



# The Army's M-4 Carbine: Background and Issues for Congress

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June 8, 2010

**Congressional Research Service**

7-5700

[www.crs.gov](http://www.crs.gov)

RS22888

## Summary

The M-4 carbine is the Army's primary individual combat weapon for infantry units. While there have been concerns raised by some about the M-4's reliability and lethality, some studies suggest that the M-4 is performing well and is viewed favorably by users. The Army is undertaking both the M4 Carbine Improvement Program and the Individual Carbine Competition, the former to identify ways to improve the current weapon, and the latter to conduct an open competition among small arms manufacturers for a follow-on weapon. An integrated product team comprising representatives from the Infantry Center; the Armament, Research, Development, and Engineering Center; the Program Executive Office Soldier; and each of the armed services will assess proposed improvements to the M4. The proposal for the industry-wide competition is currently before the Joint Requirements Oversight Council, and with the anticipated approval, solicitation for industry submissions could begin this fall. It is expected, however, that a selection for a follow-on weapon will not occur before FY2013, and that fielding of a new weapon would take an additional three to four years.

This report will be updated as events warrant.

## **Contents**

Background .....	1
M4 Carbine Improvement Program and Carbine Competition.....	1
M4 Carbine Improvement Program .....	1
Individual Carbine Competition .....	2
Concerns with M-4 Reliability and Lethality .....	2
USSOCOM M-4A1 Study.....	2
Soldier Weapons Assessment—Operation Iraqi Freedom.....	3
Center for Naval Analyses (CNA) Study on Small Arms in Combat .....	3
Special Forces Opts to Replace the M-4 .....	4
U.S. Army Rangers to Employ SCAR in Combat .....	5
Congressionally Requested M-4 Test.....	5
U.S. Army Small Arms Capabilities-Based Assessment (CBA).....	6
An Examination of the Small Arms Capability-Based Assessment .....	7
Army Looks for a Replacement for the M-4 .....	7
Department of Defense Conducts a Service-Wide Review of Small Arms .....	8
Potential Issues for Congress.....	8
M-4 Performance and Reliability.....	8
DOD's Small Arms Review Versus the Army's Plan to Replace the M-4.....	8
USSOCOM Implications of Replacing M-4s .....	8

## **Contacts**

Author Contact Information .....	9
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## Background

In the mid-1990s, the Army began fielding the M-4 carbine, a lighter, more compact version of the Vietnam-era M-16 rifle. Both M-16 and M-4 carbines are 5.56 mm caliber weapons and are primarily manufactured by Colt Defense LLC, Hartford, CT. Army officials are said to be satisfied with the M-16 family of weapons and have suggested that the M-16 is “simply too expensive to replace with anything less than a significant leap in technology.”<sup>1</sup> The Army’s “leap ahead” program to replace the M-16 family of weapons—the Objective Individual Combat Weapon (OICW) program—began in 1994, and one weapon evaluated in that program, Heckler & Koch’s XM-8 assault rifle, was considered by some as the M-16’s/M-4’s replacement. As late as 2005, the XM-8 was reportedly close to being officially approved as the Army’s new assault rifle, but alleged acquisition and bureaucratic conflicts compelled the Army to cancel the XM-8 in October 2005. The Army plans to continue its procurement of M-16s and M-4s for “years to come,” while some in Congress have called for an “open competition” to choose a successor to the M-16 and M-4 assault rifles.<sup>2</sup>

## M4 Carbine Improvement Program and Carbine Competition

### M4 Carbine Improvement Program

The M4 Carbine Improvement Program will evaluate the following potential improvements:<sup>3</sup>

- Heavier barrel for better performance during high rates of fire.
- Replacing the direct-gas system with a piston gas system.
- Improving trigger pull.
- Strengthening the rail system.
- Adding ambidextrous controls.
- Adding a round-counter to track number of total rounds fired.

The option of a heavier barrel is being considered in response to concerns about barrel warping and erosion during high rates of fire. The M4 currently has a system that uses the gas generated by a cartridge firing to cycle the next round into the weapon’s receiver. This reduces the number of moving parts in the rifle in comparison to the gas-piston system and offers potential improvements in the weapon’s stability when firing; however, it also results in greater amounts of heat and carbon deposits in the receiver, which can lead to the weapon’s malfunctioning. The rail along the top of the rifle’s receiver lends stability to the weapon and also serves as the mount for weapon attachments. Increasing its strength without adding weight to the weapon may be possible

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<sup>1</sup> Matthew Cox, “Better Than M4, But You Can’t Have One,” *Army Times*, March 1, 2007, and “Competition Sought for New Army Rifle,” *Army Times*, April 27, 2007.

<sup>2</sup> *Ibid.*

<sup>3</sup> “Major revamp Possible for M4 Carbine,” *Army Times*, November 22, 2009.

with the use of new composite materials or metal alloys. A round counter would make it possible to better evaluate when an individual weapon should be refurbished or replaced.

The assessment of these options is being undertaken by an integrated product team comprising representatives from the Infantry Center; the Armament, Research, Development, and Engineering Center; the Program Executive Office Soldier; and each of the other armed services.

## **Individual Carbine Competition**

The Army intends to conduct an open competition for a successor to the M4. Its proposal is before the Joint Requirements Oversight Council for approval and, if approved as expected, would permit the Army to solicit submissions from the small arms industry by this fall. The competition will be open to all manufacturers and is intended to provide an evaluation of the full range of weapons available. Complete results of the competition and selection of a new carbine are not expected before FY2013, and it is anticipated that it would then take another three to four years to fully field the new weapons.<sup>4</sup>

## **Concerns with M-4 Reliability and Lethality**

Reports suggest that soldiers have expressed concerns regarding the reliability and lethality of the M-4.<sup>5</sup> Reliability can be described as “the probability that an item can perform its intended function for a specified interval under stated conditions” and lethality as “the killing or stopping power of a bullet when fired from a weapon.”<sup>6</sup> Other reports, however, suggest that the M-4 has performed well and been generally well-received by troops.

## **USSOCOM M-4A1 Study<sup>7</sup>**

In February 2001, USSOCOM published a study and analysis of alternatives focused on the M-4A1 carbine used by USSOCOM units. The study concludes that the M-4A1 design was fundamentally flawed—in part due to barrel and gas tube shortening—and that a variety of factors “led to alarming failures of the M-4A1 in operations under the harsh conditions and heavy firing schedules common in SOF training and operations.”<sup>8</sup> While USSOCOM concluded in 2001 that the M-4A1 carbine in its current configuration did not meet SOF requirements,<sup>9</sup> USSOCOM noted that the shortfalls that they identified had not become evident in conventional Army units that used the M-4, likely due to the “newness” of the weapon and the lower firing schedules of

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<sup>4</sup> “The Future of US Army Small Arms”, *Soldier Systems* April 12, 2010.

<sup>5</sup> M4 Not Suited to Warfare in Afghan Hills,” *Marine Corps Times*, May 22, 2010.

<sup>6</sup> Shawn T. Jenkins and Douglas S. Lowrey, “A Comparative Small Analysis of Current and Planned Small Arms Weapon Systems,” MBA Professional Report, Naval Postgraduate School, Monterey, CA, December 2004, pp. 29-31.

<sup>7</sup> Information from this section is taken from USSOCOM Study: “M-4A1 Carbine and Related Systems Deficiencies and Solutions: Operational and Technical Study With Analysis of Alternatives,” February 23, 2001.

<sup>8</sup> *Ibid.*, p. 5.

<sup>9</sup> *Ibid.*, p. 20.

conventional unit training.<sup>10</sup> USSOCOM further noted that the M-4 met or exceeded the Army's specifications for reliability and that the M-4 met the needs of the conventional Army.<sup>11</sup>

## **Soldier Weapons Assessment—Operation Iraqi Freedom<sup>12</sup>**

In July 2003, the Army published a report to assess small arms performance during Iraqi Freedom. Army personnel interviewed over 1,000 soldiers to assess what “worked well and what did not.” The assessment was generally favorable toward all small arms examined and did not employ any discernable analytic metrics. The assessment stated that the M-4 was “by far the preferred individual weapon across the theater of operations”<sup>13</sup> and recommended in the “near term replace the M-16 with the M-4 as the standard issue weapon.”<sup>14</sup> But without any corresponding analytical data, some might question the validity of the Army's assessment.

## **Center for Naval Analyses (CNA) Study on Small Arms in Combat<sup>15</sup>**

In December 2006, the Center for Naval Analyses (CNA) published a survey and study at the request of the Army's Project Manager-Soldier Weapons of 2,600 soldiers who had returned from Iraq and Afghanistan and who had engaged in a firefight using a variety of small arms. Some of the M-4-specific observations were as follows:

- Over 50% of soldiers using the M-4 and M-16 reported that they never experienced a stoppage [malfunction] while in theater, to include during training firing of the weapons (p. 2).
- Frequency of disassembled cleaning had no effect on the occurrences of stoppages. Variations in lubrication practices, such as the type of lubrication used and the amount of lubrication applied, also had little effect on stoppages. Using a dry lubricant decreased reports for stoppages only for M-4 users (p. 3).
- Of soldiers surveyed who used the M-4, 89% reported being satisfied with their weapon (p. 11).
- Of M-4 users, 20% recommended a larger bullet for the M-4 to increase lethality (p. 30).
- Regarding M-16s and M-4s, many soldiers and experts in theater commented on the limited ability to effectively stop targets, saying that those personnel targets who were shot multiple times were still able to continue fighting (p. 29).

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<sup>10</sup> Ibid., p. 6.

<sup>11</sup> Ibid., p. 6.

<sup>12</sup> Information in this section is taken from Project Manager Soldier Weapons, “Soldier Weapons Assessment Team Report 6-03: Operation Iraqi Freedom,” July 31, 2003.

<sup>13</sup> Ibid., p. 34.

<sup>14</sup> Ibid., p. 35.

<sup>15</sup> Information in this section is taken from Center for Naval Analyses (CNA) Study: “Soldier Perspectives on Small Arms in Combat,” December 2006. CNA is a federally-funded research and development center (FFRDC) for the Department of the Navy.

Although M-4 critics cite this report as evidence of unsuitability of the M-4, it might also be interpreted as a favorable report on the M-4's overall reliability and acceptance by soldiers. The "larger bullet" recommendation for lethality purposes may, in fact, be a valid recommendation based on observations from Iraq and Afghanistan, but the "bigger bullet debate" has been a source of contention for many small arms experts ever since the Army adopted the 5.56 mm M-16 during Vietnam in lieu of the 7.62 mm M-14 rifle.

## Special Forces Opts to Replace the M-4<sup>16</sup>

In USSOCOM's February 2001 study, a number of M-4 reliability problems were documented.<sup>17</sup> The USSOCOM report described the M-4's shortened barrel and gas tube as a "fundamentally flawed design," which contributed to failures extracting and ejecting spent cartridges during firing. In recognition of these reported deficiencies, the 1<sup>st</sup> Special Forces Operational Detachment-Delta, also referred to as "Delta Force," reportedly began working with German arms manufacturer Heckler & Koch to replace the M-4's gas system with a piston operating system to improve reliability and increase parts life. In 2004, Delta reportedly replaced their M-4s with the HK-416—a weapon that combines the operating characteristics of the M-4 with the piston operating system.<sup>18</sup>

In addition to reliability problems detailed in USSOCOM's February 2001 study, another possible reason that USSOCOM might have wanted to replace the M-4 carbine is that the M-4 was a weapon procured by the Department of Defense and subject to military standards and the technical data package, meaning that USSOCOM could not make changes to the weapon. If USSOCOM became the procurement agency for a new carbine, then they could direct the carbine's manufacturer to make changes and modifications.

In early 2003, USSOCOM officials initiated efforts to identify potential new combat rifle capabilities.<sup>19</sup> From May through August 2004, USSOCOM evaluated 12 weapons from nine different manufacturers.<sup>20</sup> In November 2004, USSOCOM awarded a contract to FNH USA<sup>21</sup> to develop the Special Operations Combat Assault Rifle (SCAR).<sup>22</sup> The SCAR will come in two variants—the heavy 7.62 mm SCAR-H and the light 5.56 mm SCAR-L.<sup>23</sup> Each variant will accommodate three different barrels—a standard 35.7 cm barrel, a 25.5 cm close-combat barrel, and a sniper variant barrel. All barrels reportedly will take less than five minutes to switch. The SCAR-L is intended to replace USSOCOM M4-A1 carbines.

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<sup>16</sup> For additional information on U.S. Special Forces, see CRS Report RS21048, *U.S. Special Operations Forces (SOF): Background and Issues for Congress*, by Andrew Feickert.

<sup>17</sup> USSOCOM Study: "M-4A1 Carbine and Related Systems Deficiencies and Solutions: Operational and Technical Study With Analysis of Alternatives," February 23, 2001.

<sup>18</sup> Matthew Cox and Kris Osborn, "M4, In Their Sights," *Defense News*, February 25, 2008.

<sup>19</sup> Scott R. Gourley, "Soldier Armed: Special Operations Forces Combat Assault Rifles," *Association of the U.S. Army (AUSA) Army Magazine*, May 1, 2006.

<sup>20</sup> "US SOCOM Awards Contract for SCAR Development," *Jane's International Defense Review*, January 2008, p. 26.

<sup>21</sup> FNH USA is the U.S.-based sales and marketing entity for the Belgium-based FN Herstal S.A.

<sup>22</sup> Scott R. Gourley, "SCAR Evaluation Nears Conclusion," *Jane's Defence Weekly*, March 19, 2009, p. 12.

<sup>23</sup> Information in this section is from Joshua Kucera, "SOCOM Selects New Assault Rifle," *Jane's Defence Weekly*, February 5, 2005, p. 8.

## **U.S. Army Rangers to Employ SCAR in Combat<sup>24</sup>**

In April 2009, the first 600 of 1,800 SCARs to be issued to USSOCOM were fielded to units of the 75<sup>th</sup> Ranger Regiment, and reports suggest that the Rangers will deploy into combat with the SCAR. Because this is the first known large-scale deployment of this weapon into combat, there will likely be a significant amount of evaluation of the SCAR's reliability and performance. These evaluations may prove useful to the Army as it examines the future of small arms.

## **Congressionally Requested M-4 Test**

In April 2007, Senator Tom Coburn (R-Oklahoma) sent a letter to then Acting Secretary of the Army Peter Geren questioning why the Army planned to spend \$375 million on M-4 carbines through FY2009 “without considering newer and possibly better weapons available on the commercial market.”<sup>25</sup> Senator Coburn's letter also cited M-4 reliability and lethality concerns and called for a competition to evaluate alternatives to the M-4, citing a need to conduct a “free and open competition.” The Army initially agreed to begin the tests in August 2007 at the Army Test and Evaluation Center at Aberdeen Proving Ground, MD, but then postponed the test until December 2007.<sup>26</sup> The test evaluated the M-4 against the HK-416, the HK-XM8, and the FNH SCAR, with each weapon firing 6,000 rounds under sandstorm conditions. Officials reportedly evaluated 10 each of the four weapons, firing a total of 60,000 rounds per model resulting in the following: XM-8, 127 stoppages; FNH SCAR, 226 stoppages; HK-416, 233 stoppages; and the M-4, 882 stoppages.<sup>27</sup> On December 17, 2007, when the Army briefed Congress and the press, the Army reportedly claimed that the M-4 suffered only 296 stoppages during the test, explaining that the stoppage discrepancy from the original 882 M-4 stoppages reported could have been due to the application of the Army Test and Evaluation Center's post-test Reliability, Availability, and Maintainability (RAM) Scoring Conference.<sup>28</sup> This process attributes failures to such factors as operator error or part failure and, as an example, if evaluators linked 10 stoppages to a broken part on a weapon, they could eliminate nine of the stoppages and count only one failure for reporting purposes.

The M-4's developer, Colt Defense, LLC, contends that there were a number of factors during the test that might have resulted in testing discrepancies.<sup>29</sup> Among the issues raised, the Colt M-4 carbines used for the test were drawn from the Army's inventory and did not meet military specifications but were used in the test, whereas weapons tested from other manufacturers were provided from the manufacturers. Another point of contention was that the M-4 carbines were three-round burst weapons and the other weapons tested were fully automatic. It was also alleged that testers did not know how to operate the three-round burst M-4s in both the laboratory environment and in a related test at Aberdeen Proving Grounds and, therefore, mistakenly reported M-4 stoppages, resulting in inflated results. Given these and other allegations, it is

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<sup>24</sup> Information in this section is taken from Matthew Cox, “75<sup>th</sup> Rangers Will Take Scar Into Combat,” *Defense News*, May 11, 2009.

<sup>25</sup> Information in this section is from Matthew Cox, “Competition Sought for New Army Rifle,” *Army Times*, April 27, 2007.

<sup>26</sup> Matthew Cox, “Army Tests of Rival Carbines Postponed,” *Army Times*, September 20, 2007.

<sup>27</sup> Matthew Cox, “New Carbines Outperform M-4 in Dust Test,” *Army Times*, December 17, 2007.

<sup>28</sup> Information in this section is from Matthew Cox, “Giving M-4 Failures an Alibi,” *Army Times*, December 29, 2007.

<sup>29</sup> Information in this section is from a briefing given to CRS by Colt Defense, LLC on July 14, 2009.



possible that testing conditions during the December 2007 test were not consistent, calling into question the validity of the results.

## **U.S. Army Small Arms Capabilities-Based Assessment (CBA)<sup>30</sup>**

On January 21, 2009, the Secretary of the Army provided the House and Senate Armed Services Committees with the findings of the U.S. Army Infantry Center Small Arms Capabilities-Based Assessment (CBA), which had been completed in April 2008. The Army, as the Department of Defense (DOD) Executive Agent for Small Arms (SA), conducted the Small Arms CBA to establish and support a small arms acquisition strategy through 2015. This analysis examined 10 tasks, as described below:

1. Engage threat personnel with SA fire.
2. Engage threat personnel that are in defilade.<sup>31</sup>
3. Engage threats with precision SA fire.
4. Engage threats with SA volume fire.
5. Acquire personnel and vehicle targets.
6. Determine range to target.
7. Mark or tag targets.
8. Breach existing entry points.
9. Avoid detection caused by weapon signature.
10. Operate and maintain weapons.

Based on analysis, the study team identified 25 capability gaps associated with the 10 aforementioned tasks, as well the overall requirement from individual soldiers and their leaders that they required “greater lethality” and “more knockdown power.” The study team identified a number of non-material and material recommendations to address the identified capability gaps. Non-material solutions—which are preferable because they can be implemented relatively quickly and inexpensively—included improving training, updating doctrine, using additional SA ancillary devices (example: optics), developing a Small Arms Weapons Expert Program at battalion and brigade level, and adding a weapons repairman at company level. Material solutions included developing special airburst munitions to engage defilade targets; developing ammunition that would be more lethal at short ranges (0 to 200 meters); improving breaching and non-lethal marking 40 mm rounds; improving combat optics; developing a new weapon system for vehicle and aircraft crews that provides greater maneuverability in confined spaces and provides more firepower than a pistol; and developing SA weapons that require fewer and simpler tools to maintain and that would require less cleaning and lubrication. Another recommendation was that any new SA developed to meet these capability gaps needed to contribute to lightening the soldier’s overall combat load.

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<sup>30</sup> Information in this sections is from the U.S. Army Infantry Center Small Arms Capabilities Based Assessment provided to Congress on January 21, 2009.

<sup>31</sup> Defilade is defined as protection provided from hostile fire provided by an obstacle such as a hill, ridge, or bank; a vertical distance by which a position is concealed from enemy observation; or to shield from enemy fire or observation by using natural or artificial obstacles.

The study identified 42 separate Ideas for Material Solutions (IMAs) to address capability gaps that required a material solution. Of these 42 IMAs, 13 involved creating new munitions or improving existing munitions, and 10 involved aiming devices, optics, or laser designators; only 7 IMAs suggested modifying current SAs or developing new SAs. Other IMAs included suggestions such as improving munitions propellants and improving weapon magazines.

Secretary Geren's January 21, 2009, letter to House and Senate Armed Service Committee Leadership stated that "following the completion of the CBA, the Army decided to update the requirement for combat rifle/ carbine and compete this updated requirement in an open competition."

### **An Examination of the Small Arms Capability-Based Assessment**

The Army's SA CBA appears to be a comprehensive assessment of DOD's small arms requirements that incorporates a great amount of analytical data and many observations derived from combat operations in Iraq and Afghanistan. It can be argued that the CBA does not present a compelling case to develop and acquire a new combat rifle or carbine. Many of the CBA's recommended material solutions involve improved or new munitions or ancillary items such as optics or weapons magazines. The CBA does call for the development of a new SA system for vehicle and aircraft crew and an extended-range heavy machine gun, but nowhere explicitly calls for a new combat rifle or carbine. It is possible that many of the CBA's proposed material solutions might be readily adaptable to current combat rifles (M-16s) and carbines (M-4s) with little or no modification to the weapon. In this regard, a totally new design might be required only if new munitions, optics, other ancillary items, and reliability improvements are totally incompatible with SAs currently in use. The majority of the deficiencies cited in the SA CBA do not directly fault the current combat rifle or carbine, but instead call for ammunition, sight, and optic improvements, which might not in and of themselves appear to justify undertaking a potentially lengthy and costly development and procurement effort.

### **Army Looks for a Replacement for the M-4<sup>32</sup>**

Based in part on the results of the Small Arms CBA, the Army issued a request for information in August 2008 to the small arms industry seeking information on "the state of the art in small arms technologies." This request is viewed by some as the first step in a carbine competition that the Army intends to conduct sometime in 2009 after Colt Defense turns over the M-4's technical data rights in June 2009. The Army plans to release a request for proposal (RFP) in the late summer of 2009 requesting prototype weapons for testing. Army officials have stated that they will consider other caliber weapons other than the current 5.56mm. Factors that the Army will consider in its evaluation are improved accuracy, durability in all environments, and modularity.

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<sup>32</sup> Matthew Cox, "U.S. Army Asks Industry for an M-4 Replacement," *Army Times*, October 6, 2008 and Matthew Cox, "Army Solicits Industry for M-4 Replacement," *Army Times*, September 29, 2008.

## **Department of Defense Conducts a Service-Wide Review of Small Arms<sup>33</sup>**

DOD is currently conducting a service-wide review of small arms requirements that some believe could “challenge the Army’s decision to search for a new carbine.”<sup>34</sup> This review involves small arms experts from each service as well as experts from the small arms industry and is intended to “map out a common strategy for the Defense Department’s individual and crew-served weapons needs.”<sup>35</sup> The DOD review team is currently said to be reviewing the Army’s Small Arms CBA and was supposed to have developed a set of conclusions by the end of May 2009.

## **Potential Issues for Congress**

### **M-4 Performance and Reliability**

Based on the aforementioned studies and tests, there appears to be not only a wide range of opinions as to the M-4’s reliability and lethality, but also questions if testing of the M-4 has been consistent and whether performance results are indeed accurate. If the Army does opt to replace the M-4 and the competition involves comparative testing, efforts might be undertaken to ensure consistency between test weapons.

### **DOD’s Small Arms Review Versus the Army’s Plan to Replace the M-4**

As previously noted, the Army is basing its upcoming carbine competition to a large extent on the Small Arms CBA, which some believe does not present a compelling case to launch a competition to replace the M-4. According to reports, DOD—as part of its joint small arms review—is supposed to shortly reach a number of conclusions about the Army’s Small Arms CBA that might be relevant to any planned M-4 replacement competition. The results of DOD’s review might possibly support the Army’s planned M-4 replacement competition or instead suggest an alternative course of action. Congress might benefit from examining the results of DOD’s service-wide small arms review as it considers the future of the Army’s small arms modernization efforts.

### **USSOCOM Implications of Replacing M-4s**

It has been suggested that USSOCOM’s decision to adopt the FNH SCAR has implications for the Army. In one sense, the SCAR is the first modular small arms system adopted by the military. The SCAR-L and SCAR-H will replace the following weapons: M-4A1, MK-18 close quarter carbine, MK-11 sniper security rifle, MK-12 special purpose rifle, and the M-14 rifle.<sup>36</sup> There is

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<sup>33</sup> Information in this section is from Matthew Cox, “Program Reviews Could Affect Carbine Search,” *Army Times*, April 25, 2009.

<sup>34</sup> *Ibid.*

<sup>35</sup> *Ibid.*

<sup>36</sup> Scott R. Gourley, “Soldier Armed: Special Operations Forces Combat Assault Rifles,” *Association of the U.S. Army* (continued...)

also a 90% parts commonality between the SCAR-L and SCAR-H, including a common upper receiver and stock and trigger housing and an enhanced grenade launcher can be attached to either model.<sup>37</sup> While the SCAR might not meet all of the conventional Army's requirements, its adaptability in terms of missions (close quarters combat to long-range sniper operations), being able to rapidly convert from a 5.56 mm to a 7.62 mm weapon, and the ability to accommodate a variety of modifications such as grenade launchers and special optics, might be factors worth considering as the "modular Army" plans future small arms programs. The Rangers' forthcoming combat deployment with the SCAR and associated lessons learned and performance and lethality data might also have implications for future Army small arms development and acquisition efforts.

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(...continued)

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<sup>37</sup> Nathan Hodge, "Stopping Power," *Jane's Defence Weekly*, July 25, 2007.