent verification and validation
OCIO	Office of the Chief Information Officer

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September 29, 2021

The Honorable David E. Price
Chairman
The Honorable Mario Diaz-Balart
Ranking Member
Subcommittee on Transportation, and
Housing and Urban Development, and Related Agencies
Committee on Appropriations
House of Representatives

For many years, the Department of Housing and Urban Development (HUD) has relied on outdated information technology (IT) to insure a portfolio of over $1 trillion in single-family mortgages. Specifically, the department has operated its single-family housing programs by leveraging an outdated and inflexible infrastructure that relied on manual processes, lacked adequate data, and faced security weaknesses. At the same time, the department has experienced limited success with major IT modernization initiatives undertaken since 2010, leaving it dependent on its aging legacy systems that are expensive and difficult to maintain.

Successful modernization is critical to the department's continued progress in providing safe, affordable, and decent housing to the American people. Accordingly, through a new IT modernization program known as Federal Housing Administration (FHA) Catalyst, HUD plans to provide a more streamlined and flexible enterprise approach for enhancing its single-family housing IT systems and reducing the risks of operating with outdated legacy systems.[1]

At your request, we conducted a review of HUD's effort to modernize the IT systems that support its single-family housing programs. Our specific objectives were to (1) determine the extent to which HUD has implemented leading practices for managing requirements and identifying and mitigating risks to the single-family housing IT modernization program, (2) assess the reliability of the program's estimated costs and

[1]FHA is the HUD program office responsible for the single-family housing program and associated IT systems.

schedule, and (3) determine the extent to which HUD has established effective oversight for the program.

To address the first objective, we compared the IT modernization program's practices for managing requirements and identifying and mitigating risk to leading practices for requirements and risk management. To do so, we reviewed the Software Engineering Institute's Capability Maturity Model Integration-Development (CMMI-DEV) and identified those leading practices for requirements management and for risk management that applied to IT acquisitions and the incorporation of business needs into modernization programs.[2] This resulted in our selection of four leading practices for requirements management and two practices for risk management.

We then assessed FHA Catalyst requirements and risk documentation against the selected leading practices to determine the extent to which the department had implemented them. Specifically, we compared the requirements data and release notes for module requirements to the four selected practices for requirements management. In addition, we compared the FHA Catalyst risk register, risk management plan, testing requirements evidence, and other related risk documentation to the two selected practices for risk management.

We considered a practice to be fully implemented if HUD provided evidence that it fully satisfied the criteria defined in the selected leading practice. We considered a practice to be partially implemented if HUD provided evidence that satisfied some, but not all of the criteria. Lastly, we considered a practice to not be implemented if HUD did not provide evidence that satisfied any of the criteria.

To address the second objective, we assessed the reliability of the FHA Catalyst estimated costs and schedule by reviewing life-cycle cost estimates and program schedules for the modernization effort. In particular, we reviewed the August 2020 and February 2021 cost estimates and schedules for the program.[3]

[2]Software Engineering Institute (SEI) at Carnegie Mellon University, *CMMI® for Development (CMMI-DEV), Version 1.3* (Pittsburgh, Pa.: November 2010).

[3]We originally reviewed the August 2020 cost and schedule estimates. When HUD subsequently provided updated estimates as of February 2021, we updated our analyses to incorporate assessments of the updated estimates.

To assess the reliability of the August 2020 and February 2021 life-cycle cost estimates, we reviewed documentation supporting the estimate, such as the cost estimating methodology and the FHA Catalyst life-cycle cost summary. We then compared the cost estimating documentation to leading practices for developing a comprehensive, accurate, well-documented, and credible cost estimate, as identified in GAO's *Cost Estimating and Assessment Guide*.[4] We also interviewed HUD program officials responsible for developing and reviewing the cost estimates to understand their methodology, data, and approach for developing the estimates.

To assess the reliability of the August 2020 and February 2021 FHA Catalyst schedules, we reviewed documentation supporting the schedules. These documents included the integrated master schedule, the baseline schedule, and the schedule risk analysis. We then compared the schedule documentation to leading practices for developing a comprehensive, well-constructed, credible, and controlled schedule, as identified in GAO's *Schedule Assessment Guide*.[5]

For both the cost estimates and program schedules, we applied the standard rating scale used in GAO cost and schedule evaluations, assessing each leading practice as:

- **fully addressed—**HUD provided complete evidence that satisfied all the criteria;
- **substantially addressed—**HUD provided evidence that satisfied more than half of the criteria, but not all the criteria;
- **partially addressed—**HUD provided evidence that satisfied about half of the criteria;
- **minimally addressed—**HUD provided evidence that satisfied less than half of the criteria;
- **not addressed—**HUD did not provide evidence that satisfied any of the criteria.

[4]GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Program Costs*, GAO-20-195G (Washington, D.C.: Mar. 12, 2020).

[5]GAO, *Schedule Assessment Guide: Best Practices for Project Schedules*, GAO-16-89G (Washington, D.C.: Dec. 22, 2015).

To address the third objective, we identified leading practices for program oversight in GAO's *Information Technology Investment Management Guide,* the Software Engineering Institute's *CMMI-DEV, and GAO's Agile Assessment Guide*.[6] From these sources, we identified those practices for program oversight and performance measurement that were applicable to the modernization effort, based on the type of effort (e.g., Agile) and the oversight needed (e.g., contractor oversight).[7] This resulted in our selection of 12 practices. We then grouped the selected practices into four categories, based on the activities they require for program oversight: (1) plan for program oversight; (2) review and assess program performance; (3) take and manage corrective actions, as necessary; and (4) evaluate oversight practices.

Next, we reviewed HUD's plans and artifacts outlining the department's oversight and performance measurement practices, including the charter establishing oversight bodies for FHA Catalyst and the program's governance charter, among others. We also compared project management reviews and artifacts, such as the contractor project management plan and user manuals, to the department's standard IT governance processes.

We assessed the IT modernization program's oversight documentation and performance measurement practices against the 12 selected leading practices. For each practice, we compared HUD's documentation to the leading practice and evaluated whether the department's modernization plans included the implementation of specific features and types of content called for in the selected practices.

We considered a practice to be fully addressed if HUD's plans satisfied all of the criteria defined in the selected leading practice. We considered a practice to be partially addressed if HUD's plans satisfied some, but not

[6]GAO, *Information Technology Investment Management: A Framework for Assessing and Improving Process Maturity*, GAO-04-394G (Washington, D.C.: March 2004), *Agile Assessment Guide*: *Best Practices for Agile Adoption and Implementation,* GAO-20-590G (Washington, D.C.: Sept. 28, 2020), and *CMMI-DEV, Version 1.3*. We issued our Agile assessment guide in September 2020, after HUD had initiated FHA Catalyst. However, our Agile assessment guide is based on information from a variety of sources related to Agile adoption that were available when HUD initiated FHA Catalyst in April 2019.

[7]Agile software development is a framework for incremental development adopted by many federal agencies. Agile development describes an iterative process for managing software projects that focuses on continuous releases and incorporating customer feedback with each iteration.

all, of the criteria. Further, we considered a practice to not be addressed if HUD's plans did not satisfy any of the criteria.

For each of the objectives, we interviewed officials from HUD's headquarters in Washington, D.C. These officials included the General Deputy Assistant Secretary for Housing, as well as the Chief Information Officer (CIO), the Chief Digital Services Officer, and the Senior Advisor to the Chief Digital Services Officer in the department's Office of the Chief Information Officer (OCIO).

We determined that information provided by the department, such as requirements management data, risk data, and cost and schedule estimate data, were sufficiently reliable for the purposes of our review. To arrive at this assessment, we conducted reliability testing by corroborating statements from relevant department officials and comparing program documentation to program requirements management data, risk data, and cost and schedule estimate data to identify discrepancies. GAO cost and schedule estimation experts also assessed the reliability of the cost and schedule data and artifacts provided by the agency. Additional details about our objectives, scope, and methodology are discussed in appendix I.

We conducted this performance audit from April 2020 to September 2021 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 objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

HUD's mission is to create strong, sustainable, and inclusive communities, as well as provide access to livable rental properties, aid to renters, and financing for Americans to purchase high-quality, affordable homes, among other things. The department relies on five main organizational components to carry out its mission.[8] One of HUD's components—the Office of Housing (Housing)—has the lead

[8]The five main HUD organizational components are Community Planning and Development, Fair Housing and Equal Opportunity, Government National Mortgage Association (also known as Ginnie Mae), Housing, and Public and Indian Housing.

responsibility for improving access to housing. Programs within this office are responsible for contributing to building healthy communities, maintaining and expanding housing opportunities, and stabilizing credit markets in times of economic disruption.

This office also regulates certain aspects of the housing industry. For example, in July 2021, the department reported that Housing provides insurance on loans made by its approved lenders for 8 million single-family mortgages. In addition, FHA, which is operated by Housing, manages the effort to modernize HUD's single-family housing IT programs and systems.

Modernizing HUD's Single-Family Loan Life Cycle and System

The single-family loan life cycle involves three major functions: (1) origination and endorsement, (2) servicing, and (3) claims and disposition. These functions are collectively devised of 12 capabilities:

- The origination and endorsement function supports HUD in accepting and reviewing loan applications, performing credit underwriting, determining property valuation, managing loan closing, accepting documents delivered electronically, and submitting insurance applications for endorsement.
- The servicing function includes performing post-endorsement quality checks, actively servicing insured loans, providing portfolio reporting, and enabling loss mitigation to allow lenders to effectively work with delinquent borrowers to find solutions to avoid foreclosure.
- The claims and disposition function involves ingesting claims from different single-family housing loan programs and closing out records once records are complete.

In addition to the major functions listed above, lender management is also a part of the single-family loan life cycle. Lender management involves the processes HUD uses to approve, manage, and terminate lenders participating in single-family housing loan programs. The department activates these processes when necessary; lender management is not confined to any specific loan life-cycle function.

Processing HUD single-family housing loans involves a combination of legacy systems and manual processes. Specifically, as of 2018, HUD operated 25 single-family housing IT systems, some of which had

operated for an average of more than 18 years. Further, each function of the single-family loan life cycle involves paper-based processes. For example, the department maintains loan files in physical binders and transfers files to lenders through the United States Postal Service.

In 2018, HUD determined that its loan systems were far behind the technology improvements made by other entities in the housing industry. Accordingly, to address the challenges it faced in its single-family housing environment, the department took steps to modernize its loan processes and develop a new platform and IT systems to capture, process, and store extensive volumes of loan data.[9] Specifically, in April 2019, FHA, in coordination with the department's OCIO, initiated FHA Catalyst, a cloud-based IT program intended to modernize the single-family housing loan life cycle and associated systems.[10]

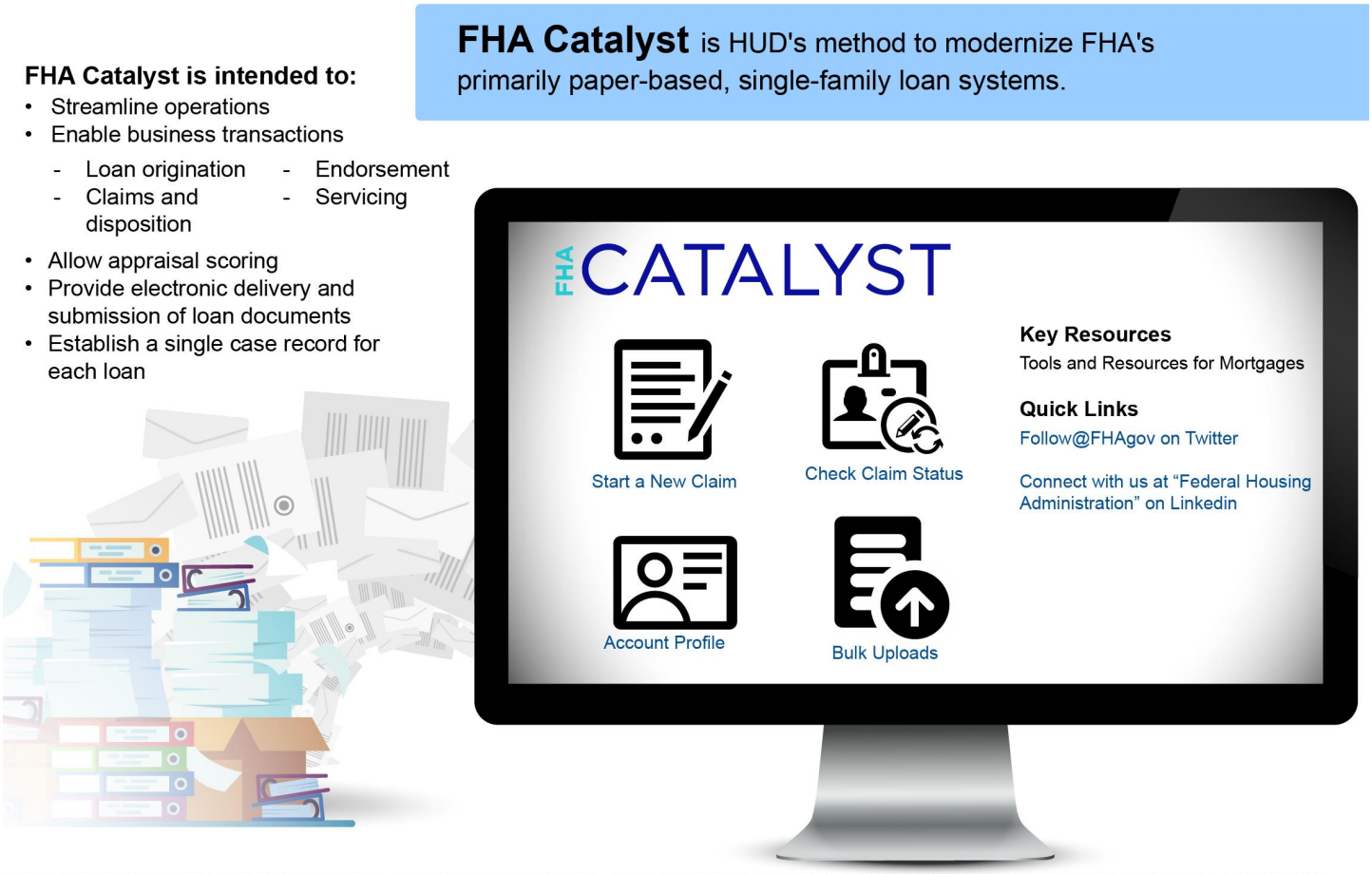
Through the FHA Catalyst program, HUD plans to modernize or enhance 15 of its 25 single-family housing systems into updated IT modules and functional components, while also adding technological efficiencies and integrating the department's information systems.[11] Figure 1 describes the functions HUD plans to provide through the development of the FHA Catalyst platform.

[9]The National Institute for Standards and Technology defines a platform as a virtual environment or a computer or hardware device and/or associated operating system, on which software can be installed or run.

[10]HUD refers to both the program intended to modernize the system, and the modernized platform, as FHA Catalyst.

[11]In 2018, OCIO completed a technical assessment of its current systems based upon various factors, including mission criticality, system usage, reliability and performance, business risk, ability to meet today's needs, flexibility to meet future demands, functional redundancy, and strategic alignment. As part of that assessment, OCIO identified a planned future state for single-family housing IT systems based on modernizing and enhancing 15 of its legacy systems.

Figure 1: Intended Functions of the Department of Housing and Urban Development's (HUD) Federal Housing Administration (FHA) Catalyst Platform



Source: Department of Housing and Urban Development, Federal Housing Administration, documentation; images: YummyBuum/stock.adobe.com; andrew_rybalko/stock.adobe.com. | GAO-21-459

HUD plans to develop the FHA Catalyst platform in three phases using Agile IT development methodologies.[12]

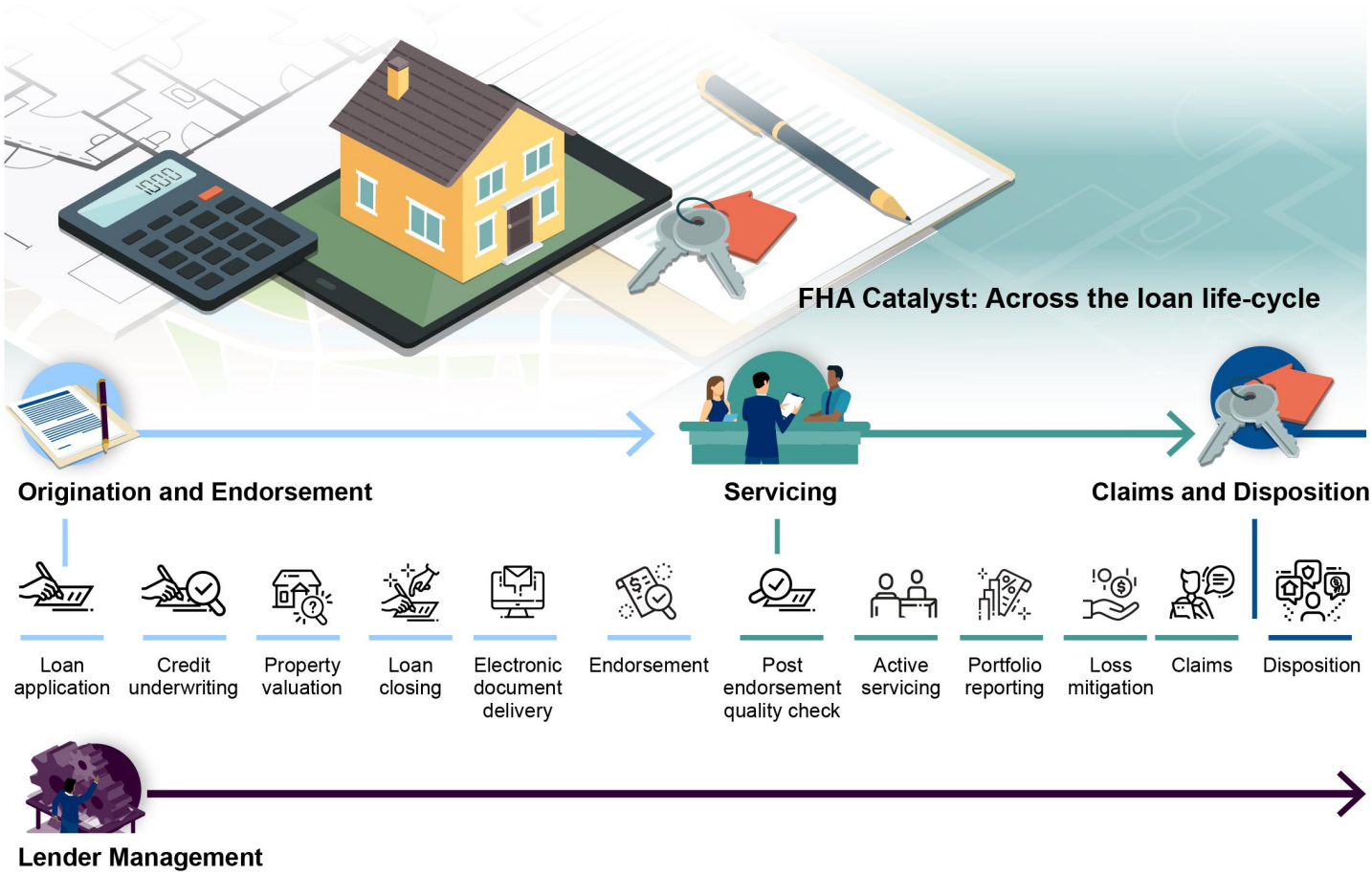
- In Phase 1, which was undertaken from April 2019 through March 2020, the department completed planning, design, five proofs of concept, and the initial operating capability for the platform.

[12]Agile software development is a framework for incremental development adopted by many federal agencies. Agile development describes an iterative process for managing software projects that focuses on continuous releases and incorporating customer feedback with each iteration.

- Phase 2, underway since April 2020 and planned for completion by April 2022, involves developing a loan portal and loan life-cycle components and migrating underlying infrastructure to the cloud.
- Phase 3, which HUD projects to begin in fiscal year 2022, is expected to develop any remaining components needed for single-family housing loans and complete the migration of all loan components to the cloud.

In October 2020, the department estimated that FHA Catalyst would cost $91.9 million over 5 years (including time elapsed since project initiation in April 2019). Figure 2 depicts the cloud-based single-family housing loan life cycle envisioned at the completion of the FHA Catalyst program.

Figure 2: Federal Housing Administration Single-Family Loan Life Cycle After Modernization through FHA Catalyst Program



Source: GAO analysis of Department of Housing and Urban Development data; images: elenabsl/stock.adobe.com, Feodora/stock.adobe.com, palau83/stock.adobe.com. | GAO-21-459

Note: Origination and Endorsement, Servicing, and Claims and Disposition represent the platform's major functions, which we have extended to show the various capabilities that occur within the FHA loan life cycle.

As of July 2021, the department reported that it had initiated development for all but two of FHA Catalyst's 13 planned capabilities and added requirements to the capabilities that were reported as complete in 2020. In addition, HUD reported it paused the development of seven capabilities in 2021, because the department had reached the FHA Catalyst contract ceiling. Table 1 shows the status of FHA Catalyst capability development, as of July 2021.

Table 1: Status of Federal Housing Administration (FHA) Catalyst Capability Development, reported as of July 2021

FHA Catalyst modules and components	Start date	Initial deployment (if applicable)	Planned completion date	Status
Origination and endorsement module				
Loan application	6/28/2019	10/30/2020	9/29/2023	Delayed. HUD reached the contract ceiling and paused this work until further notice.
Credit underwriting	5/14/2020	10/30/2020	9/29/2023	Delayed. HUD reached the contract ceiling and paused this work until further notice.
Property valuation	10/2/2019	8/28/2020	9/29/2023	Initially reported as complete on 8/28/2020, but additional requirements were added. This work is delayed. HUD reached the contract ceiling and paused this work until further notice.
Loan closing	11/2/2020	N/A	9/29/2023	Delayed. HUD reached the contract ceiling and paused this work until further notice.
Electronic document delivery	3/19/2020	4/3/2020	4/28/2023	Initially reported as complete on 4/3/2020, but additional requirements were added. This work is delayed. HUD reached the contract ceiling and paused this work until further notice.
Endorsement	11/2/2020	N/A	9/29/2023	Delayed. HUD reached the contract ceiling and paused this work until further notice.
Servicing module				
Post endorsement quality control	7/6/2020	N/A	9/29/2023	HUD may continue to modernize and develop data capabilities beyond this date.
Active servicing	7/6/2020	N/A	12/30/2022	HUD may continue to modernize and develop data capabilities beyond this date.
Portfolio reporting	7/6/2020	N/A	9/26/2021	HUD may continue to modernize and develop data capabilities beyond this date.
Loss mitigation and liquidation	10/4/2021	N/A	7/8/2023	Not started

FHA Catalyst modules and components	Start date	Initial deployment (if applicable)	Planned completion date	Status
Claims and disposition module				
Claims	7/1/2020	N/A	12/17/2021	HUD may continue to modernize and develop data capabilities beyond this date.
Disposition and post claim	10/23/2020	N/A	12/29/2023	Delayed. HUD reached the contract ceiling and paused this work until further notice.
Lender management module				
Lender management and recertification	3/06/2023	N/A	12/29/2023	Not started

Legend:
= Planned start or end dates that have occurred.
= Planned start or end dates that have not yet occurred.

Source: GAO analysis of Department of Housing and Urban Development data. | GAO-21-459

FHA Catalyst IT Oversight, Management, and Governance

As it relates to governance, HUD requires all IT projects to comply with policies that establish standard processes for managing and overseeing IT investments. Specifically, the department's IT governance policy stipulates that the policies and oversight by established IT governance boards applies to all HUD IT projects throughout their entire life cycles, regardless of funding source.[13] The department's IT governance boards are to oversee the selection, control, and evaluation of IT investments.[14] For example, the Customer Care Committee is charged with providing oversight for all IT investments. In addition, to comply with the standard project planning management processes, IT project managers submit plans and artifacts for review by the Technical Review Subcommittee.

In April 2019, the Office of Housing, in partnership with HUD's OCIO, created two additional governance bodies to manage and provide undivided oversight for initiatives designed to modernize housing IT systems, such as FHA Catalyst. The bodies are inclusive of staff from

[13]Department of Housing and Urban Development, *The Department of Housing and Urban Development Policy for Information Technology Governance*, HUD Handbook 3415.1 Revision 2.1 (Washington, D. C.: Feb. 9, 2021).

[14]The Customer Care Committee is the department's highest IT governance board. The committee, comprised of executives representing HUD's program and administrative support offices, develops policy and provides oversight for all IT investments. Other department-wide governance bodies include the Investment Review Subcommittee and Technical Review Subcommittee.

both, the department's Office of Housing and OCIO. The two bodies are responsible for the management and technical oversight of the FHA Catalyst program, including overseeing the work performed by a web-services vendor.[15] Specifically, these two bodies are the:

- ***Executive Steering Committee (ESC).*** Established to govern HUD's housing IT modernization efforts, the ESC's first oversight project is the modernization of the department's single-family housing IT. Led by HUD's General Deputy Assistant Secretary for Housing and the department's CIO, the committee is to direct and prioritize projects, monitor project performance, and resolve any issues that might impede the timely execution of the modernization efforts. The committee is also responsible for informing Congress and other stakeholders about the status of the IT modernization projects to ensure resources are secured for future phases.
- ***Housing IT Modernization (HITM) Team.*** HITM is responsible for guiding the modernization of housing systems identified and prioritized by the ESC in support of HUD's business processes. Additionally, HITM is responsible for identifying business needs and potential system solutions and for reporting this information to the ESC. The team works with the ESC to maintain quality control, manage established timelines, and ensure that modernization efforts meet program needs. Members of this body include the Chief Technology Officer, other staff members from OCIO, and three subject matter experts from the Office of Housing.

  According to HITM officials, the team is responsible for managing the day-to-day activities to develop FHA Catalyst. This includes, but is not limited to, identifying and developing requirements and identifying and mitigating risks to the program. In addition, HITM works with HUD's Chief Technology Officer to implement IT cloud services and architecture to accommodate and integrate legacy systems into fully automated processes for FHA Catalyst.

[15]According to HUD officials, the General Services Administration (GSA) handles acquisition management for FHA Catalyst. Specifically, GSA assisted HUD's contract team with the procurement of web services through a vendor. GSA works directly with the vendor on behalf of HUD and oversees the contract.

Federal Laws Govern IT Modernization

For over 40 years, Congress has enacted laws that specify requirements for federal agencies to develop, modernize, and enhance IT systems. For example:

- The *Paperwork Reduction Act* requires federal agencies to be accountable for their IT investments and responsible for maximizing the value of their investments and for managing the risks of their major information systems initiatives.[16]
- The provisions commonly referred to as *the Modernizing Government Technology Act* authorize funding mechanisms to aid the federal government's modernization of its IT systems. In particular, this law incentivizes cost savings through modernization and accelerates the acquisition and deployment of modernized IT solutions, such as cloud computing. The law established the Technology Modernization Fund to assist agencies in financing technology-related activities to, among other things, mitigate existing operational and security risks.[17]
- The consolidated appropriations acts of 2019 and 2020, respectively, required HUD to submit to Congress an expenditure plan for the development, modernization, and enhancement of its IT modernization activities.[18] The acts each specified that no more than 10 percent of the funds made available for HUD's IT modernization efforts in each of those fiscal years could be obligated until the HUD Secretary submitted an expenditure plan that identified each modernization project to the House and Senate Committees on Appropriations. In addition, the acts called for each plan to identify for each modernization project: (1) the functional and performance capabilities to be delivered and the mission benefits to be realized; (2) the estimated life-cycle cost; and (3) key milestones to be met, among other things.

[16]44 U.S.C. § 3506(h).

[17]Modernizing Government Technology provisions of the *National Defense Authorization Act for Fiscal Year 2018*, Pub. L. No. 115–91, div. A, title X, subtitle G, 131 Stat. 1283, 1586 (Dec. 12, 2017).

[18]See *Consolidated Appropriations Act, 2019*, Pub. L. No. 116-6, div. G, title II, 133 Stat. 13, 454 (Feb. 15, 2019); *Further Consolidated Appropriations Act, 2020*, Pub. L. No. 116-94, div. H, title II, 133 Stat. 2534, 2998 (Dec. 20, 2019).

Leading Practices Can Guide Organizations' IT Modernizations

We and the Software Engineering Institute have identified leading practices and guidance to assist in ensuring the proper management of IT modernization initiatives. For example:

- GAO's *Agile Assessment Guide* is intended to aid federal agencies, departments, and auditors in assessing an organization's readiness to adopt Agile software development methods.[19] The leading practices in this guide are high-level concepts of software development, contracting, and program management that highlight the aspects of Agile development throughout a program's life cycle and address key risks to an organization, program, or team.
- GAO's *Cost Estimating and Assessment Guide* establishes a consistent methodology based on 18 leading practices that can be used across the federal government for developing, managing, and evaluating program cost estimates for acquisitions and development efforts.[20] GAO grouped leading practices into the four characteristics of a reliable cost estimate—comprehensive, well-documented, accurate, and credible. The guidance considers an estimate reliable if it substantially or fully meets each of the characteristics of a reliable cost estimate.
- GAO's *Information Technology Investment Management* (ITIM) framework can be used both to assess the maturity of an agency's investment management processes and as a tool for organizational improvement.[21] The ITIM framework serves as a maturity model composed of five progressive stages that an agency can achieve in its IT investment management capabilities.

[19]GAO, *Agile Assessment Guide: Best Practices for Agile Adoption and Implementation*, GAO-20-590G (Washington, D.C.: Sept. 28, 2020). Agile is a type of incremental development, which calls for the rapid delivery of software in small, short increments rather than in the typically long, sequential phases of a traditional waterfall approach. Federal agencies have adopted Agile methods to help mitigate schedule and budget risks associated with IT modernization efforts. GAO finalized the portion of the criteria for Agile metrics derived from the Agile assessment guide after HUD had initiated FHA Catalyst.

[20]GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Program Costs*, GAO-20-195G (Washington, D.C.: Mar. 12, 2020).

[21]GAO, *Information Technology Investment Management: A Framework for Assessing and Improving Process Maturity*, GAO-04-394G (Washington, D.C.: March 2004).

- GAO's *Schedule Assessment Guide* presents 10 leading practices for scheduling.[22] Leading practices within this guide show that a well-planned schedule is a fundamental management tool that can help government programs use public funds effectively by specifying when to perform work in the future and measuring program performance against an approved plan. An integrated and reliable schedule can show when major events are expected as well as the completion dates for all activities leading up to them, which can help determine if the program's parameters are realistic and achievable.
- The Software Engineering Institute's Capability Maturity Model Integration (CMMI) provides guidance for improving an organization's processes and ability to manage the development, acquisition, and maintenance of products and services. The Software Engineering Institute published its CMMI Version 1.3 leading practices in three documents, also referred to as models—CMMI for Development,[23] CMMI for Acquisition,[24] and CMMI for Services.[25] Product teams developed these models with input from industry, government, and the Software Engineering Institute.

Prior HUD IT Modernization Efforts Faced Challenges

We have previously reported on the challenges the department faced during multiple IT modernization efforts. Though the department has taken steps to address many of our recommendations, work remains. Specifically,

- In July 2009, we reported that HUD had established key IT modernization controls to help ensure that its existing IT environment adequately supported its efforts to modernize IT systems; however, HUD had not fully implemented those controls.[26] Specifically, we reported that the department needed to strengthen its capacity to

[22]GAO, *Schedule Assessment Guide: Best Practices for Project Schedules*, GAO-16-89G (Washington, D.C.: Dec. 22, 2015).

[23]Software Engineering Institute (SEI) at Carnegie Mellon University, *CMMI® for Development (CMMI-DEV), Version 1.3* (Pittsburgh, Pa.: November 2010).

[24]Software Engineering Institute (SEI) at Carnegie Mellon University, *CMMI® for Acquisition (CMMI-ACQ), Version 1.3* (Pittsburgh, Pa.: November 2010).

[25]Software Engineering Institute (SEI) at Carnegie Mellon University, *CMMI® for Services (CMMI-SVC), Version 1.3* (Pittsburgh, Pa.: November 2010).

[26]GAO, *Information Technology: HUD Needs to Strengthen Its Capacity to Manage and Modernize Its Environment*, GAO-09-675 (Washington, D.C.: July 31, 2009).

manage and modernize its IT environment, including controls for strategic planning and performance measurement, investment management, and establishing responsibility and accountability for modernization management. We recommended that the Secretary of HUD strengthen the agency's IT management controls and complete the recommended steps to address shortcomings with each control. In response, the department implemented each of the recommendations by developing a new department-wide strategic plan, implementing practices to control the performance of its IT investment portfolio, and executing strategies to address IT workforce gaps.

- In a 2011 report on HUD's revised fiscal year 2010 expenditure plan, we noted that the plan identified the functional and performance capabilities, mission benefits, life-cycle costs, and key milestones for seven identified IT projects that supported the department's modernization efforts. However, the department had not established institutional commitment through an approved policy to guide the development, maintenance, and use of its IT enterprise architecture.[27] We recommended that HUD approve a policy to govern work to refine department-wide architecture prior to development. The department addressed this recommendation by updating its policy handbook, to include establishing a policy to define, maintain, and adhere to the department's approved enterprise architecture principles, procedures, and standards.
- In June 2013, we reported that HUD had not fully implemented key project management practices in areas of project planning, requirements management, and acquisition planning for its previous FHA Transformation Initiative.[28] As a result, we recommended that the department establish a plan of action to fully implement leading practices, provide needed project management expertise, and improve the development and use of its project management framework and governance structure.

  HUD implemented actions to address three of our four recommendations. Specifically, the agency updated its project planning and management templates and addressed deficiencies in project planning, requirements management, and acquisition

[27]GAO, *Information Technology: HUD's Expenditure Plan Satisfies Statutory Conditions, and Implementation of Management Controls Is Under Way*, GAO-11-762 (Washington, D.C.: Sept. 7, 2011).

[28]GAO, *Information Technology: HUD Needs to Improve Key Project Management Practices for Its Modernization Efforts,* GAO-13-455 (Washington, D.C.: June 12, 2013).

planning. In addition, the department directed its Customer Care Committee to review the roles and responsibilities of the technical review subcommittee.[29]

However, with regard to the one other recommendation, HUD contended that the need for project management expertise for FHA and other program office IT modernization initiative steering committees did not follow from the premises established in our report. Thus, the department opted not to take action to address the recommendation.

- In a February 2014 report on HUD's fiscal year 2013 IT expenditure plan, we noted that the plan satisfied the two sets of statutory conditions contained in the fiscal year 2013 appropriations act.[30] Specifically, the plan identified the functional and performance capabilities to be delivered, mission benefits, life-cycle costs, and key milestones for each project. In addition, the plan demonstrated that each project was in compliance with the department's enterprise architecture, was being managed in accordance with applicable life-cycle policies and guidance, conformed to capital planning and investment control requirements, and received support from an adequately staffed project office.

  However, the expenditure plan did not discuss the scope, implementation strategy, or schedule for HUD's modernization efforts or related projects beyond fiscal year 2013 funding. Further, the plan did not provide goals or measures for gauging the progress of the modernization efforts.

  We recommended that the Secretary of HUD direct the CIO to establish a means for evaluating progress toward institutionalizing management controls and to define its overall modernization approach to effectively oversee the efforts. The department addressed the first recommendation by revising its IT management framework to evaluate progress toward institutionalizing management controls. The department addressed the second recommendation by defining an overall modernization approach, including (1) outlining the scope, implementation strategy, and schedule for modernizing its

[29]The Customer Care Committee is the department's highest IT governance board. The committee, comprised of executives representing HUD's program and administrative support offices, develops policy and provides oversight for all IT investments.

[30]GAO, *Information Technology: HUD's Expenditure Plan Satisfied Statutory Conditions; Sustained Controls and Modernization Approach Needed,* GAO-14-283 (Washington, D.C.: Feb. 12, 2014).

environment and systems; and (2) in March 2021, providing draft performance measures for IT modernization efforts.

- In December 2014, we reported that HUD had not fully established its IT investment boards, policies, and procedures. In addition, we noted that the department's process for selecting investments lacked key elements, including practices for identifying, evaluating, and prioritizing proposed IT projects for funding. We also noted that HUD had not fully developed its process for overseeing investments. We made recommendations that HUD take action to improve its IT governance practices.[31] Specifically, we recommended that the executive board meet as outlined in its charter. We also recommended that the department improve its investment selection process to plan how data (including cost estimates) are to be developed, verified, and validated and establish criteria for how cost, schedule, and project risk are to be analyzed.

  Since that time, the department has revised its governance boards and issued new charters for them. Although the department disbanded the original executive board, the updated IT governance policy provides for IT investment review by the Deputy Secretary, a newly created investment review board, and the Customer Care Committee.[32] HUD has also taken action to improve its IT investment selection and oversight processes. However, as of July 2021, three of the five recommendations had not yet been addressed.

- In July 2016, we reported that HUD had initiated the New Core modernization program in 2013, which involved migrating financial management capabilities to a federal shared service provider, with expected benefits to include reducing legacy systems costs, improving financial data, and resolving weaknesses in its financial management systems.[33] HUD's efforts to implement New Core demonstrated weaknesses in the department's IT management and governance practices.

[31]GAO, *Information Technology: HUD Can Take Additional Actions to Improve Its Governance,* GAO-15-56 (Washington, D.C.: Dec. 10, 2014).

[32]Department of Housing and Urban Development, *The Department of Housing and Urban Development Policy for Information Technology Governance*, HUD Handbook 3415.1, Revision 2.1 (Washington, D. C.: Feb. 9, 2021).

[33]GAO, *Financial Management Systems: HUD Needs to Address Management and Governance Weaknesses That Jeopardize Its Modernization Efforts*, GAO-16-656 (Washington, D.C.: July 28, 2016).

After spending about $58 million over 3 years, the department decided to end New Core development in April 2016. We recommended that the department address weaknesses in key IT management practices for future financial systems modernization efforts and take action to improve its governance and strengthen investment oversight.

HUD neither agreed nor disagreed with our recommendations, but stated that it would improve management practices and governance for future efforts. In July 2020, the department began taking actions to address the recommendations. However, as of July 2021, the recommendations had not been fully implemented.

FHA Substantially Implemented Leading Practices for Requirements and Risk Management

For the FHA Catalyst program, HUD had substantially implemented leading practices in the areas of managing requirements and identifying and managing risk. For instance, the department used a commercially-available software tool to develop and manage FHA Catalyst requirements. HUD also validated and verified that approved program requirements were implemented and working appropriately, although the department did not engage an independent organization to conduct such a review. In addition, the department did not have documented agreements among the project managers responsible for managing requirements. Regarding risk management, the department identified internal and external risks through its risk register. However, HUD did not develop contingency plans for identified critical risks.

HUD Mostly Implemented Leading Practices for Managing Requirements

Leading practices for requirements management, outlined in the Software Engineering Institute's CMMI-DEV, emphasize the need to establish processes that include key practices for managing requirements.[34] The following four practices are key for managing program and product requirements.

[34]Software Engineering Institute, *CMMI-DEV, Version 1.3*.

- *Develop customer requirements*—Organizations should elicit, analyze, and establish customer product requirements. This activity includes transforming stakeholder needs into customer requirements.
- *Analyze requirements*—Organizations should analyze user requirements to determine a product's ability to satisfy stakeholders' expectations. This practice includes the development of functional analyses, such as roadmaps, to communicate how a product should perform.
- *Test requirements*—Organizations should select products for validation and verification and establish evaluation criteria (e.g., product standards, performance thresholds, proposals and agreements, and organizational policies) to ensure a product will fulfill its intended use when placed in its intended environment. Organizations should also validate and verify selected work products based on their relationship to end user needs to ensure products will meet specified requirements and fulfill the intended use. This includes subjecting a program to independent verification and validation (IV&V) to ensure that quality standards are being met.[35] Organizations should analyze the data resulting from verification and validation against the evaluation criteria.
- *Manage requirements*—Organizations should ensure that project leaders manage the set of approved requirements to support the planning and execution needs of the project. Further, this activity involves obtaining participant commitment, including documenting agreements among those who carry out activities necessary to implement requirements.

In its efforts to modernize its single-family systems, HUD fully implemented two of the selected leading practices and partially implemented the other two practices. Table 2 summarizes the extent to which the department implemented the four selected practices outlined in our review.

[35]The purpose of IV&V is to provide an independent review of system processes and products to ensure that quality standards are being met. The use of IV&V is a recognized best practice for system development and acquisition programs and involves an independent organization conducting unbiased reviews of processes, products, and results to verify and validate that they meet stated requirements and standards.

Table 2: Extent to Which HUD Implemented Selected Leading Practices for Managing Requirements for FHA Catalyst

Leading practices	Assessment	Summary of assessment
Develop customer requirements	Fully implemented	HUD elicited, analyzed, and established FHA Catalyst lender requirements using a commercially-available software tool. Specifically, the department elicited and established program requirements through discussions with program stakeholders. It then used a commercial tool to manage, analyze, and store those requirements.
Analyze requirements	Fully implemented	HUD analyzed system and lender requirements for product concepts that satisfied stakeholder needs, expectations, and constraints. For example, the department held recurring focus group meetings with lenders to obtain their requirements for FHA Catalyst. HUD used that information to develop functional analyses, such as roadmaps, to document requirements that addressed the identified needs and to communicate how FHA Catalyst products are expected to perform. HITM members, such as FHA Catalyst project managers and the HITM lead, documented the requirements and how officials addressed the requirements in FHA Catalyst module release notes.
Test requirements	Partially implemented	HUD selected all FHA Catalyst modules for verification and validation testing and established testing criteria for the verification and validation of FHA Catalyst modules. For example, the department performed a security scan of the program's Claims module that resulted in the identification of multiple web application security flaws. According to the HITM lead, the program corrected the security flaws identified prior to deploying the capability within FHA Catalyst. While HUD had performed and continues to perform verification and validation testing of FHA Catalyst modules, the program did not conduct an independent verification and validation (IV&V) review for FHA Catalyst, as required by its project oversight plan. Specifically, the plan states that the project will undergo IV&V review; however, the HITM housing team lead stated that the program does not have an IV&V contractor and did not plan to have an IV&V performed for FHA Catalyst.
Manage requirements	Partially implemented	HUD managed its requirements by using a project schedule to store specific details about the program's requirements. Project managers tracked product requirements within the project schedule and within a commercially-available software tool. However, HUD did not clearly document agreements with the project managers who are accountable for ensuring that the results of the FHA Catalyst platform address approved requirements.

HUD = Department of Housing and Urban Development.

FHA = Federal Housing Administration.

HITM = Housing Information Technology Modernization Team

Source: GAO analysis of Software Engineering Institute's *Capability Maturity Model Integration for Development, Version 1.3,* and Department of Housing and Urban Development data. | GAO-21-459

In commenting on the two partially implemented practices, the HITM team lead stated that the department decided not to have an IV&V performed for FHA Catalyst because of the ESC members' and HITM project managers close involvement in the oversight of FHA Catalyst module requirements.[36] Specifically, according to the official, members of the ESC (e.g., the General Deputy Assistant Secretary of Housing) coordinated with the project team to monitor the validation and verification process prior to module releases; therefore, an IV&V was not necessary.

[36]As noted previously, the ESC governs the department's housing IT modernization and is led by the department's General Deputy Assistant Secretary for Housing and CIO.

However, ESC involvement in module development does not provide the confidence that an unbiased review would if it had been conducted to determine if FHA Catalyst modules are performing as expected. By not subjecting FHA to an IV&V review, the department faces an increased risk of the modernized system having capabilities that do not perform properly in their intended environments, or that do not meet specified requirements. This could result in delays for module releases, cost overruns, and project schedule slips.

In addition, according to the HITM lead, project manager responsibilities are outlined in various slide presentations that document agreements with the project managers who are responsible for implementing approved requirements. For example, the HITM team provided various slide presentations to the ESC, which included key dates, milestones, and accomplishments; however, these slides did not document the agreements among those project managers who carry out activities necessary to implement requirements.

A lack of documented agreements between project managers, who are accountable for ensuring that approved FHA Catalyst requirements are implemented, could impair HUD's ability to manage its requirements. As requirements evolve, documenting responsibilities associated with requirements ensures that project participants commit to the current and approved requirements and the resulting changes in project plans, activities, and work products. Without documenting agreements detailing the responsibilities associated with managing requirements, HUD faces an increased risk that FHA Catalyst module functions will not align with the approved requirements.

HUD Implemented Leading Practices on Preparing for Risk Management, but Could Better Manage Contingency Planning

Risk management is a continuous, forward-looking process that is an important part of managing a project.[37] Effective risk management enables organizations to identify and address issues that could endanger the achievement of critical objectives. In addition, effective risk management allows organizations to anticipate and mitigate risks that can have a critical impact on a project. Early detection of risk is important

[37]Software Engineering Institute, *CMMI-DEV, Version 1.3.*

because it is typically easier, less costly, and less disruptive to make changes and correct work efforts during earlier phases of a project.

Leading practices for risk management, outlined in the Software Engineering Institute's CMMI-DEV, emphasize establishing processes that include key practices to help organizations identify potential problems and plan risk-handling activities across the life of the program. The following two selected activities are key for the management of program risks.

- *Prepare for risk management*—Organizations should establish and maintain a strategy for identifying, analyzing, and mitigating risks.
- *Identify and analyze risk*—Organizations should clearly identify and document internal and external risks throughout a project life cycle to bring management attention to risks that may impede the organization in meeting product requirements. Organizations should also evaluate risks and develop mitigation plans to document techniques and methods used to avoid, reduce, and control the probability of risk occurrence. In addition, organizations should develop contingency plans for identified high and unacceptable risks in order to determine the extent of potential damages should the risks occur.

HUD had fully implemented the activities associated with the selected leading practice of preparing for risk management and had partially implemented activities associated with the leading practice on identifying and analyzing risk. Table 3 summarizes the extent to which HUD had implemented the two leading practices for risk management.

Table 3: Extent to Which HUD Implemented Leading Practices for Risk Management for FHA Catalyst

Leading practices	Assessment	Summary of assessment
Prepare for risk management	Fully implemented	HUD established a risk management plan that defines the roles and responsibilities of FHA Catalyst stakeholders, as well as procedures for how to identify, analyze, and mitigate risks.
Identify and analyze risks	Partially implemented	HUD identified and documented both internal and external risks to FHA Catalyst within its risk register. The department also evaluated risks by identifying the probability of risk occurrence (e.g., high, medium, and low) and the level of impact for each risk. In addition, the department developed mitigation plans to avoid, reduce, and control the probability of risk occurrence. However, HUD had not developed contingency plans to define next steps for mitigation in the event that identified high risks should occur. For example, in August 2020, the department identified and documented a high impact/high occurrence risk related to validating requirements. As of July 2021, the risk remained open, and the department had not developed a contingency plan to examine its potential effects.

HUD = Department of Housing and Urban Development.

FHA = Federal Housing Administration.

Source: GAO analysis of Software Engineering Institute's *Capability Maturity Model Integration for Development, Version 1.3,* and Department of Housing and Urban Development data. | GAO-21-459

As noted in the table above, HUD had established a risk management plan and a risk register for identifying risk; however, the department had not developed contingency plans for the identified high risks to FHA Catalyst. In explaining the absence of contingency plans, the HITM lead told us that such plans should only be set up for high impact/high probably risks. Nevertheless, while the FHA Catalyst risk register showed that HUD had identified a high impact/high probably risk, the department did not develop a contingency plan for this high impact/high probability risk.

Developing contingency plans for critical risks is vital to enabling HUD to plan for the impact of risks that may occur. Without a contingency plan for identified critical risks, the department is in jeopardy of not being properly prepared to handle the damage that could be incurred, should those risks occur.

Cost and Schedule Estimates for FHA Catalyst Were Unreliable

HUD developed cost and schedule estimates for FHA Catalyst that exhibited significant weaknesses in addressing leading practices in cost and schedule estimation and were, therefore, unreliable. Specifically, the FHA Catalyst cost and schedule estimates did not substantially or fully

meet the attributes for any of the four characteristics of a reliable cost or schedule estimate.

HUD's Cost Estimate for FHA Catalyst Was Unreliable

Employing reliable cost estimates is crucial for realistic program planning, budgeting, and management. Cost estimates are necessary for government acquisition programs for many reasons, including to support decisions about funding one program over another, to develop annual budget requests, to evaluate resource requirements at key decision points, and to develop performance measurement baselines. Moreover, having a realistic estimate of projected costs makes for effective resource allocation, and it increases the probability of a program's success.

According to GAO's *Cost Estimating and Assessment Guide,* the four characteristics of a high-quality, reliable cost estimate are that it is comprehensive, well-documented, accurate, and credible.[38]

Comprehensive. A comprehensive cost estimate includes both government and contractor costs of the program over its full life cycle, from inception of the program through design, development, production, operations and maintenance, and disposal. The estimate reflects the current schedule and includes a documented technical baseline description that has been approved by management. The end product and major work of the program are documented in a work-breakdown structure that provides a framework for a variety of related activities like estimating costs, developing schedules, identifying resources, and determining where risks may occur.

Well-documented. A well-documented cost estimate can easily be repeated or updated and can be traced to original sources through auditing. Thorough documentation explicitly identifies the primary methods, calculations, results, rationales or assumptions, and sources of the data used to generate each cost element's estimate. Data contained in the estimate documentation should describe how the estimate was developed so that the estimate could be replicated. The technical data and assumptions in the cost estimate documentation are consistent with the technical baseline description. It should be evident that management

[38]GAO-20-195G.

was presented with a clear explanation of the cost estimate and how it was constructed so as to convey its level of competence.

Accurate. Using the best methodology to estimate each cost element from the data collected produces an accurate cost estimate. Validating that a cost estimate is accurate requires thoroughly understanding and investigating how the cost model was constructed. An accurate cost estimate is based on appropriate adjustments for inflation. The estimate's underlying mathematical formulas, databases, and inputs, should have been validated and the estimate should contain few, if any, minor mathematical mistakes. The estimate is updated regularly to reflect significant changes in the program. Any variances between estimated and actual costs are documented, explained, and reviewed. Finally, the estimate is based on a historical record of cost estimating and actual experiences from comparable programs to promote accuracy.

Credible. A credible cost estimate discusses and documents any limitations of the analysis, including risk and uncertainty or bias surrounding source data and assumptions. The estimate includes a sensitivity analysis that examines the effects of changing assumptions and ground rules. In addition, a credible cost estimate includes a risk and uncertainty analysis that determines the level of confidence associated with the estimate. Further, a high-value cost estimate is cross-checked with alternative estimating methodologies to validate results. Finally, the estimate is compared with an independent cost estimate conducted by a group outside the acquiring organization.

HUD's February 2021 cost estimate for FHA Catalyst was unreliable because it did not substantially address any of the four characteristics of a high-quality, reliable cost estimate. Specifically, the cost estimate partially addressed one characteristic (comprehensive), minimally addressed two characteristics (well-documented and accurate), and did not address the remaining characteristic (credible). Table 4 summarizes our assessment of HUD's cost estimate compared to leading practices for cost estimates.

Table 4: Assessment of the FHA Catalyst Cost Estimate Compared to Leading Practices for Cost Estimates, as of February 2021

Reliable cost estimate characteristics	Assessment	Leading practices	Description of assessment
Comprehensive	Partially addressed	Includes all life-cycle costs.	The estimate included some, but not all, life-cycle costs associated with FHA Catalyst. For example, the estimate did not provide details on the costs associated with the program's operating phase. In addition, the estimate excluded full-time government employees and infrastructure costs. If the cost estimate is missing some cost elements, the total cost will be underestimated and risks and uncertainty associated for missing elements will not be accounted for in a quantitative risk and uncertainty analysis. As a result, the estimate may not be credible.
		Completely defines the program and reflects the current schedule and technical baseline.	The FHA Catalyst cost estimate was based on a technical baseline description developed by OCIO, which covered three phases of Agile development and deployment. However, the technical baseline did not reflect that HUD's chief technology officer had approved it, as recommended.
		Incorporates a work-breakdown structure (WBS) with sufficient detail to ensure that cost elements are neither omitted nor double-counted.	HUD did not provide any documentation related to the use of a WBS. Without a WBS, the program lacks a framework to develop a schedule and cost plan that can easily track technical accomplishments—in terms of resources spent in relation to the plan, as well as completion of activities and tasks.
		Ensures that cost-influencing assumptions and ground rules on which the estimate is based are identified and documented.	FHA Catalyst's cost estimate documentation included ground rules and assumptions. However, HUD officials responsible for the cost estimate did not trace the risks associated with the ground rules and assumptions to specific WBS elements, nor did the officials use the ground rules and assumptions as inputs for any sensitivity and uncertainty analyses. Unless assumptions are documented with their sources and supporting historical data, decision-makers will not understand the level of certainty around the assumption or the cost estimate.
Well-documented	Minimally addressed	Shows the source data used, the reliability of the data, and the estimating methodology used to derive each element's cost.	The department did not provide documentation to support the methodology used to develop the estimate, nor did it provide documentation explaining operation, maintenance, and licensing costs. Instead, HUD officials responsible for the FHA Catalyst cost estimate explained their use of methods that considered technical characteristics of the software under development, followed by applying an inflation index. However, without good documentation, the project team lacks a basis to provide a convincing and credible estimate; supporting data may not be available for creating a historical database; questions about the approach or data used to create the estimate may not be answered; lessons learned and a history for tracking why costs changed may not be recorded; and the scope of the analysis may not be defined.

Reliable cost estimate characteristics	Assessment	Leading practices	Description of assessment
		Describes how the estimate was developed so that a cost analyst unfamiliar with the program could understand what was done and replicate it.	HUD did not provide documentation supporting the cost estimate development phase of the program. According to the GAO cost estimation guide, unless a cost estimate is fully documented, it will not support an effective independent review or reconciliation with an independent cost estimate, hindering the understanding of any differences and the ability of decision-makers to make informed decisions.
		Discusses the technical baseline description and the data in the technical baseline are consistent with the cost estimate.	The FHA Catalyst expenditure plan lacked a detailed technical baseline that described the work to be performed. Without a technical baseline, the cost estimate may not be based on a comprehensive program description and will lack specific information regarding technical and program risks.
		Provides evidence that the cost estimate was reviewed and accepted by management.	The chief information officer approved the FHA Catalyst expenditure plan. In addition, department officials responsible for the FHA Catalyst cost estimate stated that they presented the estimate to the chief information officer for approval of the expenditure plan. However, the briefing to the chief information officer did not include a description of the estimating method and data sources for each WBS element. If management is not presented with sufficient information about how the estimate was constructed—including the specific details about the program's technical characteristics, assumptions, data, cost estimating methodologies, sensitivity, and risk and uncertainty—management may not have confidence that the estimate is complete and high in quality.
Accurate	Minimally addressed	Developed by estimating each WBS element using the best methodology from the data collected.	HUD did not provide documentation for us to verify its estimating methods. Rather, department officials responsible for FHA Catalyst reported that, to arrive at the program's estimated cost, they relied on cost information from similar systems as well as methods that consider technical characteristics of the software under development.
		Adjusted properly for inflation.	HUD officials responsible for the cost estimate stated that they adjusted the estimate for inflation; however the officials did not provide documentation showing how they did so.
		Contains few, if any, minor mistakes.	We were unable to validate the estimate because HUD did not provide a detailed cost estimate showing calculations. Validating that a cost estimate is accurate requires thoroughly understanding and investigating how the cost model was constructed. Cost models with limited details complicate the ability to determine if all WBS cost estimate calculations are accurate and account for all costs.
		Regularly updated to reflect program changes and actual costs.	Although the department updated the cost estimate between November 2019 and February 2020, and again in October 2020, the update did not include documentation that explained changes to program costs. If the estimate is not updated to include explanation of changes, it will be difficult to analyze changes in program costs, and collecting cost and technical data to support future estimates will be hindered. Therefore, the cost estimate may not provide decision-makers with accurate information for assessing alternative decisions.

Reliable cost estimate characteristics	Assessment	Leading practices	Description of assessment
		Variances between planned and actual costs are documented, explained, and reviewed.	The department reported incurred costs to date in its performance plans, but did not explain variances between planned and actual costs.
		Based on a historical record of cost estimating and actual experiences from other comparable programs.	Department officials did not provide evidence showing how they used historical program costs to inform the FHA Catalyst cost estimate. A lack of historical data will leave the cost estimator without insight into actual costs of similar programs, including any cost growth since the original estimate.
Credible	Not addressed	Includes a sensitivity analysis that identifies a range of possible costs based on varying major assumptions, parameters, and data inputs.	HUD did not perform a sensitivity analysis. Without a sensitivity analysis that reveals how the cost estimate is affected by a change in a single factor, stakeholders may not fully understand which variable most affects the cost estimate. An agency that fails to conduct a sensitivity analysis to identify the effect of uncertainties associated with different assumptions increases the chance that decisions will be made without a clear understanding of these impacts on costs.
		Includes a risk and uncertainty analysis to quantify the imperfectly understood risks and identify the effects of changing key cost driver assumptions and factors.	HUD did not perform a risk and uncertainty analysis. Without a risk and uncertainty analysis, the program estimate will not reflect the degree of uncertainty, and a level of confidence cannot be given about the estimate.
		Cross-checked major costs to see if results were similar.	The department did not cross-check major cost elements. Unless an estimate employs cross-checks, the estimate will have less credibility because stakeholders will have no assurance that alternative estimating methodologies produced similar results.
		Included an independent cost estimate by a group outside the acquiring organization to determine whether other estimating methods produce similar results.	HUD did not have another entity perform an independent cost estimate to determine whether other estimating methods produce similar results. A program estimate that has not been reconciled with an independent cost estimate has an increased risk of proceeding underfunded because an independent cost estimate provides an objective and unbiased assessment of whether the program estimate can be achieved.

HUD = Department of Housing and Urban Development.

FHA = Federal Housing Administration.

Source: GAO analysis of Federal Housing Administration data and GAO, *Cost Estimation and Assessment Guide: Best Practices for Developing and Managing Program Costs*, GAO-20-195G (Washington, D.C.: March 2020) | GAO-21-459

A significant reason for the deficiencies identified in the FHA Catalyst cost estimate is the department's lack of guidance for developing cost estimates that incorporate the four characteristics of a reliable cost estimate. In 2017, we reported that HUD needed to address significant

weaknesses in its cost estimation practices.[39] Specifically, we reported that the department's cost estimates for each of the four selected investments were unreliable and did not meet the best practices associated with the four characteristics. The weaknesses identified were attributed to the lack of guidance for developing cost estimates, including a requirement for incorporating best practices identified by GAO. Accordingly, we made a related recommendation that the department finalize and ensure the implementation of cost estimation guidance. Although HUD has made progress towards implementing our recommendation, HUD has not published agency-wide cost estimation guidance.

According to the Chief of IT Portfolio Management within HUD's OCIO, the department did not have formal, approved cost estimation guidance when HUD had created the estimate for FHA Catalyst. However, the official said that the OCIO was in the process of developing agency-wide cost estimation guidance. As of July 2021, the OCIO had created a plan of action and milestones for developing the guidance and a cost estimation process. Nonetheless, OCIO officials were unsure of an estimated completion date. Moreover, according to HITM officials, neither the HITM nor OCIO had clear responsibility for developing the program's cost estimate. In June 2021, officials from FHA and the HUD OCIO stated that they planned to meet to clarify responsibility for this task going forward.

As we reported in 2017, it is imperative that HUD develop and ensure the implementation of cost estimation guidance that incorporates the best practices called for in the GAO Cost Estimating and Assessment Guide.[40] Until it develops and employs agency-wide cost estimation guidance that reflects the four characteristics of a high-quality, reliable estimate and updates the cost estimate for FHA Catalyst, the department risks being unable to effectively estimate future funding needs for FHA Catalyst and risks using unreliable data to make budgetary decisions. As such, the department faces an increased risk of cost overruns and unmet performance targets for the remaining FHA Catalyst work and for the operations and maintenance cost forecast.

[39]GAO, *Information Technology: HUD Needs to Address Significant Weaknesses in Its Cost Estimating Practices*, GAO-17-281 (Washington, D.C.: Feb. 7, 2017).

[40]GAO-17-281.

HUD's Schedule Estimate for FHA Catalyst Was Unreliable

The success of a program depends, in part, on having an integrated and reliable master schedule. The schedule provides not only a roadmap for project execution, but also the means by which to gauge progress, identify and resolve potential problems, and promote accountability at all levels of the program. Among other things, scheduling allows program management to decide between possible sequences of activities, determine the flexibility of the schedule according to available resources, predict the consequences of managerial action or inaction on events, and allocate contingency plans to mitigate risks.

According to the GAO Schedule Assessment Guide, a reliable schedule estimate is comprehensive, well-constructed, credible, and controlled.[41]

Comprehensive. A comprehensive schedule includes all activities for both the government and its contractors that are necessary to accomplish a program's objectives, as defined in the program's work breakdown structure. The schedule includes the labor, materials, travel, facilities, equipment, and other items needed to do the work and depicts when those resources are needed and when they will be available. Durations should be reasonably short, meaningful, and directly tied to task calendars that include special non-work days, such as holidays.

Well-constructed. A schedule is well-constructed if all its activities are logically sequenced with the most straightforward logic possible. Unusual or complicated logic techniques are used judiciously and justified in the schedule documentation. The schedule's critical path represents a true model of the activities that drive the program's earliest completion date, and total float accurately depicts schedule flexibility.[42]

Credible. A schedule is credible if it is horizontally traceable—that is, it reflects the order of events necessary to achieve aggregated products or outcomes. It is also vertically traceable, meaning that activities in varying levels of the schedule map to one another and key dates presented to management in periodic briefings are in sync with the schedule. Data about risks are used to predict a level of confidence in meeting the

[41]GAO-16-89G.

[42]Total float is the amount of time an activity can slip before the program's end date is affected.

program's completion date. Necessary schedule contingencies and high-priority risks are identified by conducting a robust schedule risk analysis.

Controlled. A controlled schedule is regularly updated by trained schedulers using actual progress and logic to realistically forecast dates for program activities. A schedule narrative that describes salient changes to the network accompanies updates to the schedule. The current schedule is compared against a designated baseline schedule to measure, monitor, and report the program's progress. The baseline schedule is accompanied by a basis document that explains the overall approach to the program, defines ground rules and assumptions, and describes the unique features of the schedule. The baseline schedule and current schedule are subjected to configuration management control.

FHA Catalyst's February 2021 schedule was not reliable because it did not substantially address any of the four characteristics of a reliable schedule estimate. The schedule partially addressed three of four characteristics of a reliable schedule—comprehensive, credible, and controlled—and did not address the remaining characteristic—well-constructed. Table 5 summarizes our assessment of HUD's schedule compared to leading practices for schedules.

Table 5: Assessment of the FHA Catalyst Project Schedule Compared to Leading Practices for Schedules, as of February 2021

Reliable schedule characteristics	Assessment	Leading practices	Summary of assessment
Comprehensive	Partially addressed	Captures all activities.	The schedule included efforts through the life of the program, including, but not limited to, efforts related to program initiation, oversight, and modernization. However, activities in the schedule were not aligned to a work breakdown structure (WBS). Unless the schedule is aligned to a program WBS, management cannot ensure that the total scope of work is accounted for within the schedule.
		Assigns resources to all activities.	HUD provided organization names within the schedule's resource list. However, the schedule did not specify the resources needed, such as labor, materials, facilities, and other items needed to complete schedule activities. Including resources in a schedule helps management compute total labor and equipment hours, calculate total project and per-period cost, and resolve resource conflicts.
		Establishes durations of all activities.	Activity durations in HUD's schedule were generally short enough to be effectively managed. However, we could not determine if the durations were meaningful, because the department did not provide a basis of estimate for durations in the schedule. The basis of estimate is the connection between cost and time and should be kept up-to-date as assumptions change. If durations, resources, or productivity rates change, the cost is also likely to change, and they need to be coordinated. In addition, the standard schedule calendar had no standard workdays marked as holidays. Ensuring realistic calendars provides for more accurate dates and may reveal opportunities to advance the work.
Well-constructed	Not addressed	Sequences all activities.	The department's schedule did not follow leading practices. For example, the schedule included a significant number of activities that were missing logic. Identifying interdependencies between activities is necessary for the schedule to properly calculate dates and predict changes in the future. In addition, the schedule included hard date constraints. Date constraints prevent activities from responding to network logic, including actual progress and availability of resources.
		Confirms that the critical path is valid.	We could not determine a valid critical path within HUD's schedule for FHA Catalyst. The department had identified all activities in the schedule as critical, which obscured the true sequence of discrete work activities that determine the finish date of the project. Without a valid critical path, management cannot focus on activities that will detrimentally affect the key program milestones and deliveries if they slip.
		Ensures reasonable total float.	Because the schedule included a high number of critical activities, there was no total float available; that is, HUD would have to complete all tasks on time in order for the project to be completed on time. Too little float built into the schedule may indicate insufficient time to recover from delay without the program's completion date slipping.

Reliable schedule characteristics	Assessment	Leading practices	Summary of assessment
Credible	Partially addressed	Can be horizontally and vertically traced.	The schedule partially provided horizontal and vertical traceability.[a] Specifically, the schedule's horizontal traceability suffered from missing logic links that would transfer delays and accelerations throughout the schedule network. We were able to match selected dates between the current schedule and related program management documents; however, the lack of a WBS makes matching deliverables and dates between documents difficult.
		Conducted a robust schedule risk analysis.	HUD did not conduct a schedule risk analysis for FHA Catalyst. Specifically, HITM officials provided a spreadsheet that qualitatively linked risks to task durations, but the department did not document the probability of the occurrence of those risks or their likely effects on durations. In addition, the schedule was not able to support a valid risk simulation. If a schedule risk analysis is not performed, management cannot determine the likelihood of meeting the set completion date or the contingency needed to provide an acceptable level of certainty for completion by a specific date.
Controlled	Partially addressed	Updated regularly, using actual progress and logic.	HITM officials responsible for schedule estimation stated that they update the FHA Catalyst schedule weekly, but the schedule provided to us did not have a status date, as of February 2021. Assuming a status date of the end of the prior month, the schedule provided to us included a significant number of activities with planned start and finish dates that were in the past, but the activities had not been performed. According to the GAO schedule guide, a schedule narrative should accompany the updated schedule to provide decision makers and auditors a log of changes and their effect, if any, on the schedule time.
		Maintains a baseline schedule.	HUD provided a baseline schedule from May 2019, but because baseline dates were not stored in the current version of the schedule, variances could not be easily calculated. It was not clear to what extent changes are documented, monitored, or approved between schedule versions and the baseline. According to GAO's schedule guide, a schedule should be continually monitored so as to reveal when forecasted completion dates differ from baseline dates and whether schedule variances affect downstream work.

HUD = Department of Housing and Urban Development.

HITM = Housing Information Technology Modernization Team

FHA = Federal Housing Administration.

Source: GAO analysis of Federal Housing Administration data and GAO, *Schedule Assessment Guide: Best Practices for Project Schedules*, GAO-16-89G (Washington, D.C.: Dec. 22, 2015). | GAO-21-459

[a]Horizontal traceability demonstrates that the overall schedule is rational, has been planned in a logical sequence, accounts for the interdependence of details activities and planning packages, and provides a way to evaluate current status. Vertical traceability demonstrates the consistency of dates, status, and scope requirements between different levels of a schedule—summary, intermediate, and detailed.

Shortcomings in the FHA Catalyst schedule are due to the lack of schedule estimation guidance employed by the agency. An HITM project manager acknowledged that there is no schedule guidance but noted that the department plans to use FHA Catalyst's schedule as a guide for future modernizations. The official also stated that the schedule shortcomings are also due to the learning curve associated with

managing an Agile project development instead of the traditional waterfall approach to project development.

Without action to develop and implement schedule estimation guidance that reflects GAO's schedule estimation best practices, the department faces an increased risk of uncertainty in determining the duration of FHA Catalyst. Further, until HUD revises the FHA Catalyst schedule according to the newly developed guidance, HUD runs the risk of taking longer than planned to develop FHA Catalyst. Without a reliable schedule, department leadership will be limited in its ability to make informed decisions on the program's future. Such uncertainty can cause schedule slippages and increased project costs.

Gaps in Established Processes Could Limit Effectiveness of FHA Catalyst Oversight

Leading practices for program oversight, outlined in GAO's ITIM and Agile assessment guides and the Software Engineering Institute's CMMI-DEV, emphasize, among other things, establishing processes that incorporate key practices for program oversight.[43] The practices fit into four general categories: (1) plan for program oversight; (2) review and assess program performance; (3) take and manage corrective actions, as necessary; and (4) evaluate oversight practices. Table 6 outlines the categories and selected practices designed to ensure effective oversight and performance measurement.

[43]GAO-04-394G, GAO-20-590G, and Software Engineering Institute, *CMMI-DEV, Version 1.3*.

Table 6: Leading Practices for Program Oversight and Performance Measurement

Category	Leading practices for program oversight and performance measurement
Plan for program oversight	• Establish processes (e.g., policies and procedures, plans, or standards) incorporating leading practices for program oversight and performance measurement. • Require program oversight, at least at the major life-cycle milestones. • Outline the roles of and assign responsibilities to different parties involved in overseeing the program and its performance, including ensuring oversight is objective. • Identify data needed to support decision-making and oversight and ensure data are sufficient, of high quality, and complete.

Review and assess program performance	• Establish baselines for monitoring progress toward commitments, including:
	  • evaluating actual cost and schedule progression (i.e., earned value management) to render an approximate value of the project to the organization;
	  • analyzing benefits delivered to date compared with enumerated potential benefits in the project's business case;
	  • providing adequate resources—people, funding, and tools—for information technology (IT) project oversight; and
	  • managing the program to limit changes in scope, such as increasing functionality (i.e., scope creep).
	• Require metrics for assessing Agile performance, including those:
	  • tailored based on a program's needs;
	  • focused on technical management, program management, and Agile methods;
	  • connected to strategic goals and objectives;
	  • focused on assessing product quality and performance;
	  • focused on measuring team performance and adherence to Agile development leading practices; and
	  • captured and displayed in real time by automated tools.
	• Oversee contractor performance, including determining the type and depth of oversight to perform and evaluation criteria to apply.
	• Ensure that performance measurements for Agile-based development efforts balance periodic program-wide health assessments, such as those performed in the department's IT governance process, with monitoring progress made deploying capabilities.

Take and manage corrective actions, as necessary	• Define deviations from the project plan that require corrective action. • Outline how corrective actions will occur.
Evaluate oversight practices	• Assess the types of decisions made and the degree to which they have been implemented. • Review the extent to which the oversight performed conforms to established IT governance practices.

Source: GAO analysis of leading practices from GAO's IT investment management guide (GAO-04-394G), Agile Assessment Guide (GAO-20-590G), and the Software Engineering Institute's *Capability Maturity Model Integration - Development, Version 1.3.* | GAO-21-459

While HUD had established processes (e.g., policies and procedures, plans, or standards) for overseeing the FHA Catalyst program and its performance, as of July 2021, the department had not fully addressed any of the four categories of leading practices.

- ***Plan for program oversight.*** HUD addressed one and partially addressed three practices in this category. Specifically, HUD relied on the governance bodies that it created to manage and provide oversight for its IT modernization initiatives. In this regard, HITM served as the project team for FHA Catalyst, and the ESC was the oversight committee for the initiative.

  HUD partially addressed other practices in this category. For example, the ESC partially established processes (e.g., policies and procedures, plans, or standards) incorporating leading practices for program oversight and performance measurement. Specifically, FHA Catalyst oversight plans defined and standardized certain processes, such as documenting a schedule for required weekly oversight meetings and a template for HITM to document the weekly oversight meetings. However, HUD did not provide any reports or other documentation for the monthly performance reporting meetings required by FHA Catalyst plans.

  In addition, FHA Catalyst plans did not fully address the best practices outlined in HUD's project oversight requirements. For example, as previously mentioned, HUD's project planning and management process requires IV&V plans for all IT programs; however, the department did not produce plans outlining the requirements for independent review of FHA Catalyst.

  Further, HUD did not consistently follow the practices defined for overseeing FHA Catalyst. Specifically, the department did not schedule all planned reviews by the Technical Review Subcommittee (e.g., reviews of each release's plans and readiness for deployment). Moreover, the ESC did not consistently meet weekly as required in FHA Catalyst program plans and as planned in the program schedule. According to HUD officials involved in managing the program, the ESC only cancelled meetings if most of the members had a conflict or for holiday/office closures. However, we found that ESC cancelled 17 of 42 planned meetings considered for our sample of meeting minutes. Notably, only five of those 17 meetings occurred near federal holidays.

  In addition, the plans partially addressed the practice of outlining roles and responsibilities for oversight and performance measurement and ensuring oversight is objective. For example, HUD planned for meeting minutes to provide a way to track attendance of ESC and HITM members at weekly ESC meetings. Overall, according to attendance documented in meeting minutes, ESC meetings were well attended by committee members. For the 25 meetings in our sample,

an average of nearly 80 percent of members from both groups attended the meetings.

Nevertheless, the program lacked plans, procedures, and guidance for how ESC was to provide oversight and make decisions, and the department had not implemented practices designed to ensure oversight is objective. For example, the ESC lacked procedures outlining how many members must be present at meetings or if others could be designated to attend. In addition, the ESC also lacked procedures for addressing any disagreements between Housing and OCIO. The ESC and HITM had established but not documented other practices, increasing the risk that they would not be repeatable or available for new executives or members to follow.

Regarding data needed to support decision-making and oversight, the department had identified some, but not all of the data needed for decision-making. HUD provided examples of Agile data captured and tracked the extent of system use, but HUD had not finalized related performance metrics, and meeting minutes and slides did not consistently provide data that management could use to evaluate Agile or contractor performance. Further, it had not documented processes designed to ensure that data are sufficient, of high quality, and complete.

- ***Review and assess program performance.*** HUD partially addressed three practices, and did not address one practice in this category. Specifically, the department established baselines for monitoring actual cost and schedule progress for the development of FHA Catalyst. However, the program lacked baselines for tracking actual benefits and the adequacy of staffing resources.

  HUD also lacked procedures for managing the scope of the FHA Catalyst roadmap. In addition, although more than 40 percent of the planned schedule for FHA Catalyst had elapsed as of July 2021, the department continued to manage the program without established performance measures or fully defined processes for assessing Agile and contractor performance.

  Finally, the department did not address the leading practice of balancing periodic program-wide health assessments with monitoring progress made to deploy capabilities. Specifically, although such reviews are part of HUD's established governance processes for controlling IT investments, the technical review subcommittee had not performed a department IT project health assessment for FHA Catalyst.

- ***Take and manage corrective actions, as necessary***. HUD had partially addressed one practice and had not addressed the other practice in this category. Specifically, HUD had not defined deviations from the project plan that required corrective action. In addition, the ESC and HITM were tracking certain action items, such as the department's efforts to update handbooks and issued memorandums that explained FHA Catalyst-related changes to single-family housing processes. However, the department did not clearly outline how corrective actions are to occur.
- ***Evaluate oversight practices.*** The department had partially addressed this category. Specifically, HUD had established templates designed to track which ESC meetings resulted in decisions about program oversight. However, the department had not standardized practices for analyzing and tracking decisions made or consistently documented or analyzed decisions made in ESC meetings. In addition, the department had not assessed the conformance of its oversight approach for housing IT modernization efforts with established department governance practices. For example, while the FHA Catalyst project oversight plan provided a mechanism for assessing conformance with IT governance practices, HUD did not consistently comply with the oversight plan requirements. Specifically, the oversight plan called for the ESC and HITM to supplement their program oversight with independent governance reviews of approved FHA Catalyst plans and artifacts at key decision points.[44] However, since June 2020, the ESC and HITM have deployed releases without adhering to plans for IT governance oversight.

Department officials managing FHA Catalyst stated that HUD had intended for the close involvement of ESC executives to mitigate the increased risk of initiating and managing the program with oversight practices that were not well documented or mature. HUD's Chief Digital Services Officer in the OCIO acknowledged limitations in oversight practices, and that the oversight established for FHA Catalyst is fairly new. This official also stated that HITM had worked to mature oversight

[44]In accordance with the department's established IT governance processes, the project oversight plan called for the Technical Review Subcommittee to perform investment control reviews of FHA Catalyst at key decision points. Specifically, the plan required the subcommittee to (1) review initial program plans approved by the ESC and HITM, (2) evaluate artifacts for planning each new release, and (3) assess the readiness of system releases before HUD deployed them. As part of its reviews, the subcommittee evaluates the conformance of plans and artifacts with HUD IT governance processes.

and performance measurement practices during FHA Catalyst development.

Further, HUD's Principal Deputy CIO stated that the department had acted quickly to launch the program and expedite delivery of functional components. According to this official, through the ESC and HITM, HUD focused more executive attention on FHA Catalyst planning, operations, and oversight than the department typically applies to modernization projects in order to minimize the risk that problems would not be detected.

However, according to the HITM lead, the department did not make it a priority to document its oversight and performance measurement practices or assess the extent to which its processes aligned with leading practices or standard HUD IT governance. Without action to strengthen FHA Catalyst oversight and performance measurement practices, HUD faces an increased risk of failing to ensure that the ESC and other oversight groups perform all needed oversight activities. In addition, decision-makers may not have the data they need to oversee the program and its performance. The department may also face challenges in monitoring progress against commitments, identifying problems early, and ensuring that it implements any decisions made or corrective actions needed.

Further, until HUD examines the conformance of FHA Catalyst oversight with the department's standard IT governance practices and addresses weaknesses we identified, its oversight practices may fall short. Specifically, the department may implement practices inconsistently or miss opportunities to ensure sufficient input from, and knowledge-sharing with, other stakeholders typically engaged in IT governance. Moreover, the department faces increased risk of managing FHA Catalyst with an ad hoc approach and using less mature, inconsistent oversight practices as the FHA Catalyst program moves through Phases 2 and 3.

Conclusions

HUD substantially addressed leading practices for managing requirements and risk management. However, the department did not document responsibility for ensuring that requirements are managed and did not have an independent validation and verification of FHA Catalyst performed. In addition, HUD did not develop contingency plans for high–probability, high-occurrence risks. By not fully addressing leading

practices for FHA Catalyst, the department faces increased risk that its efforts to manage requirements and risks will fall short of expectations.

In addition, HUD operated FHA Catalyst with unreliable cost and schedule estimates. Without reliable cost and schedule estimates, HUD leadership will be limited in its ability to make informed decisions on cost and schedule and will face increased risk that FHA Catalyst will not deliver expected results within budget by December 2023. Addressing cost and scheduling estimation, including implementing our prior 2017 recommendation on developing cost guidance, will better position HUD for future estimation efforts.

Finally, HUD established processes for overseeing the FHA Catalyst program; however, the department did not fully address the four categories of relevant leading practices. Such gaps in oversight practices limit FHA Catalyst oversight bodies' capacity to ensure the program is managed effectively. Improving the program's oversight and enhancing its alignment with leading practices could position HUD to implement more robust oversight practices, as well as improve the likelihood of successful modernization outcomes.

Recommendations for Executive Action

We are making the following eight recommendations to the Secretary of Housing and Urban Development.

- The Secretary of Housing and Urban Development (HUD) should direct the Federal Housing Administration and the Office of the Chief Information Officer to clearly document agreements among the staff responsible for managing requirements to maintain alignment between requirements and FHA Catalyst modules. (Recommendation 1)
- The Secretary of Housing and Urban Development (HUD) should direct the Federal Housing Administration and the Office of the Chief Information Officer to ensure that FHA Catalyst is subject to independent verification and validation. (Recommendation 2)
- The Secretary of Housing and Urban Development (HUD) should direct the Federal Housing Administration and the Office of the Chief Information Officer to develop contingency plans for risks identified as critical (high probability, high impact) to FHA Catalyst. (Recommendation 3)

- The Secretary of Housing and Urban Development should direct the Federal Housing Administration and the Office of the Chief Information Officer to ensure that cost estimation guidance that incorporates the best practices called for in the GAO Cost Estimating Guide is applied to future FHA Catalyst cost estimates. (Recommendation 4)
- The Secretary of Housing and Urban Development (HUD) should direct the Federal Housing Administration and the Office of the Chief Information Officer to develop, and ensure the implementation of, schedule guidance that incorporates the best practices called for in the GAO Schedule Guide. (Recommendation 5)
- The Secretary of Housing and Urban Development (HUD) should direct the Federal Housing Administration and the Office of the Chief Information Officer to revise the FHA Catalyst schedule estimate according to the newly developed guidance. (Recommendation 6)
- The Secretary of Housing and Urban Development (HUD) should direct the Federal Housing Administration and the Office of the Chief Information Officer to improve oversight practices for FHA Catalyst to ensure that they fully address leading practices for planning for program oversight and assessing program performance, including, but not limited to those for establishing processes, outlining responsibilities, requiring metrics for Agile performance, and balancing periodic program-wide assessments with monitoring progress. (Recommendation 7)
- The Secretary of Housing and Urban Development (HUD) should direct the Federal Housing Administration and the Office of the Chief Information Officer to improve the alignment of FHA Catalyst oversight with leading practices for managing corrective actions including, but not limited to defining when a corrective action is needed and how to address that action; and evaluating oversight practices by assessing conformance with established processes. (Recommendation 8).

Agency Comments and Our Evaluation

We received comments on a draft of this report from HUD. In its comments, reproduced in appendix II, the department concurred with all of the recommendations. The department also stated that it planned to provide more definitive information, with timelines, after this report has been issued. HUD also provided technical comments which we incorporated, as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretary of HUD, and other interested parties. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

If you or your staffs have any questions about this report, please contact Kevin Walsh at (202) 512-6151 or WalshK@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.

Kevin Walsh
Director, Information Technology and Cybersecurity

Appendix I: Objectives, Scope, and Methodology

Our objectives were to (1) determine the extent to which HUD has implemented leading practices for managing requirements and identifying and mitigating risks into the single-family housing IT modernization program, (2) assess the reliability of the program's estimated costs and schedule, and (3) determine the extent to which HUD has established effective oversight for the program.

To address our first objective, we reviewed the Software Engineering Institute's Capability Maturity Model Integration-Development (CMMI-DEV) to identify leading practices associated with managing requirements and identifying and mitigating risk.[1] We then selected four practices associated with requirements management and two practices associated with risk management. The selected practices represent leading requirements and risk management practices for IT acquisitions and the incorporation of business needs into modernization programs.

The four leading practices associated with requirements management we identified are: (1) develop customer requirements, (2) analyze requirements, (3) test requirements, and (4) manage requirements. The two leading practices associated with risk management we identified are: (1) prepare for risk management, and (2) identify and analyze risk. We assessed FHA Catalyst documentation, such as requirements data, requirements release notes, requirements testing documentation, the risk register, and risk management plan against the leading practices for requirements and risk management, and determined the extent to which HUD had implemented them.

For each individual leading practice, we considered a practice to be fully implemented if HUD provided complete evidence that fully satisfied the practice. We considered a practice to be partially implemented if HUD provided evidence that satisfied some but not all of the practice. Lastly, we considered a practice to not be implemented if HUD did not provide evidence that satisfied any of the practice.

[1]Software Engineering Institute (SEI) at Carnegie Mellon University, *CMMI® for Development (CMMI-DEV), Version 1.3* (Pittsburgh, Pa.: November 2010).

To assess the reliability of data from the program's IT requirements management tool and risk register, we interviewed knowledgeable HUD officials about the quality control procedures used by the program to assure accuracy and completeness of the data. For example, we spoke to department officials involved in the modernization about risk traceability and requirements management. We also compared the data to other relevant program documentation on requirements and risk management, such as module requirements release notes and the department's risk management plan. We determined that the data used were sufficiently reliable for the purpose of evaluating the department's practices for managing IT requirements and risk.

For our second objective, to assess the reliability of the FHA Catalyst estimated costs and schedule, we reviewed the FHA Catalyst life-cycle cost estimates and schedules, dated August 2020 and February 2021, and related documents describing HUD cost and schedule estimation practices.[2]

- To assess the reliability of the August 2020 and February 2021 life-cycle cost estimates, we evaluated documentation supporting the estimates, such as the cost estimating methodology, the FHA Catalyst Life-Cycle Cost Estimate, and performance plan updates regarding the cost estimate.[3] We assessed the cost estimating methodologies, assumptions, and results against leading practices for developing a comprehensive, accurate, well-documented, and credible cost estimate, identified in GAO's *Cost Estimating and Assessment Guide*.[4] To understand HUD's methodology, data, and approach, we interviewed relevant officials, including the Chief Digital Services Officer and Deputy CIO for Business and IT Resource Management.

[2]We originally reviewed the August 2020 cost and schedule estimates. When HUD subsequently provided updated estimates in February 2021, we updated our analyses to incorporate assessments of the updated estimates. The later assessments largely remained the same for both cost and schedule; therefore, we did not include detailed information from the August assessments in the report.

[3]Pursuant to H.R. Rep. No. 116-452, at 141 (2020) and the joint explanatory statement of conference, 166 Cong. Rec. H7879, H8829 (daily ed. Dec. 21, 2020) (statement of Chairwoman Lowey), specifically referenced in section 4 of the Consolidated Appropriations Act, 2021, Pub. L. No. 116-260, § 4, 134 Stat. 1182, 1185 (Dec. 27, 2020), HUD is instructed to provide updates on FHA's IT modernization efforts to the House and Senate Committees on Appropriations.

[4]GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Program Costs*, GAO-20-195G (Washington, D.C.: Mar. 12, 2020).

We noted in our report the instances where the quality of the cost estimation data impacted the reliability of the program's cost estimates.

- To assess the reliability of the August 2020 and February 2021 FHA Catalyst schedules, we evaluated documentation supporting the schedules, such as the integrated master schedule, the baseline schedule, and schedule risk analysis. We assessed the schedule documentation against leading practices for developing a comprehensive, well-constructed, credible, and controlled schedule, identified in GAO's *Schedule Assessment Guide*.[5] We also interviewed HUD program officials responsible for developing and managing the program schedules, including the Chief Digital Services Officer, to understand their practices for creating and maintaining the schedule. We noted in our report the instances where the quality of the schedule data impacted the reliability of the program's schedules.

For both the cost estimates and program schedules, we applied the standard rating scale used in GAO cost and schedule evaluations, assessing each leading practice as:

- **fully addressed—**HUD provided complete evidence that satisfies all the criteria;
- **substantially addressed—**HUD provided evidence that satisfies more than half of the criteria, but not all the criteria;
- **partially addressed—**HUD provided evidence that satisfies about half of the criteria;
- **minimally addressed—**HUD provided evidence that satisfies less than half of the criteria;
- **not addressed—**HUD did not provide evidence that satisfies any of the criteria.

Finally, we provided department officials with draft versions of our detailed analyses for the FHA Catalyst cost estimates and schedules. This was done to verify that the information on which we based our findings was complete, accurate, and up-to-date.

[5]GAO, *Schedule Assessment Guide: Best Practices for Project Schedules*, GAO-16-89G (Washington, D.C.: Dec. 22, 2015).

To address our third objective, we identified leading practices for program oversight in GAO's *Information Technology Investment Management Guide,* the Software Engineering Institute's *CMMI–DEV*, and GAO's *Agile Assessment Guide*.[6] From those sources, we selected practices for program oversight and performance measurement that were applicable to the modernization effort based on the type of effort (e.g., Agile) and the oversight needed (e.g., contractor oversight). This resulted in our selection of 12 practices.

We then grouped the selected practices into categories: (1) plan for program oversight, (2) review and assess program performance, (3) take and manage corrective actions, as necessary, and (4) evaluate oversight practices. Next, we reviewed the department's plans and artifacts outlining oversight and performance measurement practices, including the charter for the Executive Steering Committee (ESC) and the housing information technology modernization (HITM) team (the HUD team managing FHA Catalyst), the FHA Catalyst governance charter and program plans, such as plans for program oversight and project management.

To assess whether the department consistently followed the practices defined for overseeing FHA Catalyst, we randomly selected and analyzed minutes from 25 ESC meetings and briefing slides from 20 HITM meetings to determine if the committees were meeting and obtaining data about the planned weekly oversight. For example, we determined how the committees made and tracked decisions during these meetings. The ESC cancelled 10 of the selected ESC meetings for varied reasons.[7] We replaced the cancelled meetings with the ten additional randomly selected meetings. We also observed various FHA Catalyst focus group meetings with lenders and other FHA Catalyst end users to observe their communications with those groups about the deployment of releases and changes made to the program roadmap and schedules for testing system

[6]GAO, *Information Technology Investment Management: A Framework for Assessing and Improving Process Maturity,* GAO-04-394G (Washington, D.C.: March 2004); *Agile Assessment Guide: Best Practices for Agile Adoption and Implementation*, GAO-20-590G (Washington, D.C.: Sept. 28, 2020), and *CMMI-DEV, Version 1.3*. We issued our Agile assessment guide in September 2020, after HUD had initiated FHA Catalyst. However, our Agile assessment guide is based on information from a variety of sources related to Agile adoption that were available when HUD initiated FHA Catalyst in April 2019.

[7]The ESC cancelled two meetings after experiencing vacancies in the executive positions of General Deputy Assistant Secretary for Housing and HUD's CIO. Other reasons that the ESC cancelled meetings include one meeting cancelled at the request of the FHA Commissioner and four planned on or near federal holidays.

components. To assess FHA Catalyst conformance with IT governance processes, we compared project management reviews and artifacts, such as the project tailoring agreement and user manuals, to HUD's standard IT governance processes.

We assessed the department's documentation of oversight and performance measurement practices against the identified leading practices. For each practice, we compared HUD's documentation to the leading practice and evaluated whether the HUD team's plans included the implementation of specific features and types of content called for in the leading practices.

For individual practices, we considered a practice to be fully addressed if HUD plans satisfied all of the criteria defined in the selected leading practice. We considered a practice to be partially addressed if the department plans satisfied some but not all of the criteria. For example, if HUD successfully determined the type and depth of oversight to perform but failed to establish evaluation criteria to apply, then the department would receive a rating of partially addressed. Lastly, we considered a practice to not be addressed if HUD plans did not satisfy any of the criteria.

For each of our objectives, we interviewed officials from HUD's headquarters in Washington, D.C., including the General Deputy Assistant Secretary for Housing and the Chief Information Officer, Chief Digital Services Officer, and Senior Advisor to the Chief Digital Services Officer from the OCIO.

We conducted this performance audit from April 2020 to September 2021 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 objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Comments from the Department of Housing and Urban Development

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, D.C. 20410-3000

CHIEF INFORMATION OFFICER

September 20, 2021

MEMORANDUM FOR: Kevin Walsh, Director, Information Technology and Cybersecurity

FROM: Beth Niblock, Chief Information Officer Beth Niblock Digitally signed by: Beth Niblock CN: CN = Beth Niblock email = beth.niblock@hud.gov C = US O = HUD OU = OCIO Date: 2021.09.20 13:04:03 -04'00'

SUBJECT: HUD comments to draft GAO report on HUD Single-family Modernization GAO-21-459 (GAO 104309)

This memorandum is in response to the Government Accountability Office (GAO) draft report entitled *IT Modernization: HUD Needs to Improve Its Estimation and Oversight Practices for Single-Family Housing* (GAO 21-459) issued in August 2021. The Office of the Chief Information Officer (OCIO) has carefully reviewed the Draft Report.

The Department of Housing and Urban Development (HUD) reviewed the draft report and concurs with the recommendations for Executive Action. More definitive information with timelines will be provided once the final report has been issued. Enclosed are the Department's comments on the draft report.

If you have questions or require additional information, please contact Patrick Wells, Director, Division of Administrative Management, Office of Business IT Resource Management, at (202)-402-4589 (Patrick.A.Wells@hud.gov), or Ebony Johnson, Audit Liaison Officer, at (202) 402-2164 (Ebony.A.Johnson@hud.gov).

Enclosure:
- HUD Comments for Draft Report GAO-21-459 (GAO 104309)

Agency Comment Letter

Text of Appendix II: Comments from the Department of Housing and Urban Development

Page 1

September 20, 2021

MEMORANDUM FOR: Kevin Walsh, Director, Information Technology and Cybersecurity

FROM: Beth Niblock, Chief Information Officer

SUBJECT: HUD comments to draft GAO report on HUD Single-family Modernization GAO-21-459 (GAO 104309)

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The Department of Housing and Urban Development (HUD) reviewed the draft report and concurs with the recommendations for Executive Action. More definitive information with timelines will be provided once the final report has been issued. Enclosed are the Department's comments on the draft report.

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(202) 402-2164 (Ebony.A.Johnson@hud.gov).

Enclosure:

- HUD Comments for Draft Report GAO-21-459 (GAO 104309)

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

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