



March 2024

ARMY MODERNIZATION

Production Challenges for Stryker Upgrade Reinforce Need to Follow Acquisition Leading Practices in Future Efforts

Reissued with revisions on April 3, 2024 to correct typographical errors on the Highlights page and report page 16.

GAO Highlights

Highlights of [GAO-24-106590](#), a report to the Committee on Armed Services, House of Representatives

Why GAO Did This Study

In response to a 2015 urgent need request from a unit in Germany, the Army developed and fielded a limited number of Stryker combat vehicles with increased lethality, including an uncrewed, turreted 30-millimeter automatic cannon on a Stryker. After testing, further modifications were made and a competition was held to produce additional upgraded vehicles for all Stryker brigades. This upgraded vehicle was subsequently termed the Medium Caliber Weapon System.

A House report includes a provision for GAO to review the Army's efforts to upgrade and improve the lethality of the Medium Caliber Weapon System. This report addresses the (1) requirements and acquisition approaches for the system, and (2) extent to which the Army followed relevant GAO leading practices in identifying and mitigating risks, among other issues.

GAO reviewed and analyzed relevant policies, requirements, and acquisition documents, and contracts. GAO also interviewed Army and Marine Corps officials and a representative of the contractor responsible for the upgrades.

What GAO Recommends

GAO recommends that the Army apply acquisition leading practices before beginning production of future Stryker upgrades. The Army concurred with the intent of the report without specifically addressing the recommendation. GAO continues to believe that the Army should implement the recommendation.

View [GAO-24-106590](#). For more information, contact Mona Sehgal at (202) 512-4841 or sehgal@gao.gov.

March 2024

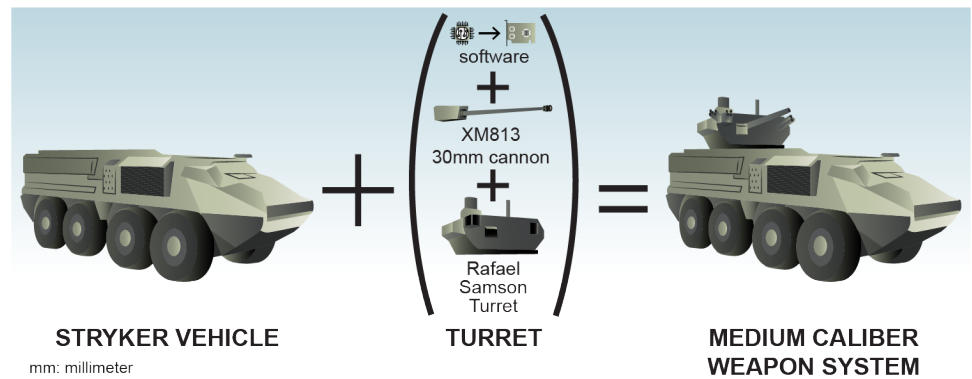
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Production Challenges for Stryker Upgrade Reinforce Need to Follow Acquisition Leading Practices in Future Efforts

What GAO Found

After the drawdown of U.S. Army armored combat vehicles from Europe in 2013, the Army reassessed threats in the region and determined that its Stryker brigades did not have sufficient firepower compared with potential adversaries. The Medium Caliber Weapon System is one of the Army's latest modernization efforts to increase the lethality of its Stryker Family of Vehicles Program.

The Components of a Medium Caliber Weapon System



GAO found that the Army followed leading practices when developing requirements for the Medium Caliber Weapon System. In 2018, the Army used the lessons learned when field testing 83 modified Stryker vehicles delivered to the 2nd Cavalry Regiment in Germany. It used the 2nd Cavalry's experience to inform and refine weapon system requirements, including increases in lethality, survivability, and situational awareness. Subsequently, the Army developed an accelerated acquisition approach for the system by placing it within the Stryker Family of Vehicles Program, rather than designating it a separate program of record. This allowed the Army to minimize documentation required for approval. According to program officials, the accelerated approach was intended to shorten the acquisition by 2 years.

The Army, however, did not fully implement leading practices for acquisition to mitigate production risks, which were introduced, in part, by using a different turret and chassis than what was tested in Germany. Since production started in March 2022, the Army found problems with the contractor's manufacturing processes as well as software issues. Ultimately, this resulted in the Army halting acceptance of vehicles in February 2023, after 19 had been delivered. These challenges may have been identified and addressed earlier if the Army followed sound acquisition practices, such as conducting a production readiness review and ensuring that software worked as intended before ordering most of the 269 vehicles. While the Army mitigated its cost risk by awarding fixed-price orders, the time needed to address production issues will delay fielding by a year. Implementing leading practices for acquisition in production would ensure that the Army develops sufficient knowledge about production maturity for future Stryker upgrades prior to entering production and potentially avoids the issues experienced with the Medium Caliber Weapon System.

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Abbreviations

ACAT	Acquisition Category
AROC	Army Requirements Oversight Council
DCMA	Defense Contract Management Agency
DOD	Department of Defense
DOT&E	Director, Operational Test and Evaluation
DOTMLPF-P	doctrine, organization, training, materiel, leadership, personnel, facilities, and policy
FAR	Federal Acquisition Regulation
MCA	major capability acquisition
MCWS	Medium Caliber Weapon System
mm	millimeter
MRL	manufacturing readiness level
MTA	middle tier of acquisition
PEO GCS	Program Executive Office Ground Combat Systems
PM SBCT	Project Manager Stryker Brigade Combat Team
PRR	production readiness review
U.S.	United States
U.S.C.	United States Code

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March 20, 2024

The Honorable Mike Rogers
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

The Army is pursuing efforts to modernize its capabilities to meet the challenges from great-power competitors, such as China and Russia.¹ The drawdown of U. S. armored combat forces in 2013 from Europe reduced the firepower that units needed to deter aggression from Russia. To address an urgent request for increased lethality from a Germany-based Stryker brigade in 2015, the Army developed and fielded a limited number of Stryker Infantry Carrier Vehicles with an uncrewed, turreted 30-millimeter automatic cannon in 2018 known as the Infantry Carrier Vehicle - Dragoon. Subsequently, the Army decided to refine and expand the capability demonstrated by the Dragoon to the Stryker brigades in the United States and planned to procure 269 vehicles with final delivery in 2025. The first unit was planned to be equipped in 2022, but the program has faced delays.

A House Armed Services Committee report accompanying the James M. Inhofe National Defense Authorization Act for Fiscal Year 2023 contains a provision for GAO to review the Army's efforts to upgrade and improve the lethality of the Stryker with an uncrewed, turreted 30-millimeter automatic cannon. This asset was subsequently termed the Medium Caliber Weapon System (MCWS).² This report addresses the (1) requirements and acquisition approaches for the MCWS, (2) extent to which the Army followed GAO's leading practices in identifying and mitigating risks for the MCWS, and (3) sources the Army considered in developing the MCWS life-cycle costs.

¹The Department of Defense (DOD) defines great-power competitors as countries with diplomatic, informational, military, and economic capacity that are nearly comparable to that of the United States, and that are capable of waging large-scale conventional war.

²H.R. Rep. No. 117-347, at 8 (2023). James M. Inhofe National Defense Authorization Act for Fiscal Year 2023, Pub. L. No. 117-263 (2022).

To address the first objective, we reviewed documents such as operational requirements documents, acquisition decision memorandums, acquisition plans, budget information, and Department of Defense (DOD) and Army acquisition policy and guidance. We interviewed Army officials from the Program Executive Office Ground Combat Systems (PEO GCS) - Project Manager Stryker Brigade Combat Team (PM SBCT); the Assistant Secretary of the Army for Acquisition, Logistics, and Technology; and the Army Futures Command's Maneuver Capabilities Development and Integration Directorate.

To address the second objective, we analyzed and compared MCWS documentation to our leading practices for lessons learned as well as leading practices for acquisition related to production.³ We interviewed officials from the PEO GCS - PM SBCT, Army Test and Evaluation Command, Army Contracting Command-Detroit Arsenal, Defense Contract Management Agency, and the Office of the Director, Operational Test and Evaluation. We also spoke to a representative from Oshkosh Defense, LLC, the contractor producing the MCWS. Our report scope focused on the transfer of lessons learned from the 2015 urgent request for increased Stryker lethality to the MCWS. We focused on acquisition leading practices related to production because of the acquisition approach chosen by the Army for MCWS.

To address the third objective, we reviewed the program office's approach to develop the life-cycle cost estimate and model against one of the 12 steps of the cost estimating process outlined in our Cost Estimating and Assessment Guide—specifically, Chapter 10: Step 7: Develop the Point Estimate.⁴ A description of the approach to the point estimate provides information on the methods and data sources, and also include elements from the first six steps of the guide. Because the objective focuses on sources for the cost estimate, and the Army has

³GAO, *Project Management: DOE and NNSA Should Improve Their Lessons-Learned Process for Capital Asset Projects*, [GAO-19-25](#) (Washington, D.C.: Dec. 21, 2019); *Leading DOD Utilities Privatization: Improved Data Collection and Lessons Learned Archive Could Help Reduce Time to Award Contracts*, [GAO-20-104](#) (Washington, D.C.: Apr. 2, 2020); *Weapon Systems Annual Assessment: Challenges to Fielding Capabilities Faster Persist*, [GAO-22-105230](#) (Washington, D.C.: June 8, 2022); *Leading Practices: Agency Acquisition Policies Could Better Implement Key Product Development Principles*, [GAO-22-104513](#) (Washington, D.C.: Mar. 10, 2022); and *Leading Practices: Iterative Cycles Enable Rapid Delivery of Complex, Innovative Products*, [GAO-23-106222](#) (Washington, D.C.: July 27, 2023).

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

already placed orders and obligated funds for all of the Stryker MCWS it planned to procure, we determined that performing a detailed review of the approach to the last five steps of the guide—which focus on conducting sensitivity and risk or uncertainty analyses, documenting and presenting the estimate, and updating it to reflect actual costs—would add little value to the analysis. We interviewed officials from the Army PEO GCS - PM SBCT, Deputy Assistant Secretary of the Army for Cost and Economics, and the Marine Corps' Program Executive Office Land Systems to better understand what sources the Army considered in development of the MCWS cost estimate. For more information on our objectives, scope, and methodology, see appendix I.

We conducted this performance audit from January 2023 to March 2024 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

Since the early 2000s, the Stryker has served as the Army's primary combat and combat support infantry fighting vehicle for its Stryker brigades. The Stryker is an eight-wheeled armored vehicle that transports infantry into combat and then supports them. There are eight Army Stryker brigades, six of which are active Army and two of which are National Guard. The Army has made many improvements to the Stryker for lethality, mobility, and survivability based on combat experiences. Currently, the Stryker Family of Vehicles is comprised of 26 variants. Our report focuses on one of the latest Stryker modernization efforts to increase lethality—the Stryker Infantry Carrier Vehicle Double-V Hull A1 30-millimeter cannon variant. This variant was formerly known as the Stryker MCWS variant. We use the name MCWS in this report to mean the Stryker variant upgraded with an uncrewed, turreted 30-millimeter automatic cannon in keeping with the mandate and several acquisition documents (see fig. 1).

Figure 1: Stryker Medium Caliber Weapon System



Source: Oshkosh Defense; (Photo) (All rights reserved). | GAO-24-106590

DOD Acquisition Process

DOD defines an acquisition program as a directed, funded effort that provides a new, improved, or continuing materiel, weapon, information system, or service capability in response to an approved need. DOD Directive 5000.01, the Defense Acquisition System, and DOD Instruction 5000.02, Operation of the Adaptive Acquisition Framework, and its associated instructions, provide principles, policies, and procedures for

managing all acquisition programs.⁵ The directive and instructions also emphasize flexibility in acquisition.⁶

Defense acquisition programs following the major capability acquisition pathway are classified into acquisition categories based on the estimated cost and type of acquisition. DOD's most costly major defense programs have historically been categorized as Major Defense Acquisition or Acquisition Category I programs.⁷ Programs with lower costs are categorized as Acquisition Category II or III programs.⁸ The acquisition category of a program can determine the level of oversight and applicable procedures, such as what information and documents are required for approval at major decision points and which office is responsible and accountable for those decisions. Among other responsibilities, the milestone decision authority approves entry of an acquisition program into the next phase of the acquisition process and is accountable for cost, schedule, and performance reporting.

Leading Practices for Lessons Learned and Acquisition

Leading Practices for Lessons Learned are a principal component of an organizational culture committed to continuous improvement. The leading practices include sharing information and knowledge gained on positive and negative experiences. Sharing lessons learned serves to communicate knowledge more effectively and to ensure that beneficial information is factored into planning, work processes, and activities. See figure 2 for the lessons learned process that both we and the Army identified.

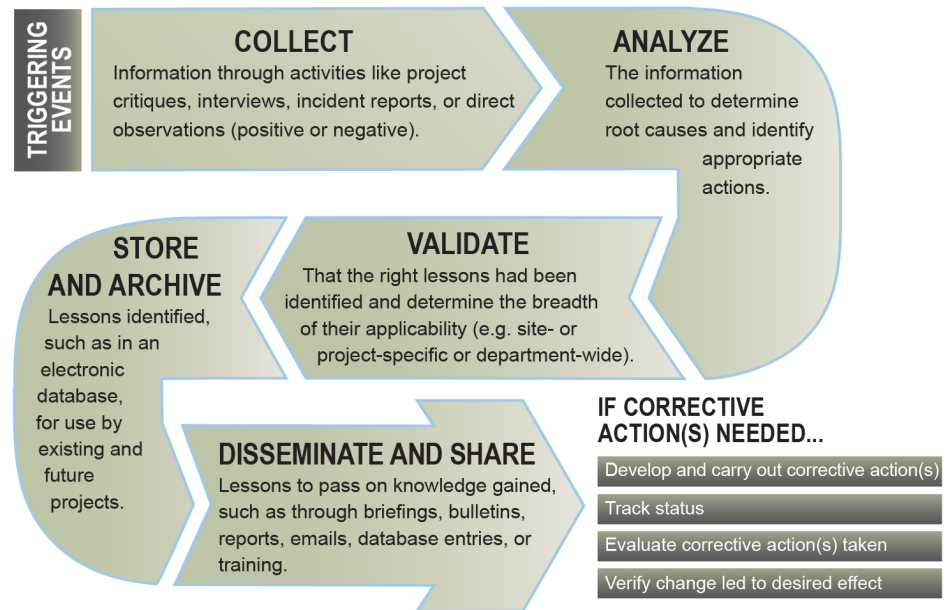
⁵Department of Defense, DOD Directive 5000.01, *The Defense Acquisition System* (Sept. 9, 2020) (incorporating change 1, July 28, 2022).

⁶The Adaptive Acquisition Framework acquisition pathways provide opportunities for program decision-makers to develop acquisition strategies and employ acquisition processes that match the characteristics of the capability being acquired. Department of Defense, DOD Instruction 5000.02, *Operation of the Adaptive Acquisition Framework* (Jan. 23, 2020) (incorporating change 1, June 8, 2022).

⁷Major defense acquisition programs are those identified by DOD or that have a dollar value for all increments estimated to require eventual total expenditure for research, development, test, and evaluation of more than \$525 million, or for procurement of more than \$3.065 billion, in fiscal year 2020 constant dollars. Department of Defense, DOD Instruction 5000.85, *Major Capability Acquisition* (Aug. 6, 2020) (incorporating change 1, Nov. 4, 2021). See also 10 U.S.C. § 4201.

⁸Department of Defense, DOD Instruction 5000.85, *Major Capability Acquisition* (Aug. 6, 2020) (incorporating change 1, Nov. 4, 2021). See also 10 U.S.C. § 4201.

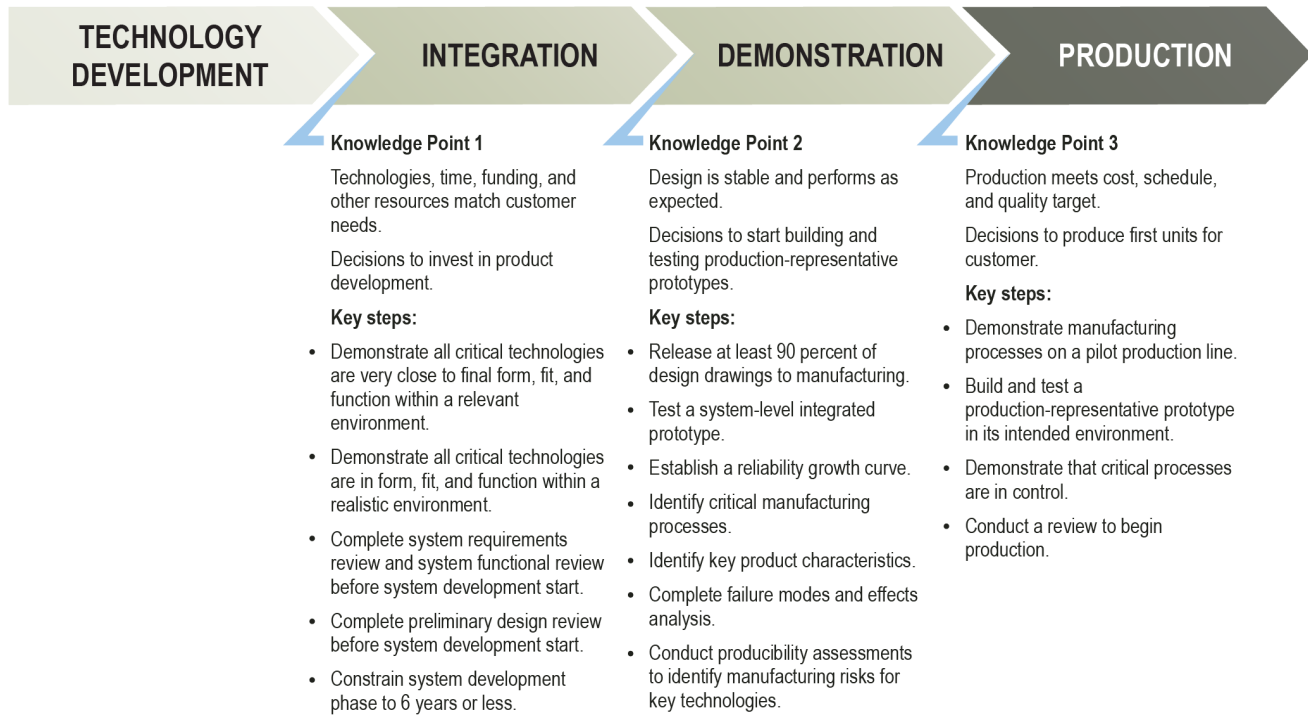
Figure 2: Leading Practices for Lessons Learned Process



Sources: GAO and Center for Army Lessons Learned. | GAO-24-106590

Leading Practices for Acquisition identify steps that successful programs take to develop a high level of knowledge at three key decision points. Our body of work since 1999 has shown that attaining high levels of knowledge before programs make significant commitments during product development drives positive acquisition outcomes. Program knowledge associated with these three key decision points builds over time. In recent reports, we identified additional leading practices that pertain to product development. For example, digital twins are virtual representations of their physical products and incorporate dynamic data of a physical object or a system. These approaches also increase knowledge at key decision points (see fig. 3).

Figure 3: GAO-Identified Knowledge Points



Source: GAO. | GAO-24-106590

Army Updated Existing Requirements and Developed an Accelerated Acquisition Approach for Medium Caliber Weapon System

Army Updated Existing Stryker Requirements for System

The Army developed requirements for the MCWS by assessing threats not addressed in existing Stryker requirements, identifying gaps, and updating requirements to address those gaps. The Stryker Family of Vehicles Operational Requirements Document, which was originally approved in 2000 and was recently updated in 2019 to lay out requirements for Stryker variants. After the drawdown of U. S. Army armored combat vehicles from Europe in 2013, the Army assessed the existing capabilities of the Stryker against threats in the region based on intelligence reports. Through various analyses, the Army identified gaps in the Stryker brigades' lethality, in terms of direct fire capability and range, to defeat light armored vehicles and to support infantry formations.

In 2015, the Army approved an Operational Needs Statement—an urgent request for increased lethality—submitted by the 2nd Cavalry Regiment based in Germany to address these gaps. According to Maneuver Capabilities Development and Integration Directorate officials, they worked with the 2nd Cavalry Regiment to develop requirements for a capability that would best meet its needs within the required time frame. To fulfill the operational need, the Army authorized PEO GCS to execute an engineering change proposal to integrate 91 flat-bottom hull Strykers with an uncrewed, turreted 30-millimeter automatic cannon.⁹ Of these 91 modified vehicles, 83 vehicles were fielded to the 2nd Cavalry Regiment and 8 vehicles were for prototype testing. General Dynamics Land Systems Inc., the original Stryker manufacturer, conducted these upgrades under a modification to the existing production contract for the

⁹An engineering change proposal is a management tool used to propose a change to an existing system and its performance requirements and configuration. This proposal is prepared by a contractor to propose engineering changes within the scope of activity under that contract. See Defense Federal Acquisition Regulation Supplement 243.205-70.

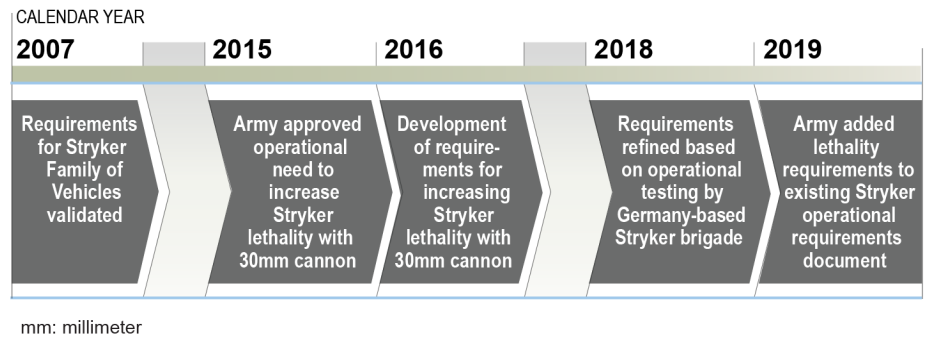
effort in 2016. According to the Army, this approach allowed the Army to develop and field an upgraded Stryker in 2 years. In 2018, the Army fielded these new vehicles, called the Infantry Carrier Vehicle - Dagoon, to the 2nd Cavalry Regiment in Germany, and according to program officials verified the need for lethality upgrades across additional Stryker brigades during operational testing.

According to the documentation we reviewed and Army officials, the directorate used the 2nd Cavalry Regiment's experience to inform and refine MCWS requirements. Several MCWS requirements were the direct result of soldier feedback on the Dagoon. For example, the 2nd Cavalry Regiment's concerns about visibility and situational awareness in the Dagoon led to the requirement for a secondary set of optics available to the squad leader.

The directorate also updated the requirements to incorporate the newer Stryker Double-V Hull A1 rather than the flat-bottom hull used for the Dagoon. According to officials, the Double-V Hull A1 provides the system better underbelly blast protection and accommodate the additional weight and power needed for the new turret and larger cannon. In addition to soldier feedback, officials stated that the directorate used modeling, simulations, and analysis to inform MCWS requirements. For example, the directorate reexamined the total number of MCWS per brigade. Officials explained that they used simulations and data to confirm that 83 vehicles (81 per brigade plus two spares) was the optimal number needed for mission accomplishment and survivability.

In 2019, the Army validated the lethality upgrades and added them as an annex to the existing Stryker Operational Requirements Document. The updated requirements document authorized the acquisition of 269 MCWS—three brigades with 83 vehicles each, and an additional 20 for testing, among other things. See figure 4 for a timeline of the MCWS requirements.

Figure 4: Timeline of Requirements for Medium Caliber Weapon System



Source: GAO review of Army documentation. | GAO-24-106590

Army Developed an Accelerated Acquisition Approach for the System

The Army developed an accelerated acquisition approach for the MCWS by using flexibilities allowed by DOD policies. According to program officials and program documentation, the MCWS is an effort within the Stryker Family of Vehicles program and is not a separate program of record. Officials described the MCWS as a post-milestone C, “Acquisition Category (ACAT) II-equivalent engineering change” effort under the Stryker Family of Vehicles ACAT IC program, which is post-milestone C. This refers to the fact that the Stryker Family of Vehicles has held all of its required acquisition milestones and related reviews. These officials stated that they used the term “ACAT II-equivalent” to convey that the MCWS equates to an ACAT II program in dollar value despite not carrying the official designation as a separate program.¹⁰

The Army developed a tailored acquisition approach for the MCWS effort using the Accelerated Acquisition Program model laid out in the 2017

¹⁰An Acquisition Category (ACAT) II is a program that does not meet the dollar thresholds for an Acquisition Category I designation and is estimated by the DOD component head to require an eventual total expenditure for research, development, test, and evaluation of more than \$200 million (fiscal year 2020 constant dollars) or, for procurement, of more than \$920 million (fiscal year 2020 constant dollars). The milestone decision authority for an ACAT II program is the component acquisition executive or their designee. Department of Defense, DOD Instruction 5000.85, *Major Capability Acquisition* (Aug. 6, 2020) (incorporating change 1, Nov. 4, 2021). Based on the May 2019 Acquisition Program Baseline, the estimated procurement cost for MCWS was \$966 million (base year 2019 dollars).

version of DOD Instruction 5000.02, that was in place at the time.¹¹ The Army explained that it used the flexibilities allowed under DOD Instruction 5000.02 to build certain oversight and key decision points, such as a production decision, into the planning of the MCWS effort. According to program officials, the Army considered using the same urgent needs process used for the Dragoon to acquire the MCWS. In addition, an Army official stated the Army required additional capabilities to that provided by the Dragoon and conducted market research that indicated that multiple vendors could provide those capabilities. This official also noted that they could not use this approach, however, because the MCWS capability would be fielded to Stryker brigades located in the continental United States, and the urgent operational needs process is for units engaged in ongoing or anticipated contingency operations.¹²

The Army chose the accelerated acquisition approach from four alternatives during a March 2019 Army Requirements Oversight Council meeting. According to program officials, by including the effort under the Stryker Family of Vehicles program, they reduced the need for new documentation for the MCWS. Instead, they used existing program documentation, such as the Stryker life-cycle sustainment plan. The program office also completed key documentation requirements for an ACAT II program, such as an acquisition program baseline. Even though MCWS is not a separate program, PEO GCS established guidelines for oversight by setting cost and schedule parameters in an April 2019 Acquisition Decision Memorandum. The memorandum also cited acquisition flexibilities, such as delegating decision authority from the Assistant Secretary of the Army for Acquisition, Logistics, and Technology to PEO GCS, and authorizing the use of a Simplified Acquisition Management Plan to streamline documentation. The memorandum also authorized a total of 269 Stryker MCWS vehicles, set key decision points, and supported the decision to begin production.

The Army chose an accelerated approach that was intended to shorten the acquisition timeline for the MCWS by 2 years. The Army continued using this accelerated acquisition approach after DOD issued DOD Instruction 5000.02, *Operation of the Adaptive Acquisition Framework* in

¹¹Department of Defense, DOD Instruction 5000.02, *Operation of the Defense Acquisition System* (Jan. 7, 2015) (incorporating change 3, Aug. 10, 2017).

¹²Department of Defense, DOD Instruction 5000.81, *Urgent Capability Acquisition* (Dec. 31, 2019).

January 2020, 9 months after the MCWS April 2019 memorandum.¹³ The restructuring and issuance of the Adaptive Acquisition Framework provided six acquisition pathways.¹⁴ Program officials stated that they chose not to transition the MCWS onto one of the new pathways because program documentation was ready to be sent for approval. According to these officials, a transition onto one of the new acquisition pathways, such as the middle tier of acquisition, would have required the Army to restart this process and delay the MCWS acquisition and fielding.¹⁵

According to Army officials, the tailored acquisition approach for acquiring the MCWS was intended to enable program officials to initiate integration and production efforts more quickly. For a program following the Major Capability Acquisition pathway, integration and demonstration of a system occur before the start of production.¹⁶ Army officials stated that they chose to accelerate production of the Stryker MCWS, rather than begin system development, because the effort integrated mature, proven technologies—the Stryker Double-V Hull A1 and the 30-millimeter cannon. Additionally, the Dragoon effort included integration and demonstration events which resulted in a capability that partially met the warfighter requirement for increased Stryker lethality. The Army awarded

¹³Department of Defense, DOD Instruction 5000.02, *Operation of the Adaptive Acquisition Framework*, (Jan. 23, 2020) (incorporating change 1, June 8, 2022).

¹⁴The six acquisition pathways are major capability acquisition, middle tier of acquisition, urgent capability acquisition, software acquisition, acquisition of services, and defense business systems. Under the Major Capability Acquisition Pathway, all ACAT ID or ACAT IC programs will continue to follow the acquisition information and reporting requirements under the pathway’s instruction and program managers can choose to utilize multiple pathways to fulfill their requirements. Department of Defense, DOD Instruction 5000.85, *Major Capability Acquisition* (Aug. 6, 2020) (incorporating change 1, Nov. 4, 2021). Since the Stryker MCWS was not an ACAT ID or ACAT IC program, but an “ACAT II equivalent” under the Stryker Family of Vehicles, it was not required to use or transition onto an Adaptive Acquisition Framework pathway.

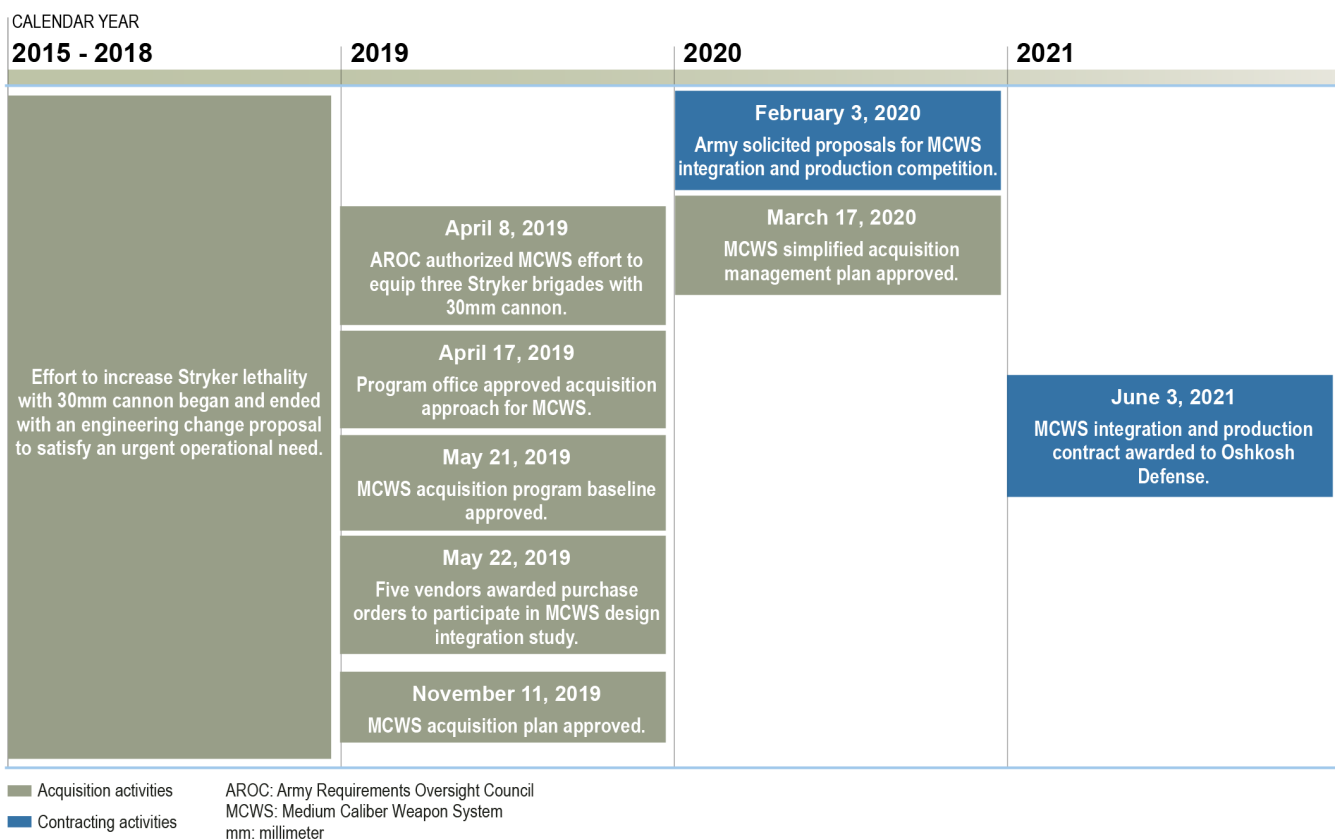
¹⁵The middle tier of acquisition pathway (MTA) is the DOD acquisition approach used to facilitate rapid prototyping and rapid fielding of new weapons and other resources the military has identified it needs. The MTA pathway seeks to provide these capabilities within 2 to 5 years of an acquisition program’s start. DOD generally exempts MTA programs from its traditional acquisition and requirement development policies, which is intended to reduce bureaucratic processes. Department of Defense, DOD Instruction 5000.80, *Operation of the Middle Tier of Acquisition* (MTA) (Dec. 30, 2019).

¹⁶Integration and demonstration activities are part of the engineering and manufacturing development phase, which consists of developing, building, testing, and evaluating a materiel solution to verify that all requirements have been met and to support production, deployment, and sustainment decisions.

a contract to Oshkosh Defense in June 2021 for integration and production of the MCWS.

See figure 5 for a timeline of the MCWS acquisition process.

Figure 5: Timeline of Medium Caliber Weapon System Acquisition Process



Source: GAO review of Army documentation. | GAO-24-106590

Contracting Approach for System Included Two Non-competitive Procurements and Two Competitive Procurements

The MCWS acquisition plan detailed the Army’s contracting approach as using a combination of non-competitive and competitive procurements. The Army procured the MCWS subcomponents—the 30-millimeter cannon and Stryker Double-V Hull A1 vehicle—on a non-competitive basis from the two original equipment manufacturers to avoid duplicative

costs and delays in meeting warfighter needs.¹⁷ Through market research, the Army determined that Alliant Techsystems Operations' (a Northrop Grumman subsidiary) XM813 30-millimeter cannon was the only U.S. government-qualified 30x173-millimeter cannon capable of firing the full suite of ammunition required for the MCWS. The 30-millimeter cannon is the same cannon used for the Dragoon. The Army used its existing sole-source production contract with General Dynamics Land Systems to procure the Stryker Double-V Hull A1 for the MCWS.

The Army procured MCWS design, integration, production, and logistics support through two competitively-awarded contracts. According to Army officials, while they awarded a non-competitive contract to General Dynamics Land Systems to develop and integrate the components for the Dragoon, the Army determined that the MCWS had to be acquired through full and open competition because it did not qualify for an exception to full and open competition.¹⁸

For the first competitive procurement related to the MCWS, the Army issued a request for quotes from potential offerors to participate in a design integration study, as previously shown in figure 5.¹⁹ The Army awarded design integration study contracts to five vendors in May 2019 to build a Stryker MCWS production representative system sample using government-furnished equipment—a Stryker Double-V Hull A1 and 30-millimeter cannon. Each vendor received up to \$150,000 to integrate a turret of its choosing with the Stryker and cannon. This approach put much of the research development cost and risks on the vendors, as they reported investing tens of millions of dollars into building their samples. According to program officials, the design integration study also served as

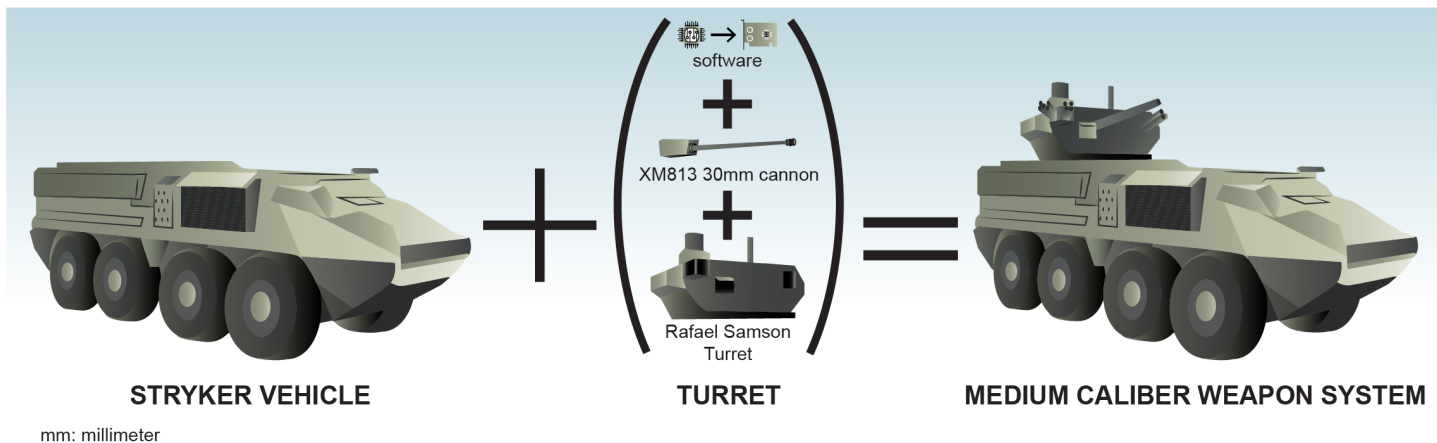
¹⁷Both non-competitive efforts were justified under federal Acquisition Regulation (FAR) 6.302-1 as only one responsible source and no other supplies or services will satisfy agency requirements. The Army details in its acquisition plan that selecting another vendor via a full and open competition for the 30-millimeter cannon would have required additional costs to develop a different cannon to an acceptable level of maturity for production and fielding. The estimated savings expected to be recovered via competition would not have offset the costs of the sole-source procurement.

¹⁸FAR 6.302 provides for authority to permit contracting without providing for full and open competition. The planned acquisition time frame for 269 MCWS vehicles was for 5 years, with final delivery in 2025.

¹⁹Request for Quotation is a method of soliciting offers from suppliers for customer's requirements for supplies or services that fit within the simplified acquisition procedures. See FAR Part 13. Simplified acquisition procedures are government procurement procedures that aim to reduce the administrative burden and time of awarding procurements below a certain dollar threshold, currently, generally \$250,000. FAR 13.002

further engineering and development activity prior to the start of contractor production of the MCWS. The five vendors were General Dynamics Land Systems Inc., Kollsman Inc., DRS Sustainment Systems Inc., Raytheon Company, and Pratt and Miller Engineering and Fabrication Inc. Pratt & Miller designed and built the sample for the design integration study competition using a Rafael Samson turret in 2020. Oshkosh Defense began an acquisition of Pratt & Miller in 2020 and completed it in 2021. An Oshkosh Defense representative we interviewed stated that in 2020 Oshkosh Defense used the production representative system sample built by its subsidiary Pratt & Miller and submitted that sample with its written proposal in the competition for the MCWS integration and production contract. See figure 6 for the MCWS integration components.

Figure 6: Integration of Medium Caliber Weapon System Components



Source: GAO review of Army documentation; GAO (illustrations). | GAO-24-106590

For the second competitive procurement, the Army issued a request for proposal for a contract that included MCWS integration, production, and logistics support.²⁰ Three vendors that participated in the design integration study submitted their MCWS production representative system sample along with written proposals for the integration, production, and

²⁰This contract is a hybrid requirements contract, with the delivery of the vehicles provided through firm-fixed-priced delivery orders. A requirements contract provides for filling all actual purchase requirements of designated government activities for supplies or services during a specified contract period (from one contractor), with deliveries or performance to be scheduled by placing orders with the contractor. FAR 16.503(a). The contract also included cost plus fixed fee line items for logistics and technical support.

logistics support contract. As previously stated, in 2020 Oshkosh Defense submitted Pratt & Miller's sample with its written proposal. In 2021, the Army selected Oshkosh Defense from the three proposals based on a best value tradeoff source selection process and awarded a requirements contract that included firm-fixed-priced delivery orders for the MCWS.²¹ The winning proposal was about 35 percent lower in cost than the next highest rated offeror.

The Army Used Leading Practices to Improve the Design, But Did Not Adequately Mitigate Production Risks

The Army used leading practices for lessons learned to improve the MCWS design but did not follow leading acquisition practices to adequately mitigate production risks. The Army applied leading practices for lessons learned by collecting, analyzing, validating, archiving, and sharing lessons from the 2nd Cavalry Regiment's experience with the Dragoon. Officials developed corrective actions based on this information and incorporated them into the MCWS requirements to improve its design. Due to corrective actions identified for the Dragoon, the program introduced new production risks to the MCWS because it required different hardware and software. While the Army took some steps to mitigate these risks with the vendors, such as the design integration study and system samples, it made production decisions prior to gaining sufficient knowledge consistent with our leading practices. More importantly, the program office did not adequately mitigate these production risks by following leading acquisition practices to obtain sufficient knowledge before authorizing the start of production. As a result of subsequent problems in the production line, the Army halted deliveries of the MCWS for 9 months (from February to November 2023) and delayed fielding the MCWS by at least a year.

Army Used Lessons Learned to Identify and Mitigate Design Risks

The Army applied leading practices for lessons learned by collecting, analyzing, validating, archiving, and sharing lessons from the 2nd Cavalry Regiment's experience with the Dragoon to mitigate design risks for the

²¹Best value tradeoff evaluation during a competitive source selection is appropriate when it may be in the best interest of the government to consider an award to other than the lowest priced offeror or other than the highest technically rated offeror. The process permits tradeoffs among cost or price and non-cost factors and allows the government to accept other than the lowest price. FAR 15.101-1 (a)-(c). For more information on source selection procedures, including the use of best value tradeoffs, see GAO, *Federal Contracting: Information on Agencies' Use of the Lowest Price Technically Acceptable Process*. [GAO-19-691](#) (Washington, D.C.: Sept. 26, 2019) and *Defense Contracting: Factors DOD Considers When Choosing Best Value Processes Are Consistent with Guidance for Selected Acquisitions* [GAO-14-584](#) (Washington, D.C.: July 30, 2014).

MCWS. These leading practices had been identified by us and others.²² Further, the Army acted on the information gathered from the lessons learned process by developing and incorporating specific requirements into the MCWS that addressed several risks identified in the Dragoon. Several offices were involved at points throughout this process, including:

- **DOD Office of the Director, Operational Test and Evaluation**, which reports to the Secretary of Defense on all DOD matters related to operational and live fire test and evaluation of DOD systems and services.
- **Army Test and Evaluation Command**, which has overall responsibility for all Army developmental and operational testing.
- **Army Maneuver Capabilities Development and Integration Directorate**, which determines and develops future force capabilities and future infantry and armor requirements through concept development, requirements determination, and experimentation and capability integration.
- **Stryker Warfighters' Forum** is unique to the Stryker Family of Vehicles. The forum was chartered in 2008 by the Commanders of Army Materiel Command, Army Training and Doctrine Command, and Army Forces Command. Its mission is to promote and sustain a combined Stryker Brigade Combat Team community to facilitate the modernization of the Stryker Brigade Combat Team formation.

We assessed how the Army took actions consistent with our leading practices for lessons learned process including collecting, analyzing, validating, archiving, and sharing lessons learned to reduce design risks for the MCWS. Demonstration of these leading practices is critical to ensuring that lessons learned endure and that processes are improved. We found several examples of the Army demonstrating each of the steps of the leading practices, with the need for increased lethality acting as the triggering event for the start of the process.

Collect information. This leading practice involves capturing information in the area of interest through activities like project critiques, interviews, reports, or direct observations. Army officials told us that they collected

²²GAO-19-25 and GAO-20-104. Center for Army Lessons Learned, *Establishing a Lessons Learned Program: Observations, Insights, and Lessons* (Fort Leavenworth, Kans.: June 2011).

information from the Dragoon through activities such as testing, direct observations, and user feedback. For example:

- From February to April 2018, DOD and Army test officials and requirements development officials conducted early user testing on the Dragoon in Germany. Officials collaborated with soldiers in the 2nd Cavalry Regiment to validate the effectiveness and suitability of lethality upgrades, collect gunnery lessons learned, and collect data to further refine 30-millimeter gunnery qualifications. They also collected feedback from soldiers and officers throughout the process. Through these actions, the Army identified several shortcomings in the Dragoon, including the loss of situational awareness, a lack of Dragoon-specific simulators and training devices, and an increased task load on vehicle crew.
- In March 2019, forum officials also travelled to Germany to collect direct observations and soldier feedback during an assessment of the Dragoon's doctrine, organization, training, materiel, leadership, personnel, facilities, and policy. A forum official we spoke with participated in these training exercises with the 2nd Cavalry Regiment as a member of the crew to collect information. The official noted some shortcomings on the Dragoon, such as the hatch placement on the vehicle leading to poor visibility and a lack of situational awareness for soldiers.

Analyze information. The next leading practice is to analyze the information collected to determine root causes of challenges and identify appropriate actions. Army officials told us that they analyzed the information gathered from the tests and assessments conducted on the Dragoon. For example:

- DOD test officials analyzed the information that Army test officials and requirements development officials collected during the early user testing and drafted an early fielding report on the Dragoon. This 2018 report identified challenges and provided several recommendations for the Army to consider in resolving them. These included recommendations for restoring lost situational awareness by providing a 360-degree driver's vision enhancer system, providing higher fidelity training resources for the Dragoon, and developing a plan to mitigate the task loading on the vehicle commander and gunner.
- Forum officials analyzed the information gathered during their assessment of the Dragoon in 2019 and drafted a report that highlighted their findings and provided recommendations to the Army. For example, the forum recommended that the PM SBCT develop and

add a 360-degree driver's vision enhancer system to the platform to improve diminished situational awareness.

Validate information. Once collection and analysis have identified the lessons learned, the next leading practice is to validate that the right lessons have been identified and determine the scope of their applicability. Subject matter experts or other stakeholders may be involved in this step of the process. Army officials told us they coordinated with other offices to confirm their findings before sharing them with leadership to validate that the Dragoon improved Stryker lethality. For example:

- According to requirements development officials, their leadership reviewed and validated their findings from early user testing. These officials also sent their findings to program officials to get their concurrence before leadership officially signed off on the report.
- DOD test officials stated that they shared a draft of the early fielding report with key stakeholders who participated in early user testing, including program officials and Army test officials, to validate that the Dragoon improved Stryker lethality. DOD test officials also provided the final report to members of Congress in 2018.²³
- According to a forum official, they shared their report with the program officials and requirements development officials to validate the need for increased lethality.

Store and archive lessons. Archiving lessons learned involves using a repository to disseminate and share information. As appropriate, these repositories should have the capability to store and share data and to secure classified, sensitive, or proprietary data. Archiving lessons learned should remain an ongoing process; otherwise, it risks becoming cumbersome and irrelevant. The Army identified methods for sharing lessons learned both within and outside of the Stryker community. For example:

- Requirements development and forum officials told us they stored their lessons learned reports on an internal Stryker database created by the forum titled StrykerNet. According to a forum official,

²³The Director, Operational Test and Evaluation (DOT&E) report was done under 10 U.S.C. § 2399 (renumbered as § 4171), which requires DOT&E reporting on major defense acquisition programs beyond the low-rate initial production decision. The Army provided this report to Congress even though the Dragoon was not a program of record.

StrykerNet originated in the late 2000s as a way for soldiers to share lessons learned from Iraq. It evolved into a database for the Stryker community to collaborate, share lessons learned, and receive news and announcements. StrykerNet stores documents, such as lessons learned reports, training resources, and standard operating procedures, for several Stryker initiatives.

In addition to storing their findings on StrykerNet, requirements development officials told us they stored their lessons learned report internally and uploaded it to the Center for Army Lessons Learned's Joint Lessons Learned Information System. This system facilitates the collection, tracking, management, sharing, collaborative resolution, dissemination, and archiving of information to improve the development, design, and readiness of the Joint Forces.

Disseminate and share lessons. A critical step in any lessons learned process is sharing and disseminating knowledge gained. Agencies can disseminate lessons in many ways, such as briefings, bulletins, reports, emails, websites, database entries, the revision of work processes or procedures, and training. Lessons can be "pushed," where they are automatically delivered to a user, or "pulled," where a user searches for them in an archive of lessons learned information. For example:

- StrykerNet provides daily access to the forum's repository of lessons learned including those from the Dragoon to DOD personnel who can then pull information with a common access card and a ".mil" email address. In addition, users can send questions and requests to StrykerNet experts through emails or instant messages. StrykerNet also pushes information out to users through a monthly bulletin sharing news and announcements.
- The forum hosts quarterly Stryker symposiums to share updates, review lessons learned, and discuss initiatives such as Stryker modernization. The forum also conducts new leader orientation for Stryker brigades every summer.
- The Center for Army Lessons Learned disseminates information through a variety of print and electronic formats, with its information system serving as the central repository. Anyone with a common access card has access to validated and released observations, issues, recommendations, and reports through the information system.

Develop and carry out corrective action(s). According to the Center for Army Lessons Learned, the most challenging component of the lessons learned process is establishing a way to legitimately resolve issues. This requires a deliberate process to commit resources, make decisions, and implement those decisions. For example, requirements development officials used lessons learned from the Dragoon to develop and incorporate requirements into the MCWS to mitigate the identified risks. These included, among others, requirements to improve crew 360-degree visibility while under armor and embed training capabilities, and improvements to protection while reloading ammunition. These requirements were included in the contract awarded to Oshkosh Defense in 2021.

Track status of corrective action(s). After developing and carrying out corrective actions based on lessons learned, the next leading practice is to track the status of the implementation and continue to observe the results. For example, Army officials have been actively tracking the integration and production of the MCWS, through communication with and oversight of Oshkosh Defense. Program officials stated that they conducted weekly integrated product team meetings with Oshkosh Defense and other Army offices involved with producing the MCWS. In these meetings, they discussed the production status and schedule, material and procurement status, and updates on quality and evaluations.

Evaluate and verify the corrective action(s). The final step of the lessons learned process is to determine if the corrective actions had the desired effect. Some ways to evaluate the effectiveness of the corrective actions include assessing organization behavior, organization performance, and mission effectiveness. The Army is still in the process of evaluating and verifying the integration of lessons learned from the Dragoon into the MCWS through government testing, which is scheduled to be completed by May 2024. Program officials confirmed that they plan to continue collecting lessons learned throughout testing.

Army Did Not Adequately Mitigate MCWS Production Risks

While the program used leading practices to improve the MCWS design, it did not adequately mitigate production risks that were introduced to the MCWS. These risks stemmed from the Army choosing Oshkosh Defense's approach which used hardware and software in MCWS production that differed from those used in the Dragoon. Table 1 identifies some of the differences between the Dragoon and the MCWS.

Table 1: Key Similarities and Differences between Stryker Dragoon and Medium Caliber Weapon System

	Infantry carrier vehicle – Dragoon	Medium Caliber Weapon System
Prime contractor	General Dynamics Land Systems	Oshkosh Defense
Stryker chassis	Flat-bottom hull	Double-V hull A1
Turret	Kongsberg MCT-30 turret and software	Rafael Samson turret and software
Cannon	XM813	XM813

Source: GAO review of Army documentation. | GAO-24-106590

According to our leading practices on acquisitions, programs should take steps to gather knowledge that confirms their production process is in control prior to the start of production. This helps programs identify, and subsequently mitigate, risks to ensure the program is well-positioned to field the expected capabilities in a timely manner. Key practices to gather knowledge prior to starting production include:

- **Demonstrating manufacturing processes on a pilot production line, whether physical or digital.** This step is important to validate manufacturing processes, eliminate waste, and scale up gradually to the required manufacturing level. It helps to reduce errors and inefficiencies on the production line. This practice can also be done digitally through modeling and simulations to identify potential problems early.
- **Building and testing production-representative prototypes to demonstrate products in their intended environment.** This allows the program to identify deficiencies before entering production. Identifying deficiencies after this point may require costly, time-intensive rework on units already produced and redesigns for future units.
- **Demonstrating that critical processes are in control.** This provides confidence that the product can be produced within cost, schedule, and quality targets. These processes should be repeatable, sustainable, and consistent in producing parts within the quality standards.

-
- **Conducting review before production.** This allows the program to review with decision-makers all the knowledge gathered to carefully assess the programs readiness to proceed with production.

We analyzed the extent to which the Army gathered knowledge at each of these key steps prior to starting production on the MCWS. We found that, while the Army gathered knowledge through its design integration study and production readiness reviews, among others, it made production decisions prior to gaining sufficient knowledge for a fully informed decision and did not adequately mitigate all of the risks identified.²⁴

Demonstrate manufacturing processes on a pilot production line, whether physical or digital. The Army held a full and open competition to select a vendor to integrate and produce the MCWS. According to an Oshkosh Defense representative, a part of that competition required vendors to submit a written description of their production line as part of their competition proposal. For the design integration study, a company representative told us that Oshkosh Defense built its production representative system sample in a bay environment with engineers and not on a pilot production line. Whereas, on the actual production line, hourly workers build the MCWS. The representative also stated that Oshkosh Defense did not use digital modeling or twinning to optimize production. According to this representative, as part of the full and open competition to select a vendor to integrate and produce MCWS, Oshkosh Defense submitted a written description of its production line as part of its competition proposal. Oshkosh Defense did not produce a fully integrated vehicle off a production line until July 2022, after the Army had placed delivery orders for all of the 269 vehicles authorized by the April 2019 Acquisition Decision Memorandum.

Build and test production-representative prototypes to demonstrate products in their intended environment. As part of the two-phase acquisition approach, vendors were required to build and demonstrate a production representative system sample. As previously discussed, Oshkosh Defense's sample was not built in a production-representative environment in the design integration study. The samples were also not tested by soldiers in their intended environment during the evaluation of the samples. Instead, the vendors acted as the commanders and gunners

²⁴The April 2019 acquisition decision memorandum supported a production decision, and for the purposes of this analysis we consider the production decision to be the date at or before the award of the manufacturing, integration, logistics and technical support contract, which included firm-fixed-price delivery orders for production of the MCWS.

during testing on a range. From these tests, the Army identified some technical risks with Oshkosh Defense's sample due to software performance level. The Army stated these risks were moderate because of Oshkosh Defense's assurance of a future software fix. Army officials acknowledged that they would not have the ability to evaluate the success of the software fix prior to awarding the production contract. Despite this, the Army had placed all three delivery orders for the 269 MCWS by June 2022, before validating the updated software. This situation is addressed further below.

Demonstrate that critical processes are in control. The Defense Contract Management Agency and program officials stated that they did not identify any critical processes for the production line.²⁵ Further, a company representative told us that Oshkosh Defense did not identify a Manufacturing Readiness Level (MRL) for the MCWS. MRL is a metric used to assess production readiness and provides decision-makers with an understanding of the relative maturity and risks associated with manufacturing. In 2011, DOD updated its guidance for acquisitions to encourage defense programs to use MRL criteria as a tool and resource for manufacturing related reporting and oversight.²⁶ Instead of identifying critical processes or conducting an MRL assessment to demonstrate that critical processes were in control prior to award, the program office identified 617 items, including some related to manufacturing, that both it and Oshkosh Defense representatives would independently assess to determine production readiness after award.

Conduct review before production. The Army awarded the first two delivery orders of vehicles within the first 2 months of the contract, before Oshkosh Defense held a production readiness review. Program officials and Oshkosh Defense representatives jointly held an initial production readiness review in December 2021 and a follow-on review in March 2022 as required under the contract. This type of review is held to determine whether a program's system design is ready for production and

²⁵The Defense Contract Management Agency (DCMA) provides contract administration services for DOD buying activities and works with defense contractors to help them deliver goods and services on time, at projected costs, and in accordance with performance requirements. DCMA works to identify quality deficiencies at all points throughout the production process. It oversees production by inspecting and testing the contractor's completed work and issuing requests for the contractor to correct any identified deficiencies.

²⁶Department of Defense, *DOD Manufacturing Readiness Level (MRL) Deskbook* (2020).

whether the developer had adequately conducted production planning.²⁷ At the time of the December 2021 review, the program officials and Oshkosh Defense representatives' assessments determined that Oshkosh Defense was still working to complete about 30 percent of the 617 open items for production. These open items included the software, which program officials identified as at a high risk of not being completed by the start of production. Other items included identification of facilities and equipment required for production as well as completion of quality assurance plans and metrics. At the March 2022 follow-on review, program officials and Oshkosh Defense representatives closed out most of the remaining items before starting production. At that time, however, the software was still identified as a high risk as it was not functioning as required.

The Army decided to proceed with MCWS production, which began in March 2022. The Army authorized the start of production prior to gathering sufficient knowledge of key production steps for a fully informed decision. According to program officials, they awarded the firm-fixed-price delivery orders quickly to achieve cost savings and because they wanted to field the capability to the warfighter as fast as possible. The contract with Oshkosh Defense, signed in June 2021, set a schedule for the pricing of vehicles in 12-month increments with prices increasing on later orders. The Army awarded the first two delivery orders of vehicles within the first 2 months of the contract, before Oshkosh Defense held the production readiness review or demonstrated its manufacturing process on a pilot production line, and well before the period to exercise the orders expired.

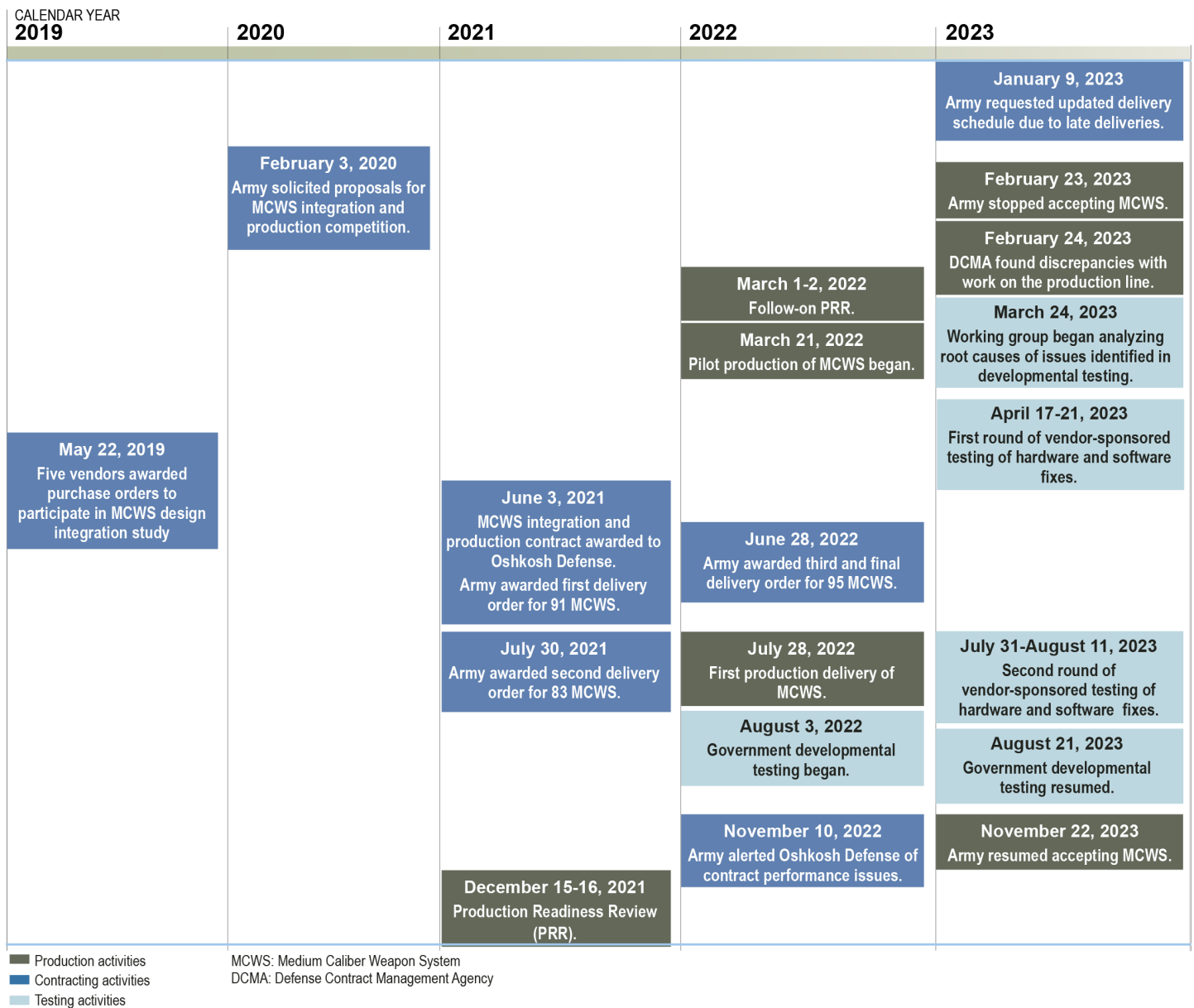
Further, since production started in March 2022, Oshkosh Defense has experienced challenges on its production line. Specifically, the Army noted inadequate work instructions for the production line, missing or damaged parts on the produced vehicles, and persistent late deliveries of vehicles due to supply chain and quality issues. In addition, Army testing found safety hazards, as well as issues with the ability to fully rotate the turret, and software related to weapon accuracy and reliability. These challenges in testing and production led the Army to stop accepting the MCWS in February 2023. As a result, according to an Oshkosh Defense representative, Oshkosh Defense significantly slowed production, halting final assembly completely. At that time, the Army had only accepted 19

²⁷Even though the acquisition approach did not include an engineering and manufacturing development phase, the contract did require Oshkosh Defense to conduct a production readiness review within 180 days of contract award.

MCWS, some of which were late and had missing or damaged parts. According to an Oshkosh Defense representative, in August 2023, Oshkosh Defense completed internal verification testing of fixes for the software issues identified during government testing. Army officials told us that government verification testing resumed in late August 2023 and is scheduled to continue through May 2024. According to program and test officials, early testing shows that while some challenges were successfully mitigated, others persist. The program office informed us that overall MCWS vehicle performance and reliability has increased by 80 percent.

See figure 7 for a timeline of production events.

Figure 7: Timeline of MCWS Production Events



Source: GAO review of Army documentation. | GAO-24-106590

Program officials told us that they resumed acceptance of the MCWS in November 2023 after the Army verified the contractor's fixes and a review of test results. Program officials told us that the production line was updated to reflect changes needed as a result of testing. Prior to resuming acceptance, Oshkosh Defense was 99 units behind schedule in production according to the contract delivery schedule. As a result of these delays, program officials stated that fielding of the first MCWS brigade is delayed by 1-year to the first quarter of fiscal year 2025.

As stated previously, the Army has incorporated lessons learned into the MCWS design effort. However, the Army could also apply the same lessons learned process for the challenges it experienced in production. In this case, the Army did not fully follow sound acquisition practices that would have identified and potentially mitigated the hardware and software challenges encountered in production of the MCWS. As a result, the Army faces at least a 1-year delay in fielding a capability that the warfighter needs. Following acquisition leading practices for future Stryker upgrade efforts would mitigate production risks by ensuring that the Army collects sufficient knowledge about production maturity prior to entering production.

Army Used Historical Data to Inform Cost Estimate for the Medium Caliber Weapon System

The program office primarily used historical costs associated with the Stryker Dragoon and Stryker Family of Vehicles fielding costs as sources to calculate the life-cycle costs for the MCWS. In addition, the office used the Bradley infantry fighting vehicle as a source for the costs of a specific subsystem. According to PEO GCS and Marine Corps officials, the Army made no cost comparisons to any Marine Corps combat vehicles because none of them have a 30-millimeter cannon like the MCWS.²⁸ The Army estimated the life-cycle costs for the 269 MCWS vehicles to be about \$1.1 billion. The acquisition cost was estimated at \$880 million.

As the milestone decision authority, in April 2019, the PEO GCS required program officials to develop a cost estimate, which was signed in May 2019. According to PEO GCS officials, the program office cost estimate was structured according to the May 2002 *Army Cost Analysis Manual*.²⁹ According to program officials and documentation, the estimate included

²⁸Our mandate included a provision for us to do an analysis of MCWS program costs, including a comparison of MCWS costs to those for similar combat systems in the Army and Marine Corps. H.R. Rep. No. 117-347, at 8 (2023); Pub. L. No. 117-263 (2022).

²⁹Department of the Army, *Cost Analysis Manual*, U.S. Army Cost and Economics Analysis Center (May 2002).

elements such as research, development, test and evaluation for prototyping and testing; procurement for production and hardware upgrades; and fielding for spare parts and interim contractor logistics training. These elements included only the costs for integration and production of the turret and 30-millimeter cannon onto the Stryker Double-V Hull A1 chassis and did not include the cost of the chassis itself since it was provided as government-furnished equipment.

For a major defense acquisition program following the Major Capability Acquisition pathway, an independent life-cycle cost estimate is conducted.³⁰ This type of cost estimate is conducted by an entity outside of the program office, frequently using different methods, and is thus less burdened with organizational bias to create the estimate. According to program officials, since the MCWS was not considered a separate program from the Stryker Family of Vehicles but an accelerated acquisition, the MCWS did not follow any adaptive acquisition framework pathway, and no independent cost estimate was required.

Even though the Army did not require or conduct an independent cost estimate, some Army offices did provide limited reviews. According to officials from the Office of the Deputy Assistant Secretary of the Army for Cost and Economics, they reviewed the program office's cost estimate and found it to be reasonable. These officials did not validate the cost estimate, provide a sufficiency review, or document their review comments and resolutions. Program officials noted that the DOD Office of Cost Assessment and Program Evaluation, responsible for conducting or reviewing independent cost estimates for the Office of the Secretary of Defense for selected programs, did not review the cost estimate. According to Army G-8 officials, they reviewed the cost estimate for reasonableness but did not document their review activities or conduct an affordability analysis as would be required for a major defense acquisition program. An affordability analysis demonstrates whether a program's acquisition strategy has an adequate budget.

Program officials noted that they do not intend to update the MCWS cost estimate because all 269 MCWS required to equip the three Stryker brigades have been ordered and requisite funding was obligated at that time. These officials stated that the operations and support costs for the MCWS were subsumed into the Stryker Family of Vehicles cost estimate beginning with the fiscal year 2021 budget. They also noted that the

³⁰10 U.S.C. § 3222 (a).

operations and support costs for individual variants within the family of vehicles are not reported separately to Congress.

In general, our review found the MCWS cost estimate to be reasonably calculated, albeit with some discrepancies. For example, according to program officials and documentation, the life-cycle cost estimate of about \$1.1 billion was a point estimate and did not include a sensitivity or risk and uncertainty analysis, which helps establish how input changes affect total program costs and a range of possible cost outcomes, respectively. We also identified minor mistakes in calculation of the cost estimate, including one historical comparison that was not fully explained and the possible overestimation of a labor rate due to a miscalculation.

Conclusions

To respond to increased competition from adversaries, the Army intended to rapidly upgrade its existing Stryker infantry fighting vehicles for enhanced lethality. However, in prioritizing cost savings and rapid fielding, the Army assumed additional production risks because it did not follow sound acquisition practices. These included conducting a production readiness review and ensuring that key software worked as intended, prior to awarding delivery orders for production of 269 MCWS. While the Army mitigated some of its cost-risk by awarding firm-fixed-price delivery orders, the time needed to address manufacturing and software issues ultimately resulted in delaying fielding of required capability by at least a year. Implementing leading practices for acquisition production would ensure that future upgrades for the Stryker develop sufficient knowledge about production maturity prior to entering production and potentially avoid the issues experienced on the MCWS.

Recommendation for Executive Action

The Secretary of the Army should ensure that Program Executive Office Ground Combat Systems applies acquisition leading practices to manage and address production risk to inform future Stryker upgrade efforts. (Recommendation 1)

Agency Comments and Our Evaluation

We provided a draft of this report to the Army for review and comment. In its comments, reproduced in Appendix II, the Army concurred with the intent of the report without specifically addressing the recommendation. The Army noted that it had taken certain actions, which we identified in the report, that reflect some of our leading practices. As we note in the report, however, the Army conducted production readiness reviews after ordering most of the 269 Medium Caliber Weapon System vehicles. By not conducting timely production readiness reviews to determine if the contractor's production line met maturity standards and ensuring the software worked as intended, the Army is delayed by at least one year in

providing capability to the warfighter. Our recommendation is intended to ensure that the Army follows leading acquisition practices prior to entering production on future upgrades to the Stryker Family of Vehicles. We will continue to monitor the Army's actions to implement the recommendation. The Army also provided technical comments that we incorporated as appropriate.

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

If you or your staff have any questions about this report, please contact me at (202) 512-4841 or sehgal@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.

A handwritten signature in black ink, appearing to read 'M. Sehgal', with a long horizontal stroke extending to the left.

Mona Sehgal
Acting Director, Contracting and National Security Acquisitions

Appendix I: Objectives, Scope, and Methodology

A House Armed Services Committee report accompanying the James M. Inhofe National Defense Authorization Act for Fiscal Year 2023 contains a provision for us to review the Army's efforts to upgrade and improve the lethality of the Stryker with an uncrewed, turreted 30-millimeter automatic cannon, which was subsequently termed the Medium Caliber Weapon System (MCWS).¹ This report addresses the (1) requirements and acquisition approaches for the MCWS, (2) extent to which the Army followed our leading practices in identifying and mitigating risks for the MCWS, and (3) sources the Army considered in developing the MCWS's life-cycle costs.

To describe the requirements and acquisition approaches for the MCWS, we reviewed documentation dating back to the Army's 2015 Operational Needs Statement to its current effort to acquire the MCWS capability. To understand the requirements development process, we reviewed the Stryker Operational Requirements Document, Stryker lethality requirements trace, and briefings and memorandums from the Army Requirements Oversight Council regarding Stryker lethality. To understand the MCWS acquisition approach, we reviewed acquisition decision memorandums, acquisition plans, budget information, Department of Defense and Army acquisition policy and guidance, MCWS acquisition program baseline, source selection documentation, contracts, and requests for quotes and proposals. We used the information in these documents to describe how the Army developed the acquisition to meet MCWS requirements.

We also interviewed Army officials to supplement our understanding of the requirements development and acquisition approaches. We interviewed the Program Executive Office Ground Combat Systems (PEO GCS) - Project Manager Stryker Brigade Combat Team (PM SBCT); Assistant Secretary of the Army for Acquisition, Logistics, and Technology; and Army Futures Command's Maneuver Capabilities Development and Integration Directorate to better understand both the requirements development and acquisition approaches. In addition, we interviewed the Army Contracting Command-Detroit Arsenal; Deputy Assistant Secretary of the Army for Cost and Economics; and Army Deputy Chief of Staff, G-8 to better understand the MCWS acquisition approach. Our report scope focused on the transfer of lessons learned from the 2015 urgent request for increased Stryker lethality to the MCWS.

¹H.R. Rep. No. 117-347, at 8 (2023); James M. Inhofe National Defense Authorization Act for Fiscal Year 2023, Pub. L. No. 117-263 (2022).

We applied acquisition leading practices related to production because the scope of our review focused on the production of MCWS.

To assess the extent to which the Army followed our leading practices in identifying and mitigating risks for the MCWS, we used two different leading practices criteria: those for lessons learned, and those for acquisition.

To determine the extent to which the Army took actions consistent with leading practices identified by us and the Center for Army Lessons Learned for collecting, analyzing, validating, archiving, and sharing and disseminating lessons learned, we compared the Army's activities related to lessons learned for development of the Stryker Dragoon in response to the 2015 Operational Needs Statement against the leading practices identified in our prior work.² For each step of the lessons learned process, one analyst reviewed documentation including the Stryker Warfighters' Forum's database titled StrykerNet; the Office of the Director, Operational Test and Evaluation's Early Fielding Report of the Stryker Infantry Carrier Vehicle - Dragoon; and the Stryker Brigade Combat Team Lethality DOTMLPF-P Assessment; to determine whether the Army took actions consistent with the leading practices.³ A second analyst then checked the same documents and activities to verify the initial results. The analysts came to the same results. To gain further insight into these actions, we interviewed officials from the PEO GCS - PM SBCT; Army Test and Evaluation Command; the Office of the Director, Operational Test and Evaluation; and the Stryker Warfighters' Forum.

To determine the extent to which the Army took steps consistent with our leading practices for acquisition, we compared the Army's actions against

²GAO, *Project Management: DOE and NNSA Should Improve Their Lessons-Learned Process for Capital Asset Projects*, [GAO-19-25](#) (Washington, D.C.: Dec. 21, 2018); and *DOD Utilities Privatization: Improved Data Collection and Lessons Learned Archive Could Help Reduce Time to Award Contracts*, [GAO-20-104](#) (Washington, D.C.: Apr. 2, 2020).

³DOTMLPF-P means Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities, and Policy.

the leading practices we identified in our prior work.⁴ We selected leading practices associated with production because of the MCWS' acquisition plan and its focus on production. We analyzed Army actions to: (1) demonstrate manufacturing processes on a pilot production line, whether physical or digital; (2) build and test production-representative prototypes to demonstrate product in the intended environment; (3) demonstrate that critical processes are in control; and 4) conduct review before production. In doing so, an analyst reviewed testing and production documentation, including test plans and schedules, production readiness review documents, and source selection documentation. Another analyst reviewed the same documentation and verified this analysis. The analysts came to the same results. To gain further insight on these actions, we interviewed officials from the PEO GCS - PM SBCT; Army Test and Evaluation Command; the Office of the Director, Operational Test and Evaluation; Army Contracting Command-Detroit Arsenal; and the Defense Contract Management Agency. We also interviewed a representative from Oshkosh Defense, LLC, the prime vendor for the MCWS, to gain perspective on production.

To describe the sources the Army considered in developing the MCWS life-cycle costs, we obtained and analyzed the MCWS program office's cost estimate and model. This allowed us to describe its approach to one of the steps of the 12-step cost estimating process outlined in our *Cost Estimating and Assessment Guide—specifically, Chapter 10: Step 7: Develop the Point Estimate*.⁵ A description of the approach to the point estimate provides information on the methods and data sources, and also

⁴GAO, *Leading Practices: Agency Acquisition Policies Could Better Implement Key Product Development Principles*, GAO-22-104513 (Washington, D.C.: Mar. 10, 2022); *Weapon Systems Annual Assessment: Challenges to Fielding Capabilities Faster Persist*, GAO-22-105230 (Washington, D.C.: June 8, 2022); *Weapon Systems Annual Assessment: Programs Are Not Consistently Implementing Practices That Can Help Accelerate Acquisitions*, [GAO-23-106059](#) (Washington, D.C.: June 8, 2023); and *Leading Practices: Iterative Cycles Enable Rapid Delivery of Complex, Innovative Products*, [GAO-23-106222](#) (Washington, D.C.: July 27, 2023).

⁵The 12-step process addresses best practices, including defining the program's purpose, developing the estimating plan, defining the program's characteristics, determining the estimating approach, identifying ground rules and assumptions, obtaining data, and developing the point estimate. The last five steps are conducting sensitivity analysis, performing a risk or uncertainty analysis, documenting the estimate, presenting it to management for approval, and updating it to reflect actual costs and changes. Following these steps ensures that realistic cost estimates are developed and presented to management, enabling them to make informed decisions. See GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Program Costs*, [GAO-20-195G](#) (Washington, D.C.: Mar. 12, 2020).

includes elements from the first six steps of the guide. Because the objective focuses on sources for the cost estimate, and the Army has already obligated all the funds for production of the authorized 269 MCWS, we determined that performing a detailed review of the last five steps of the guide would add little value to the analysis. We also reviewed the *Army Cost Analysis Manual* dated May 2002. We interviewed officials from the Army PEO GCS - PM SBCT and Deputy Assistant Secretary of the Army for Cost and Economics, and the Marine Corps' Program Executive Office Land Systems.

We conducted this performance audit from January 2023 to March 2024 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 the Army



**OFFICE OF THE PERFORMANCE IMPROVEMENT OFFICER AND
DIRECTOR OF ADMINISTRATION AND MANAGEMENT**

1950 DEFENSE PENTAGON
WASHINGTON, DC 20301-1950

MARCH 4, 2024

PERFORMANCE IMPROVEMENT
DIRECTORATE

Ms. Mona Sehgal
Director, Contracting and National Security Acquisitions
U.S. Government Accountability Office
441 G Street NW
Washington, DC 20548

Dear Ms. Sehgal,

I am transmitting the Department of Defense (DoD) response to the GAO Draft Report, GAO-24-106590, 'ARMY MODERNIZATION: Production Challenges for Stryker Upgrade Reinforce Need to Follow Acquisition Leading Practices in Future Efforts,' dated January 8, 2024 (GAO Code 106590) on behalf of the Department of the Army. Attached is DoD's response to the subject report. Thank you.

GARZA.MIRAND Digitally signed by
GARZA.MIRAND.A.L.1155067698
A.L.1155067698 Date: 2024.03.04 19:28:24
-05'00'
Miranda L. Garza
Associate Director, Audit Management
Performance Improvement Directorate

Appendix II: Comments from the Department
of the Army



SECRETARY OF THE ARMY
WASHINGTON
MAR 01 2024

Ms. Miranda L. Garza
Associate Director, Audit Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC, 20548

Dear Ms. Garza:

The Army concurs with the intent of the GAO Draft Report, GAO-24-106590, "Army Modernization: Production Challenges for Stryker Upgrade Reinforce Need to Follow Acquisition Leading Practices in Future Efforts" (GAO Code 106590). Clarifying information for consideration:

Observed performance challenges and lessons learned from the Infantry Carrier Vehicle-Dragon (ICV-D) generated updated requirements. The updated requirements resulted in the Army developing a new Medium Caliber Weapon System (MCWS) and updating the vehicle platform, now called the Stryker Infantry Carrier Vehicle Double-V Hull A1 30-milimeter (ICVVA1-30mm).

The Army assessed and mitigated ICVVA1-30mm production risks through lessons learned from the following: operation of the ICV-D; design integration studies with industry; the source selection process; risk mitigation testing; production readiness reviews; and production verification testing.

Thank you again for the opportunity to comment. My point of contact is Mr. Dale N. Fletcher, Office of the Assistant Secretary of the Army (Acquisition, Logistics, and Technology), dale.n.fletcher.civ@army.mil or 703-614-8694.

Sincerely,

A handwritten signature in black ink, reading "Christine R. Wormuth", is positioned above the printed name.

Christine R. Wormuth

GAO DRAFT REPORT DATED JANUARY 8, 2024
GAO-24-106590 (GAO CODE 106590)

“ARMY MODERNIZATION: PRODUCTION CHALLENGES FOR STRYKER
UPGRADE REINFORCE NEED TO FOLLOW ACQUISITION LEADING PRACTICES
IN FUTURE EFFORTS”

DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATION

RECOMMENDATION 1: The Secretary of the Army should ensure that Program Executive Office Ground Combat Systems applies acquisition leading practices to manage and address production risk to inform future Stryker upgrade efforts.

DoD RESPONSE: The Army concurs with the intent of the GAO Draft Report, GAO-24-106590, “Army Modernization: Production Challenges for Stryker Upgrade Reinforce Need to Follow Acquisition Leading Practices in Future Efforts”, dated January 8, 2024 (GAO Code 106590) and provides the following clarifying information for consideration:

- Observed performance challenges and lessons learned from the Infantry Carrier Vehicle Dragoon (ICV-D) generated updated requirements. The updated requirements resulted in the Army developing a new the Medium Caliber Weapon System (MCWS) and updating the vehicle platform, now called the Stryker Infantry Carrier Vehicle Double-V Hull A1 30-milimeter (ICVVA1-30mm).
- The Army assessed and mitigated ICVVA1-30mm production risks through lessons learned from the following: operation of the ICV-D; Design Integration Studies with Industry; the Source Selection process; Risk Mitigation Testing; Production Readiness Reviews; and Production Verification Testing.

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

Mona Sehgal, (202) 512-4841 or sehgalm@gao.gov

Staff Acknowledgments

In addition to the contact named above, J. Kristopher Keener (Assistant Director), Joe E. Hunter (Analyst-in-Charge), Emily Smith, Joseph Oudin, Rose Brister, Breanne Cave, Scott Hepler, Tonya Humiston, William Laing, Jennifer Leotta, Kevin O'Neill, and Christine Pecora made key contributions to this report.

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