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Soldier Perspectives on Small Arms in Combat

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Contents

Executive Summary

Project Manager Soldier Weapons (PMSW) supports soldiers through the development and procurement of weapon systems, ammunition, and other associated target acquisition/fire control products. During Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF), individual soldiers have raised concerns with their small arms in combat. The Army would like to obtain a much broader understanding of soldiers' views of their small arms.

This study assessed soldier perspectives on the reliability and durability of their weapon systems in combat to aid in decisions regarding current and future small arms needs of the Army. The weapons examined in this study were the M9 pistol, M4 and M16 (A2 and A4) rifles, and the M249 light machine gun. These four weapon systems are the standard issue individual weapons being used by Army soldiers in Iraq and Afghanistan. Weapon reliability is defined as soldier level of confidence that their weapon will fire without stoppage in the combat environment. Weapon durability is defined as soldier level of confidence that their weapon will not suffer breakage or failure that necessitates repair before further use.

CNA conducted over 2,600 surveys with soldiers who had returned from Iraq or Afghanistan within the previous 12 months and had engaged in a firefight using the M9, M4, M16 (A2 or A4), or M249 during their last deployment. The survey covered key issues related to weapon reliability and durability including training and experience, weapon maintenance/cleaning, weapon stoppages, accessories, and environment. In addition, the survey assessed soldier satisfaction levels with the weapon systems and related components.

Most soldiers indicate satisfaction & confidence in the reliability and durability of their weapons. Levels of satisfaction and confidence with the M9 and M249 are consistently lower than for the other weapons. Soldiers reported being most satisfied with the M4 and least satisfied with the M9. This trend was found with regard to satisfaction with weapon accessories, maintainability, training, clean-

ing equipment, ammunition, corrosion resistance, accuracy, smoke/noise/flash, range, and rate of fire. High levels of confidence were attributed to soldier maintenance and low levels of confidence were attributed to weapon age, stoppages, and difficulty in maintaining the weapon.

Soldiers reported being most satisfied with the handling qualities of the M4. Handling qualities include weapon grips/handguards, heat, size, and weight. The size of the M16 and the weight of the M249 are most often cited as the reason for dissatisfaction with the weapon's handling qualities. The grips/handguards of the M9 and M4 are cited as a major reason for dissatisfaction with weapon handling.

When soldiers were asked if they experienced a weapon stoppage at any time during an engagement in theater, they reported the most stoppages with the M9 (26 percent) and the M249 (30 percent). Most stoppages were reported to have a small impact on continuing in the engagement with the weapon. The impacts of stoppages experienced were reported to be most serious with the M9 and M249. A large impact is the inability to engage the target with the weapon during a significant portion or entire firefight after performing immediate and remedial action to clear the stoppage. A small impact is the ability to engage the target with the weapon after performing immediate or remedial action to clear the stoppage. Over fifty percent of soldiers utilizing the M4 and M16 reported that they never experienced a stoppage while in theater (this finding includes stoppages during an entire deployment and is therefore not limited to firefights and includes training).

Statistical models were estimated to identify individual effects while holding other factors constant and establish the statistical significance of factors contributing to soldier confidence in weapon reliability, durability, repairs, and stoppages.

In most cases, attaching accessories using methods of attachment other than rails has negative impact with regard to weapon stoppages, repairs, and confidence in reliability and durability.

For the M4, M16, and M249, firing in semi-automatic mode decreased the reported occurrence of stoppages and repairs, as well as

increasing soldier levels of confidence in weapon reliability and durability.

Soldiers issued cleaning kits were less likely to experience stoppages and more likely to be confident in weapon reliability. However, weapon cleaning type and frequency had little impact on stoppages and repairs overall. Soldiers who frequently performed quick wipe-down cleanings experienced more stoppages. Soldiers may be responding to existing problems with the weapon by increasing the frequency of wipe down cleanings. Frequency of disassembled cleanings had no effect on the occurrence of stoppages. Variations in lubrication practices, such as type of lubrication used and amount of lubrication applied, also had little effect on stoppages. Using a dry lubricant decreased reports of stoppages only for the M4 users. However, soldiers using a non-Army issued lubricant were more likely to have confidence in the reliability of their weapon.

Qualification level and soldier training did not have an effect on reported stoppages. However, confidence in weapon reliability was higher for soldiers in upper qualification levels. Soldiers who had trained with the weapon in an environment similar to theater prior to deployment were also more likely to be confident in the reliability of their weapon.

Weapons that were rebuilt were reportedly repaired more often than non-rebuilt weapons, and those with rebuilt weapons were less likely to be confident in the durability of the weapon.

Finally, this study gathered recommendations by soldiers for weapon modifications and/or improvements. Over 75 percent of the soldiers surveyed provided recommendations. The most frequent recommendations included weapons and ammunition with more stopping power/lethality, higher quality magazines for the M9, M4, and M16, more durable ammo belt links and drum systems for the M249, and reduced size and weight in the M16 and M249.

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Background and objectives

Project Manager, Soldier Weapons (PMSW) supports soldiers through the development, and procurement of future and current weapon systems, ammunition, and associated target acquisition/fire control products for the United States Army. Individual soldiers have raised concerns with their small arms in combat. Specifically, a few informal reports out of Iraq and Afghanistan indicate that some soldiers have concerns with the durability and reliability of the small arms they used during combat operations in support of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). It is unclear, however, whether those comments are representative of the views of all soldiers with OIF/OEF combat experience. The Army, therefore, sought broader understanding of soldiers' views regarding their small arms before deciding on any course of action.

PMSW asked CNA to conduct a formal independent review of soldier perspectives on their small arms in combat situations. Specifically, they wanted to know soldier perspectives on the reliability and durability of the M9 pistol, M4 and M16 (A2 and A4) rifles, and the M249 light machine gun. These four weapon systems are the standard issue individual weapons being used by Army soldiers in Iraq and Afghanistan.

To aid decisions regarding current and future small arms needs of the Army, CNA constructed a survey to assess soldier levels of confidence in reliability and durability of these weapon systems and areas related to weapon performance, such as soldier training and experience, weapon maintenance/cleaning, weapon stoppages and repairs, and weapon components and accessories. To ensure a representative sample of soldiers, the survey was given to over 2,600 soldiers encompassing five separate divisions, including the 48th Infantry Division, the 2/140th Infantry Regiment, the 3rd Infantry Division, the 82nd Airborne Division, and the 10th Mountain Division.

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Approach

Survey development

The Army requested that CNA investigate two issues with regard to soldier small arms use–weapon reliability and durability in combat. For the purposes of this study PMSW and CNA defined reliability as soldier level of confidence that their weapon will fire without malfunction in the combat environment. Malfunction is defined as a weapon stoppage, usually corrected by immediate or remedial clearing actions, and not necessitating an actual repair. Durability is defined as soldier level of confidence that their weapon will not suffer major breakage or failure that necessitates repair before further use.

CNA conducted background research to create a survey encompassing relevant issues indicative of and related to weapon reliability and durability. This research included literature reviews, evaluation of previously conducted weapons studies, interviews with Army and weapons experts, and participation in weapons instruction and live fire exercises.

Many factors can affect the perceived and actual reliability and durability of weapon systems. Therefore, in addition to assessing soldier confidence levels in the reliability and durability of their weapons, the survey included questions about key issues related to weapon reliability and durability such as:

- Soldier training and experience
- Weapon maintenance/cleaning
- Weapon stoppages and repairs
- Weapon components and accessories.

Survey deployment

Over the course of 5 months in 2006, CNA conducted 2,608 surveys with soldiers who had returned from Iraq or Afghanistan within the previous 12 months. Most soldiers surveyed had returned from theater weeks or days before participating in the survey. Only soldiers who had engaged in a firefight using the M9, M4, M16 (A2 or A4), or M249 during their last deployment were eligible to participate in the survey.

CNA utilized dynamically generated survey technology in order to screen for relevant sample criteria and automatically adjust for each soldier. In other words, the survey would discontinue if a soldier had not been deployed to Iraq or Afghanistan within the past 12 months or had not engaged in a firefight with the M9, M4, M16, or M249. Given the wide range of issues to be covered and the limited availability of soldiers just returning from theater, it was necessary to create a survey that had the ability to quickly focus on relevant areas and information specific to each soldier. In addition, some questions needed to be specific to the weapon being surveyed. This survey technology automatically directed the soldiers to questions tailored to their relevant experience. For example, if a soldier indicated they experienced a stoppage with their M4 while engaging the enemy, they were presented with additional questions addressing M4 malfunctions. In total, the bank of questions created for this survey exceeded 400. However, the average time spent per soldier on the survey rarely exceeded 30 minutes, because the survey only presented questions relevant to each soldier.

In order to control the data collection environment and ensure any soldier's questions or concerns regarding the survey were quickly and expertly addressed, CNA secured 56 laptops loaded with the survey software. The CNA survey team was thus able to quickly deploy within a few days notice and, once on location, complete data collection within 2 to 3 days. This system allowed the CNA survey team to easily conduct surveys with over 800 soldiers per day, if needed.

Results

The results of this study are broken up into four major sections. First, characteristics of those surveyed and a comparison to all Army personnel are presented. Second, overall satisfaction levels, confidence levels, and soldier practices and experiences related to their weapons are presented. This section includes results related to confidence in weapon reliability and durability. In addition, results regarding weapon maintenance routines, soldier reports of weapon stoppages and repairs, and other related areas such as ammunition, weapon accessories, weapon handling, weapon condition, and soldier training are reviewed. Third, regression models using the variables listed in the previous section are provided to help explain factors contributing to soldier confidence in weapon reliability, durability, and reports of weapon repairs and stoppages experienced. Finally, a summary of soldier recommendations for weapon modifications and/or improvements are listed for each weapon.

Sample demographics

In order to draw sound conclusions about the population of soldiers engaging the enemy in Iraq and Afghanistan, the sample must parallel the actual population as closely as possible. This includes matching ratios of active, reserve, and National Guard, sampling from different divisions, and capturing data on the mix of weapons used. The ratio of active to National Guard/Reserves is approximately 70 percent to 30 percent. This ratio is supported by the 2006 Uniformed Services Almanac's[1] selected reserve and active strength. Our final sample consisted of 69.5 percent active and 30.5 percent National Guard/Reserves, which closely matches the actual population.

1. 2006 Uniformed Services Almanac (48th ed.).

It was critical to visit and sample from multiple bases, regiments, and divisions to achieve a diverse sample. Sampling from different divisions allows consideration for potential differences in tactics, techniques, procedures, zones of operation, attitudes, etc. Data collection was conducted at Forts Bragg, Drum, and Stewart. At these bases soldiers from the 48th Infantry Division, the 2/140th Infantry Regiment, the 3rd Infantry Division, the 82nd Airborne Division, and the 10th Mountain Division were surveyed.

It was also important to achieve a sample that reflects the realistic mix of the four weapon systems in the study. The actual populations of the weapons used in theater are as follows: M9, 16 percent; M4, 25 percent; M16, 49 percent; and M249, 9 percent.[2] The sample taken for this study shows a similar breakdown: M9, 6 percent; M4, 35 percent; M16, 46 percent; and M249, 13 percent. The specific population chosen for this study explains differences in percentages for the M9 and the M249. That is, only soldiers who had fired their weapon at enemy targets while in theater were selected to participate in this study. Most soldiers meeting these criteria are frontline infantry who are less likely to be issued a M9 pistol and more likely to be issued a M249 light machine gun. Further sample characteristics are listed in table 1.

2. Taken from AMC CFLCC-C4 Reports Manager, information includes consolidated data for Iraq, Kuwait, and Afghanistan.

Table 1. Sample demographics

	Count	%		Count	%
Weapon			**Theater**		
M9	161	6	Iraq	2,473	95
M4	917	35	Afghanistan	106	4
M16	1,188	46	Both Iraq & Afghanistan	12	1
M249	341	13	**Number of engagements**		
Organization			1-5	2,182	84
48th ID	616	24	6-15	289	11
2-140th IR	168	6	16-30	82	3
3rd ID	1,008	39	31-50	28	1
82nd Airborne	174	7	More than 50	27	1
10th Mountain	544	21	**Qualification level**		
Rank			None	386	15
E1-E3	282	11	Marksman	220	8
E4-E6	2,089	80	Sharpshooter	796	31
E7-E9	106	4	Expert	1,205	46
W1-W5	3	0	**Area**		
O1-O3	112	4	Active Army	1,812	70
O4-O6	16	1	Army Reserves	8	0
Time in Army			National Guard	788	30
0-6 months	48	2			
7-12 months	113	4			
1-5 years	1,584	61			
6-10 years	390	15			
11-20 years	356	14			
More than 20 years	117	5			

Soldier satisfaction, confidence, and experiences

Overall, 78 percent of soldiers surveyed reported being satisfied with their weapons. Soldiers were most satisfied with the M4 (89 percent) and least satisfied with the M9 (58 percent). M16 and M249 users were 75 percent and 71 percent satisfied, respectively. In table 2, overall satisfaction and satisfaction with specific weapon and weapon related attributes are reported.

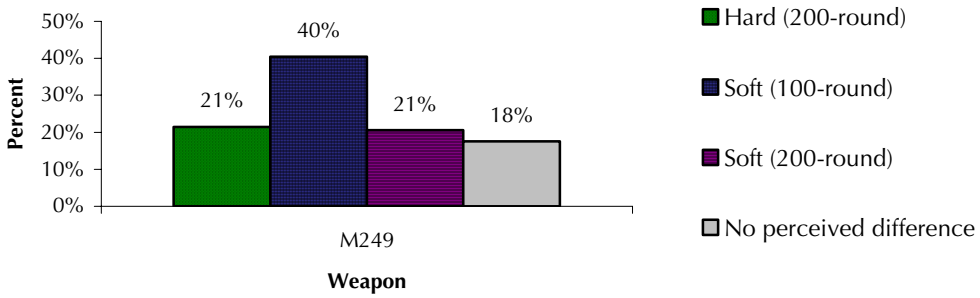
Table 2. Soldier-reported satisfaction levels

	% Satisfied				
	M9	**M4**	**M16**	**M249**	**Total all weapons**
Weapon overall	58	89	75	71	78
Ammunition	52	79	79	72	77
Handling	64	90	60	60	71
Accuracy	76	94	89	87	90
Range	66	92	88	89	88
Rate of fire	88	93	88	94	91
Training	71	85	82	77	82
Maintainability	81	87	82	70	82
Cleaning equipment	70	75	68	63	70
Corrosion resistance	75	80	70	65	73
Accessories	52	86	75	71	77

Ammunition

Seventy-seven percent of soldiers reported being satisfied with their ammunition. M9 users reported the greatest dissatisfaction with ammunition (48 percent dissatisfied), as compared to the M4, M16, and M249 ammunition users. When asked how to best improve the weapon, 48 percent of M9 user responses suggested improvements to the M9 ammunition or magazine. As a matter of fact, improving ammunition is the number one recommendation suggested by soldiers across all four weapons. M249 users were asked which type of ammunition pouch they found to be most effective. As shown in figure 1, there is a considerable range of preferences. Forty percent chose the soft 100-round pouch, 21 percent preferred the soft 200-round pouch, 21 percent chose the hard 200-round pouch, and 18 percent did not perceive any difference between pouches. Soldier recommendations for other weapon improvements are discussed in more detail later in this report.

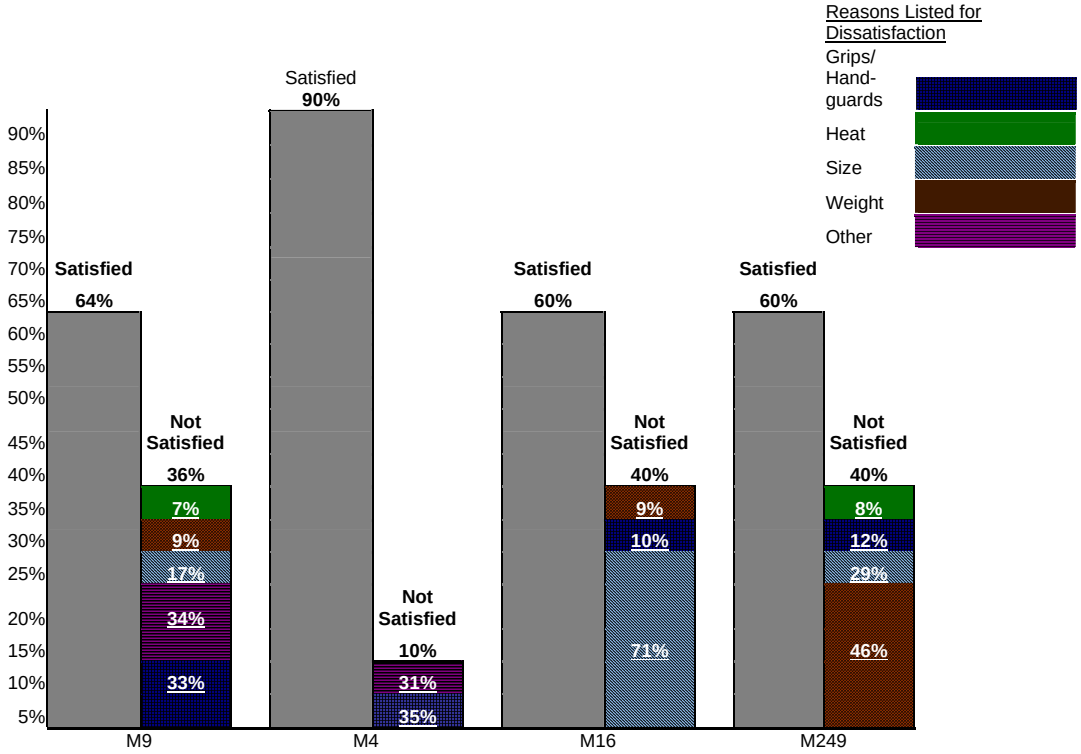
Figure 1. M249 users' ammunition pouch preference



Weapon handling

Weapon handling included weapon attributes such as grips/hand guards, heat, size of weapon, and weight of weapon. Overall, 71 percent of soldiers reported satisfaction with weapon handling. Soldiers reported being most satisfied with the handling qualities of the M4 (90 percent satisfied) and relatively less satisfied with the M16 (60 percent satisfied) and M249 (60 percent satisfied). Figure 2 displays soldier satisfaction with weapon handling.

Figure 2. Reported reasons for dissatisfaction with weapon handling



When citing reasons for dissatisfaction with a weapon's handling qualities, soldiers most often chose the size of the M16 (71 percent of those dissatisfied) and the weight of the M249 (46 percent dissatisfied). The grips/hand guards of the M9 (33 percent dissatisfied) and M4 (35 percent dissatisfied) were cited as a major reason for dissatisfaction with weapon handling.

Weapon condition

Four percent of soldiers reported that their weapon had been rebuilt. This information was ascertained by asking if there were any Xs stamped next to the serial number on the weapon, indicating a rebuild. Twenty-seven percent could not recall whether or not Xs followed the serial number. Seventy-nine percent of soldiers listed their weapon as being in good or perfect condition at the beginning of their deployment, and 74 percent reported the same at the end of deployment.

Weapon accuracy, range, and rate of fire

The survey did not focus on the performance of the weapon but some questions did touch on that issue. Overall, soldiers reported high levels of satisfaction with weapon accuracy (90 percent), range (88 percent), and rate of fire (91 percent). M4 users reported the highest levels of satisfaction with weapon accuracy, range, and rate of fire (94, 92, and 93 percent) and M9 users reported the lowest levels of satisfaction in these areas (76, 66, and 88 percent).

Training for combat

Most soldiers (82 percent) reported satisfaction with the weapon training they had received, and 76 percent found their training to be effective in preparing them for using their weapon in live combat situations. As shown in table 3, the soldiers surveyed found tactical, reflexive, and marksmanship training to be most effective in preparing them to use their weapons in combat situations. Soldiers reported the highest levels of dissatisfaction with M9 training (29 percent) as compared to the training received for the M4, M16, and M249. Seventy-four percent of the soldiers sampled had trained

with their weapon in an environment comparable to theater prior to deployment. Thirty percent trained on the live ranges while in theater at least once per month. The effects of training on malfunction and repair will be discussed later in this report.

Table 3. Weapon training perceived by soldiers to be most effective in preparing for combat situations

Type of training	Count	%
Tactical	648	25
Reflexive techniques	601	23
Marksmanship	577	22
Simulation	323	12
Other	112	8
Training on own time	149	6
Civilian	98	4

Maintenance

Eighty-two percent of soldiers are satisfied with the maintainability of their weapons. Soldiers reported the least amount of satisfaction with maintaining the M249 (70 percent satisfied) as compared to the maintainability of the M9, M4, and M16. Qualitative feedback from M249 users suggests much of their dissatisfaction with maintenance is due to the difficulty of removing/gaining access to the many small components of the weapon. In addition, M249 users were relatively less satisfied with the weapon's corrosion resistance.

Cleaning

Sixty-four percent of soldiers were issued cleaning kits along with their weapon, but 20 percent of soldiers supplemented their cleaning kits with commercial bore brushes.

The majority of soldiers (63 percent) reported giving their weapon a quick wipe-down at least once a day. While only 33 percent reported performing a complete weapon tear-down cleaning on a daily basis, 78 percent reported performing this type of detailed cleaning at least once a week. Soldier weapon cleaning methods and frequencies are listed in table 4.

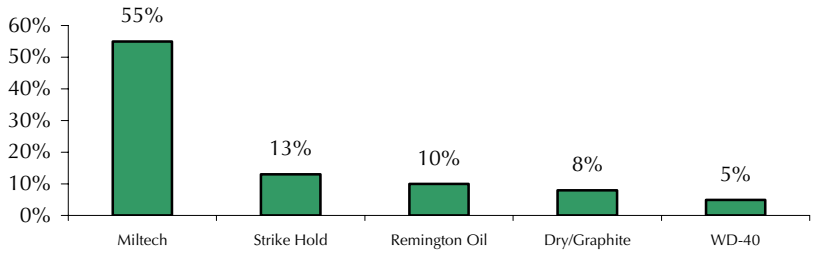
Table 4. Frequency of weapon cleaning

	Multiple times a day		Once a day		Once a week		Once a month		Once every 3 months		Once every 6 months		Never	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Quick wipe-down cleaning	429	16	1208	46	554	21	99	4	27	1	18	1	189	7
Complete tear-down cleaning	115	4	753	29	1161	45	297	11	63	2	30	1	105	4

Lubrication

Most soldiers (82 percent) reported applying a light layer of lubrication to their weapons. Most often soldiers reported applying lubrication at least once a day (45 percent) or once a week (35 percent). Wet lubricants were most commonly applied (56 percent). Sixty two percent used an Army issued lubricant. The majority of those who did not use an Army issued lubricant used Miltech (55 percent). Figure 3 shows the distribution of non-Army issued lubricants used.

Figure 3. Percent of non-Army issued weapon lubricant used[a]



a. This chart shows the breakdown of the 610 soldiers surveyed, or 23 percent of the total sample, who reported using a non-Army issued lubricant.

Method of accessory attachment

Overall, 77 percent of soldiers were satisfied with their weapon accessories. However, only 52 percent of M9 users were satisfied with its accessories. The most commonly used accessories issued to soldiers were red-dot sights/scopes (31 percent) and lasers/IR pointers (24 percent). Soldiers requested that lasers/IR pointers (31 percent), holographic sights (29 percent), and red-dot sights/scopes (14 percent) become standard issue. Thirty-one

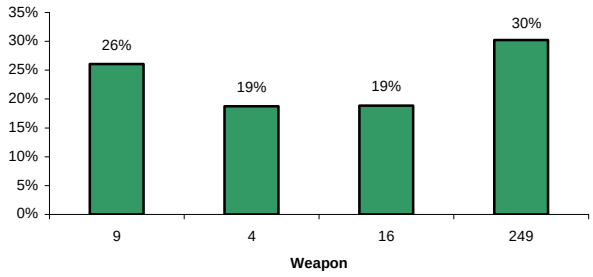
percent of soldiers reported not being issued any accessories for their weapons. The majority of soldiers (83 percent) reported that they did not add or purchase non-Army issued weapon accessories.

When attaching accessories to weapons, soldiers most commonly used rails (40 percent) and dummy cord (15 percent). Of those soldiers using rails to attach accessories, 64 percent reported using Army issued rail systems. Twenty-nine percent reported that they did not attach accessories to their weapon. The implications of these attachment methods are discussed in a later section.

Weapon stoppages

Weapon stoppages can be caused by many factors, such as failure to feed, failure to fire, and failure to eject/extract. Many times weapon users are not able to specify the exact cause of a stoppage. Therefore, here the occurrence of stoppages are reviewed but not diagnosed. The highest percentage of soldiers reported weapon stoppages with the M9 (26 percent) and the M249 (30 percent) while engaging the enemy in theater. Reports of stoppages with the M4 and M16 were equal at 19 percent. This equality is not surprising given the similarity of the two rifles.

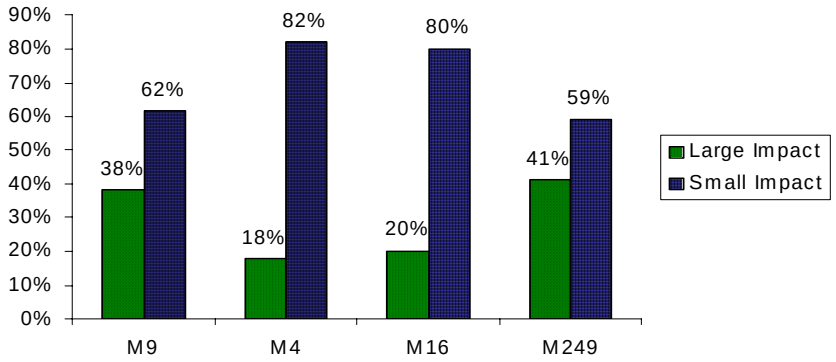
Figure 4. Percentage of soldiers who report experiencing a stoppage while engaging the enemy



If a soldier reported he had experienced a stoppage while engaging the enemy, he was then asked to report the impact that stoppage had on his ability to continue in the firefight. A small impact means the soldier had the ability to engage target with weapon after performing immediate or remedial action to clear the stoppage. A large impact means the soldier was unable to engage the target with that weapon during a significant portion of or the entire firefight after performing immediate or remedial action to clear the stoppage.

The impact of malfunctions was reported to be most serious with the M9 and M249. Levels of stoppage impact are shown in figure 5.

Figure 5. Impact of stoppages during enemy engagement[a]



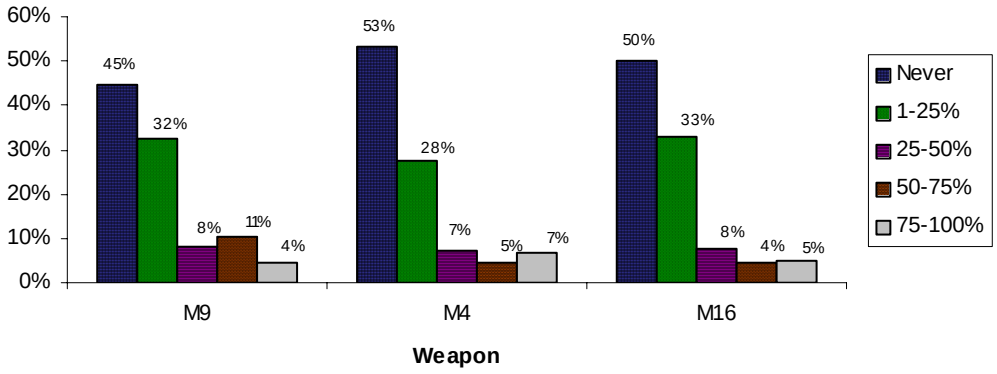
a. These numbers reflect the responses from the 541 (21 percent) of soldiers who experienced a weapon stoppage while engaging the enemy in theater.

Small impact – Ability to engage target with weapon after performing immediate or remedial action to clear the stoppage.

Large impact – Inability to engage target with weapon during a significant portion or entire firefight after performing immediate or remedial action to clear the stoppage.

Soldiers reporting on the M9, M4, and M16 were also asked to report the percentage of time a magazine failed to empty completely without a stoppage during their entire deployment (including training and not limited to enemy engagements). Over 50 percent of soldiers using the M4 and M16 reported that they never experienced a malfunction while in theater. These results are displayed in figure 6.

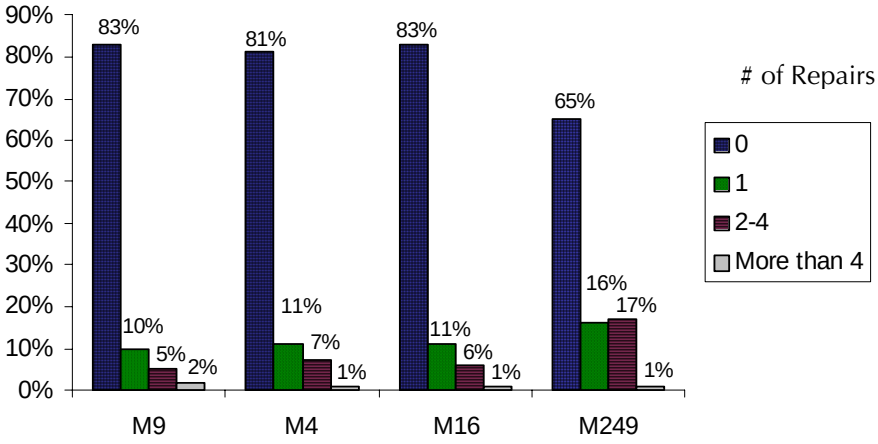
Figure 6. Percentage of time a magazine failed to empty completely without a stoppage



Weapon repairs

As shown in figure 7, most soldiers reported that their weapon was not repaired while in theater. Those who did report repairs stated that they are most often performed by the armorer.

Figure 7. Number of soldier-reported weapon repairs performed in theater



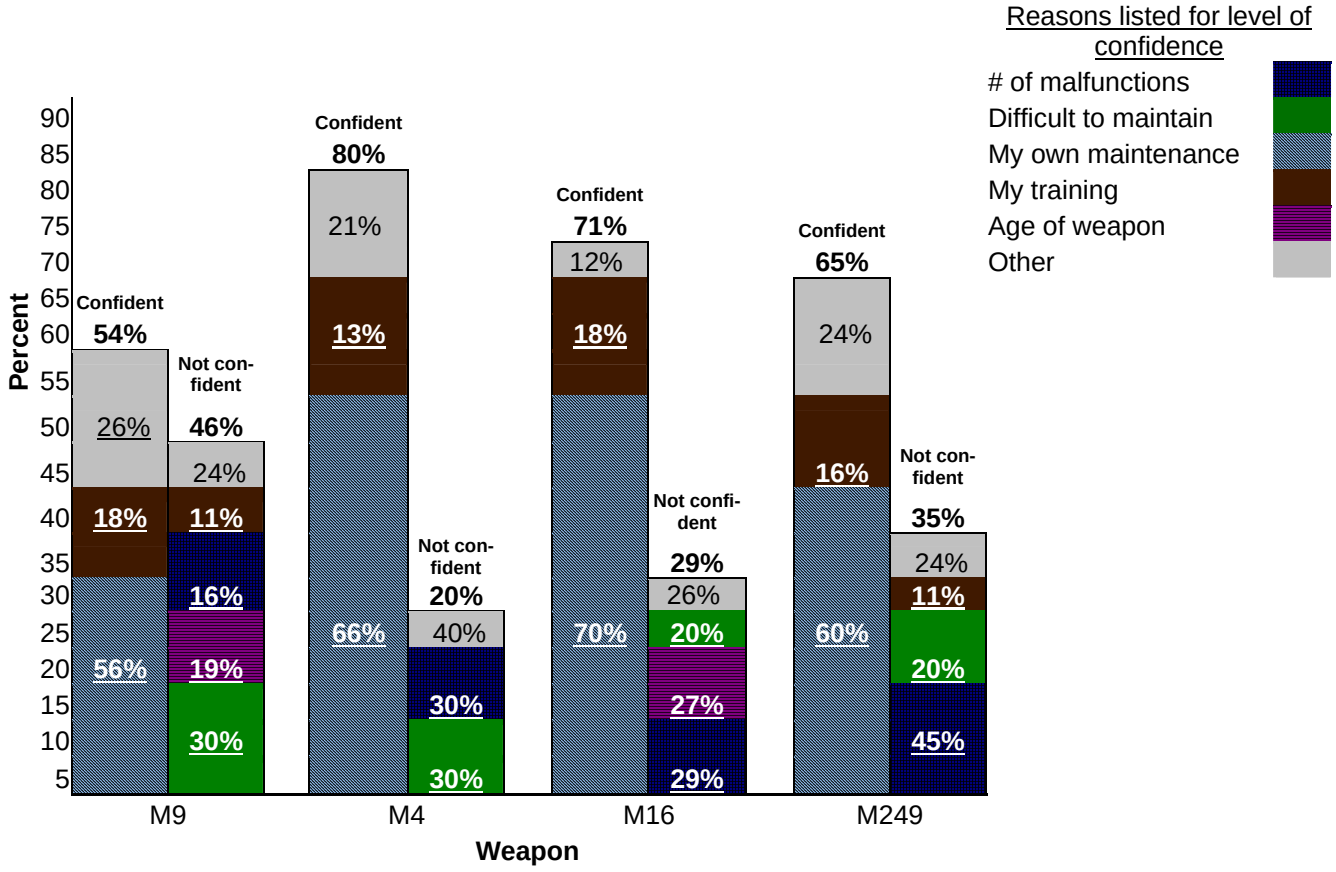
Soldier confidence in weapon reliability

As described previously, weapon reliability is defined as soldier level of confidence that their weapon will fire without malfunction in the combat environment. Malfunction is defined as a weapon stoppage,

usually corrected by immediate or remedial clearing actions not necessitating an actual repair of the weapon.

Soldiers were most confident in the reliability of the M4 (80 percent) and M16 (71 percent) and least confident in the reliability of the M9 (54 percent). Soldiers most often attributed confidence in the reliability of their weapon to their own maintenance, and reported the high number of malfunctions and difficulty of maintaining the weapon as reason for their lack of confidence in weapon reliability. Figure 8 displays soldier levels of confidence in weapon reliability.

Figure 8. Soldier level of confidence and reason for level of confidence in weapon reliability



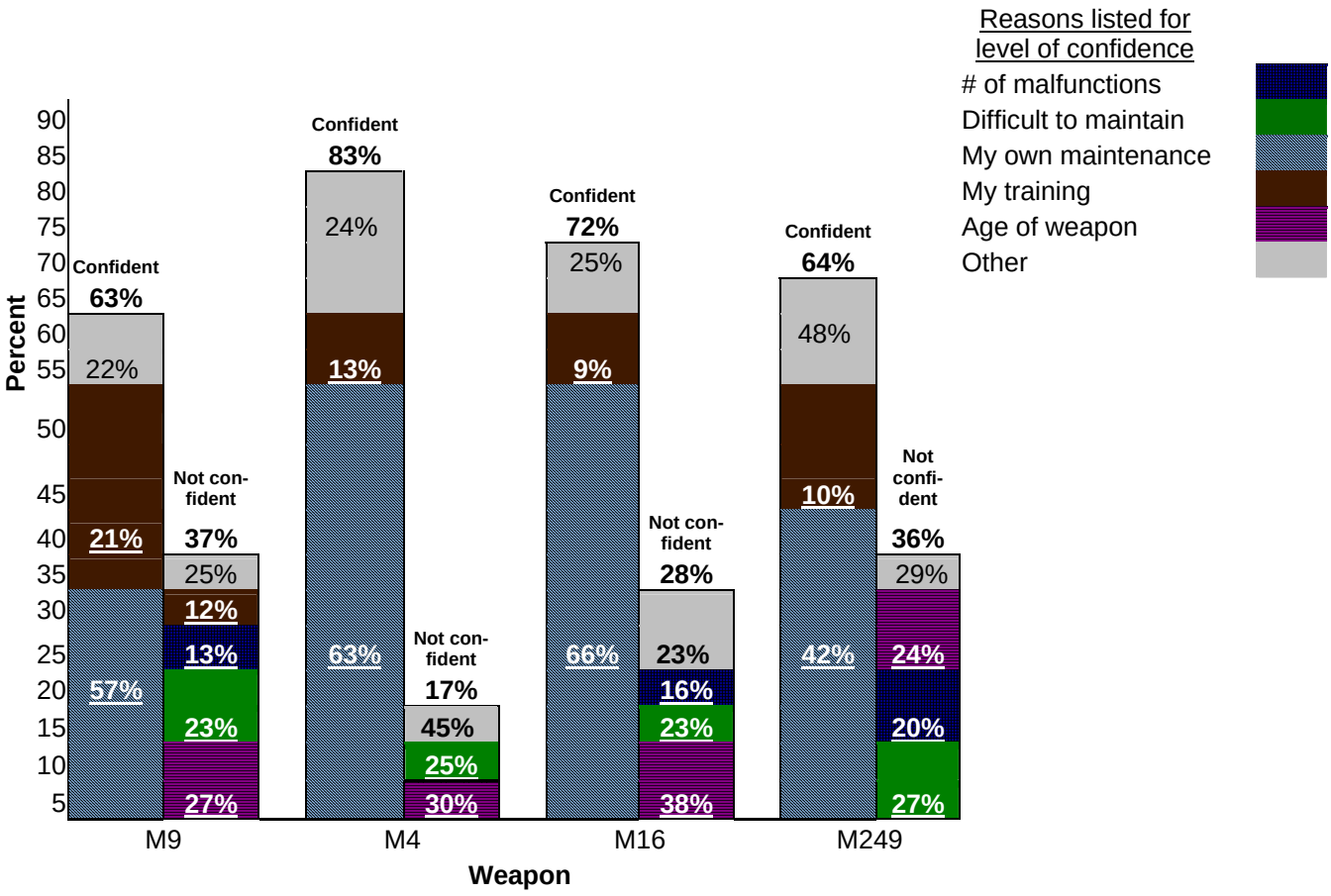
Soldier confidence in weapon durability

Recall that durability is defined as soldier level of confidence that their weapon will not suffer major breakage or failure that necessitates repair before further use. As with reliability, soldiers are most

confident in the durability of the M4 (83 percent) and M16 (72 percent) and least confident in the durability of the M9 (63 percent) and the M249 (64 percent). While level of confidence remains fairly equal across reliability and durability for the M4, M16, and M249, M9 users have more confidence in the durability of the weapon than in its reliability.

Soldiers most often attributed confidence in the durability of their weapon to their own maintenance, and reported the age of the weapon and difficulty of maintaining the weapon as reasons for their lack of confidence in weapon durability. Figure 9 displays soldier levels of confidence in weapon durability.

Figure 9. Soldier level of confidence and reason for level of confidence in weapon durability



Regression models for reliability, durability, stoppages, and repairs

In this section, the results of binary logistic regression analyses are reported for soldier levels of confidence in weapon reliability and durability, as well as soldier reports of weapon stoppages and repairs. Logistic regression is used to predict categorical (dichotomous) variables from a set of predictor variables. For example, in the first section below, our variable of interest is weapon stoppages. This variable is coded as stoppage or no stoppage and is therefore dichotomous. Multiple variables are regressed onto the stoppage variable to better understand and establish statistical significance of factors predicting or indicative of weapon stoppages.

Stoppages

The factors likely to impact the occurrence or non-occurrence of weapon stoppages include weapon maintenance (cleaning/lubrication type and frequency), weapon use (accessory attachment methods, firing mode), and soldier level of proficiency with the weapon (qualification level and training in environment comparable to theater environment).

The survey covers the soldiers experiences over an entire tour and this means we can't always capture casual effects. This is most evident for weapon cleaning. For example, cleaning and lubrication should theoretically decrease stoppages, but those who do the most cleaning and lubrication may be responding to having experienced stoppages. Recognizing this problem in interpreting the data, we note that in total, and with all other factors considered, reports of maintenance regimens, including weapon cleaning and lubrication, had very little or no impact on reports of weapon stoppages.

Soldiers issued a cleaning kit with their weapons were one-third less likely to experience a stoppage than those not issued a cleaning kit. Given that only 64 percent of soldiers reported being issued a cleaning kit, this appears to be an area where the Army might easily have an impact in decreasing weapon stoppages. Lubrication of the weapon did have a slight impact on reported stoppages. Soldiers reporting a high frequency of lube application (one or more times

per day) were more likely to experience stoppages. This result was most significantly linked to M16 users. Increased frequency in quick wipe down weapon cleaning also increased the odds of experiencing a stoppage. This somewhat counter-intuitive finding is most likely a result of soldiers replacing fully disassembled cleanings with quicker and less effective methods.

Accessory attachment had significant impact on reported stoppages. Those who attached accessories to their weapon were more likely to experience stoppages, regardless of how the accessories were attached (those using duct tape and zip cord were more likely to experience stoppages). This finding had the most impact on M249 users. Regardless of method, attaching accessories to the M249 significantly increased the odds of experiencing a stoppage. M249 users were nine times more likely to experience a stoppage if accessories were attached via zip cord, four times more likely if attaching with duct tape, and three times more likely if attaching with dummy cords or rails.

Soldiers firing weapons on the semi-automatic setting decreased the probability of experiencing a stoppage by half. This result does not apply to M9 users.

Qualification level had no impact on reports of stoppages. In other words, marksmen, sharpshooters, experts, and soldiers reporting no level of qualification did not differ significantly in reporting weapon stoppages. This finding holds true across weapons.

When the same regression model is run separately with each weapon significant results were found for the M4 and M16. M4 and M16 users using duct tape and zip cord to attach accessories to their weapon were two and three times more likely to experience a stoppage. Those who were issued a rebuilt M4 were 3.5 times more likely to experience a stoppage. Rebuilt M16s, M9s, and M249s had comparable stoppages to those that hadn't been rebuilt. Finally, using a dry lubricant on the M4 decreased the probability of experiencing a stoppage by half.

Reliability

Recall that reliability has been defined as soldier level of confidence that their weapon will fire without malfunction in the combat environment. Malfunction is defined as a weapon stoppage usually corrected by immediate or remedial clearing actions not necessitating an actual repair of the weapon. Therefore, the factors used in the stoppage regression model were also used to assess their impact on soldier level of confidence in the reliability of their weapon. One additional factor used in the reliability model is the occurrence of weapon stoppages, as experiencing stoppages could have some impact on a soldier's level of confidence in weapon reliability.

As expected, soldiers who reported experiencing a stoppage while engaging the enemy were four times less likely to have confidence in their weapon. This finding was most significant with M249 users, who were seven times less likely to have confidence in weapon reliability if they reported experiencing a stoppage. Additionally, those who reported that the M249 ammo belt was most susceptible to malfunction due to sand and dirt were almost nine times more likely *not* to have confidence in the reliability of their weapon.

As with stoppages, increased frequency of lubrication application was related to decreased confidence in weapon reliability, and soldiers issued a cleaning kit were more likely to be confident in the reliability of their weapon. Also, soldiers using a non-Army issued lubricant were almost two times more likely to report confidence in the reliability of their weapon. M9 users were over 21 times more likely to report confidence in weapon reliability if they reported using a non-Army issued lubricant.

Soldiers using rails to attach their accessories were one-third more likely to have confidence in the reliability of their weapon. As with reports of weapon stoppages, soldiers firing weapons on the semiautomatic setting were twice as likely to be confident in weapon reliability. This result does not apply to M9 users.

Unlike weapon stoppages, soldier level of proficiency and training had significant impact on levels of confidence in weapon reliability. Those with higher levels of qualification are approximately two times more likely to be confident in their weapon reliability. Although soldiers at a higher level of qualification (expert and

sharpshooter) were more confident in the reliability and durability of their weapons, they did not report a lower level of stoppages as described in the previous section. On average, they were able to clear their weapons of malfunctions in a shorter amount of time. Therefore, one explanation is that their quick clearing capabilities lessened the impact of the malfunction, thereby not significantly impacting their perceptions of overall weapon performance and effectiveness. Soldiers with higher level qualification were more likely to report that the stoppage had a small impact on their ability to continue engaging the enemy.

Soldiers who trained in an environment similar to the theater environment prior to deployment were one-third more likely to have confidence in weapon reliability. M4 users reporting this type of training were twice as likely to have confidence in weapon reliability. Figure 10 and table 5 summarize the results of the stoppages and reliability analyses.

Figure 10. Stoppage and confidence in reliability regression summary chart

	Soldiers report more stoppages	Soldiers report fewer stoppages	Not confident in reliability	Confident in reliability
If a cleaning kit was issued with weapon		✓		✓
If firing mode most commonly used was semi-automatic[a]		✓		✓
If rails were used to attach accessories		✓		✓
Type of lubrication most commonly applied (wet or dry)		✓ M4 users applying dry lubricant		
If non-Army issued lubricant was used				✓
Higher levels of qualification				✓
Trained in an environment comparable to theater				✓
Components susceptible to damage from environment			✓ M249 belt only	
High frequency of wipe down cleaning	✓			
High frequency of lubrication	✓		✓	

a. This result does not apply to the M9

Table 5. Variables that had no significant effect on soldier reports of weapon stoppages or levels of soldier confidence in weapon reliability.

Demographic	Operational	Training	Maintenance
Rank/Pay Grade	Number of firefights	Hours of weapon training	Tear-down cleanings
Number of years in the army	Theater environment (climate conditions & location)	Use of live fire ranges in theater	Amount of lubrication applied
MOS	Type of rails used		
Branch (National guard or active)	Range of targets		
Gender	Battle sight zeroing practices		
Soldier height	Amount of ammunition fired		
Soldier weight			

Repairs

Factors that may help explain causation of weapon repairs covered in this study include weapon corrosion resistance, methods of accessory attachment, whether the weapon has been rebuilt, how much the weapon has been used, and components reported to be most susceptible to damage from the environment.

Soldiers using duct tape, dummy cord, or zip cord/parachute cord to attach accessories to their weapon are 1.7 times more likely to need a weapon repair. M9 users attaching accessories using these methods were 11 and 12 times more likely and M16 users were four times more likely to have had a weapon repair. M249 users were three times more likely to need a repair if they used dummy cord to attach accessories.

Soldiers issued a rebuilt weapon were more likely to report a repair while in theater. Soldiers carrying rebuilt M16s were 2.5 times more likely to have had or have needed a repair. Although not statistically significant by two thousandths, those issued a rebuilt M9 were much more likely to experience a repair (the lack of significance is likely due to the very few reports (6) of rebuilt M9s).

As would be expected, more usage of the weapon (defined as reported amount of ammunition used) increased the odds of weapons needing repair while in theater. Additionally, soldiers firing weapons on the semi-automatic setting were two times less likely to experience a repair. This result does not apply to M9 users.

Durability

Recall that durability is defined as soldier level of confidence that their weapon will not suffer major breakage or failure that necessitates repair before further use. Therefore, the factors used in the repair regression model were also used to assess their impact on soldier level of confidence in the durability of their weapon. One additional factor used in the durability model is the occurrence of weapon repairs, as it is anticipated that needing a repair could have some impact on a soldier's level of confidence in weapon durability.

Those using rails to attach accessories to their weapon are more likely to be confident in the durability of their weapon. M249 users using dummy cord to attach accessories were 2.5 times more likely *not* to be confident in weapon durability.

Those issued a rebuilt weapon were less likely to be confident in weapon durability. Most significantly, M249 users that had a rebuilt weapon were 6.5 times less likely to be confident in the durability, while carrying a weapon that was not rebuilt almost doubled the odds of being confident in durability.

As expected, those who did not experience a weapon repair were more than twice as likely to be confident in their weapon's durability. Across weapons, as soldier reports of weapon corrosion resistance increases, soldier confidence in weapon durability and the need of a weapon repair increases.

Similar to all previous models described to this point, those firing weapons on the semi-automatic setting are twice as likely to be confident in the durability of their weapon. M16 users firing on the semi setting doubled the odds of being confident in durability. This result does not apply to M9 users. Figure 11 and table 6 summarize the results of the repair and durability analyses.

Figure 11. Repair and confidence in durability regression summary chart

	Soldiers report weapon was repaired	Soldiers report weapon was not repaired	Not confident in durability	Confident in durability
If firing mode most commonly used was semi-automatic[a]		✓		✓
If rails were used to attach accessories		✓		✓
Soldier satisfaction with weapon's corrosion resistance		✓		✓
If weapon had been previously rebuilt	✓		✓	
High amount of ammunition fired through weapon in theater	✓			

a This result does not apply to the M9.

Table 6. Variables that had no significant effect on soldier reports of weapon repairs or levels of soldier confidence in weapon durability.

Demographic	Operational	Training	Maintenance
Rank/Pay Grade	Number of firefights	Hours of weapon training	Lubrication amount and frequency
Number of years in the army	Theater environment (climate conditions & location)	Use of live fire ranges in theater	Lubrication type (wet vs. dry)
MOS	Type of rails used	Qualification level	Cleaning frequency
Branch (National guard or active)	Range of targets		Cleaning kit issued with weapon
Gender			
Soldier height			
Soldier weight			

Soldier recommendations

This section reviews the most frequently reported recommendations by soldiers for weapon modifications and/or improvements. Over 75 percent of the soldiers surveyed provided recommendations. Across weapons, soldiers have requested weapons and ammunition with more stopping power/lethality. Soldiers also recommend higher quality magazines for the M9, M4, and M16; more durable

ammo belt links and drum systems for the M249; and reduced size and weight in the M16 and M249.

Twenty-six percent of M9 users requested higher caliber ammunition and increased stopping power. M4 and M16 users echoed this recommendation. When speaking to experts and soldiers on site, many commented on the limited ability to effectively stop targets, saying that those personnel targets who were shot multiple times were still able to continue pursuit. M249 users also expressed a desire for increased ammunition caliber, but to a much lesser degree than other weapon users.

Twenty percent of M9 users called for a replacement of the weapon. Some were more specific and requested a return to the Colt .45 for standard issue pistols, given its higher stopping power. Users of the M4, M16, and M249 also requested weapon replacements. Some M16 users would like the weapons to be replaced with newly built M16s.

Fifteen percent of M9 users and 9 to 10 percent of M4 and M16 users called for improvements in magazine quality. Soldiers stated that the magazines are easily dented during the course of normal use and carrying in theater, causing problems in ammunition feed from the magazine. In addition, M4 and M16 users requested increased magazine capacity.

M9 and M4 users requested armor-piercing and hollow-point ammunition. The use of hollow point bullets is illegal for military use. However, these requests should be interpreted as a desire for increased stopping power/lethality.

Some M16 users recommended lighter and shorter weapons such as the M4. M16 users were consistent and adamant about their desire to be issued an M4. M249 users also recommended shortening and lightening the weapon. However, most M249 users recommended changes to the ammunition belts and drums. Soldiers stated that the belt links and drums are not durable enough. Many soldiers said that the clips on the plastic drums used to attach the drum to the weapon frequently breaks. Soldier recommendations are listed in tables 7 through 10.

Table 7. Soldier recommendations for the M9

Descriptor	% of M9 users	Recommend
Bullet	**26%**	Increase Caliber
		Increase stoppage - lethality
General	**20%**	Replace weapon
		Replace weapon with .45
Magazine	**15%**	Improve quality
		Better/more durable spring
Ammo type	**7%**	Request hollow-point
		Request armor-piercing
Hand guards/grips	**6%**	Request laser grips standard

Table 8. Soldier recommendations for the M4

Descriptor	% of M4 users	Recommend
Bullet	**20%**	Larger caliber bullet
		Increase stoppage - lethality
Magazine	**10%**	Improve quality
		Larger capacity
		See-through magazine
General	**8%**	Replace weapon
		Too much noise - request silencer
		Increase range of weapon
Ammo packaging	**6%**	Include loading system
		Make more secure/durable
Ammo type	**5%**	Request hollow-point
		Request armor-piercing
Element susceptibility	**5%**	Too much maintenance
		Too susceptible to elements

Table 9. Soldier recommendations for the M16

Descriptor	% of M16 users	Recommend
Bullet	**13%**	Larger caliber
		Increase stoppage - lethality
Length	**13%**	Make weapon shorter
General	**10%**	Replace weapon
		Same but newer weapon
Magazine	**9%**	Improve quality
		Request larger capacity
Weight	**9%**	Make weapon lighter
Butt stock	**6%**	Request shorter/collapsible

Table 10. Soldier recommendations for the M249

Descriptor	% of M249 users	Recommend
Ammunition belt	**17%**	Better/more durable links
		Better drum system
		Better feed from drum
Weight	**17%**	Make weapon lighter
Ammunition packaging	**8%**	More secure/durable
		Smaller ammo pouches
General	**6%**	Replace
		Reduce noise
Bullet	**6%**	Increase caliber
		Stoppage/lethality
Butt stock	**6%**	Make adjustable/collapsible

Conclusions

Overall, most soldiers indicate satisfaction and confidence in the reliability and durability of their weapons. This statement is true with regard to ammunition, weapon handling, condition, accuracy, rate of fire, range, training, maintenance, and accessories. Levels of satisfaction and confidence with the M9 and M249 are consistently lower across these areas. Most often, high levels of confidence are attributed to soldier maintenance, while low levels of confidence are attributed to weapon age, malfunction, and difficulty in maintaining the weapon.

Reports of weapon stoppages at least one time while engaging the enemy were 30 percent or less across all weapons. Most stoppages were reported to have a small impact on continuing in the engagement with the weapon. The M9 and M249 were reported to have the most stoppages and the highest resulting negative impact. In most cases, attaching accessories using methods of attachment other than rails has negative impact with regard to weapon stoppages, repairs, and confidence in reliability and durability. For the M4, M16, and M249, firing in semi-automatic mode resulted in positive effects, such as decreasing repairs and stoppages, as well as increasing soldier levels of confidence in weapon reliability and durability.

Soldiers issued cleaning kits were less likely to experience stoppages and more likely to be confident in weapon reliability. Weapon cleaning type and frequency had little impact on stoppages and repairs overall. However, soldiers who frequently performed quick wipe-down cleanings experienced more stoppages. Frequency of disassembled cleanings had no effect on the occurrence of stoppages. Variations in lubrication practices, such as type of lubrication used and amount of lubrication applied, also had little effect on stoppages. Using a dry lubricant decreased reports of stoppages only for the M4 users. However, soldiers using a non-Army issued lubricant were more likely to have confidence in the reliability of their weapon.

Qualification level and soldier training did not have an effect on reported stoppages. However, confidence in weapon reliability was higher for soldiers in upper qualification levels. Soldiers who had trained with the weapon in an environment similar to theater prior to deployment were also more likely to be confident in the reliability of their weapon.

More usage of the weapon (defined as reported amount of ammunition used) increased the odds of weapons needing repair while in theater. Weapons that were rebuilt were also reportedly repaired more often than non-rebuilt weapons, and those with rebuilt weapons were less likely to be confident in the durability of the weapon.

For all four weapon types, soldiers requested weapons and ammunition with more stopping power/lethality. Soldiers also recommended higher quality magazines for the M9, M4, and M16; more durable ammunition belt links and drum systems; and reduced size and weight in the M16 and M249.

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Appendix: Repair, durability, stoppage, and reliability regression tables

Table 9: Logistic regression predicting weapon repairs

Predictor	B	Wald x2	p	Odds ratio
Satisfaction with corrosion resistance	-0.38	30.96	0.00	0.68
Accessory attachment method		17.24	0.00	
Duct tape	0.53	7.75	0.01	1.70
Dummy cord	0.58	12.75	0.00	1.79
Zip cord/parachute cord	0.50	4.38	0.04	1.65
Rails	0.21	2.41	0.12	1.24
No accessories		constant		
Weapon rebuilt		9.93	0.01	
Yes	0.50	4.78	0.03	1.66
No	-0.16	2.04	0.15	0.85
Don't know		constant		
How much ammunition	0.08	13.92	0.00	1.08
Burst[a]		28.06	0.00	
Semi	-0.72	13.86	0.00	0.49
Burst	-0.09	0.18	0.67	0.91
Automatic		constant		
Components Most Susceptible to Damage from Environment		23.37	0.00	
Trigger Group	-0.02	0.00	0.96	0.98
Magazine/Belt	-0.22	0.43	0.51	0.80
Ammunition	0.05	0.02	0.89	1.05
Bolt/Operating Rod	-0.23	0.53	0.47	0.80
Gas/Cylinder/Piston Assemblies	0.39	0.93	0.33	1.70
Do Not Know	-0.78	5.19	0.02	0.46
Feeder Assembly		constant		

a. Does not apply to M9 users

Table 10: Logistic regression predicting confidence in weapon durability

Predictor	B	Wald x2	p	Odds ratio
Satisfaction with corrosion resistance	-0.78	121.30	0.00	0.46
Accessory attachment method		11.16	0.03	
Duct tape	-0.02	0.01	0.93	0.98
Dummy cord	-0.04	0.05	0.82	0.97

Table 10: Logistic regression predicting confidence in weapon durability

Predictor	B	Wald x2	p	Odds ratio
Zip cord/parachute cord	0.21	0.85	0.36	1.24
Rails	-0.33	6.39	0.01	0.72
No accessories		constant		
Weapon rebuilt		22.32	0.00	
Yes	0.32	1.86	0.17	1.38
No	-0.44	15.19	0.00	0.65
Don't know		constant		
How much ammunition	-0.01	0.45	0.50	0.99
Burst[a]		32.97	0.00	
Semi	-0.76	14.89	0.00	0.47
Burst	-0.06	0.06	0.80	0.95
Automatic		constant		
Components most susceptible to damage from environment		12.45	0.50	
Trigger group	-0.24	0.32	0.56	0.79
Magazine/belt	-0.10	0.08	0.78	0.90
Ammunition	0.39	1.38	0.24	1.48
Bolt/operating rod	0.39	1.41	0.24	1.47
Gas/cylinder/piston assemblies	0.25	0.33	0.56	1.28
Don’t know	0.37	1.40	0.29	1.44
Feeder assembly		constant		
Repaired (0=N)	-0.86	57.50	0.00	0.42

a. Does not apply to M9 users.

Table 11: Logistic regression predicting reports of weapon stoppages

Predictor	B	Wald x2	p	Odds ratio
Accessory attachment method		17.72	0.00	
Duct tape	0.74	10.51	0.00	2.10
Dummy cord	0.47	5.19	0.02	1.60
Zip cord/parachute cord	0.97	12.31	0.00	2.60
Rails	0.35	4.17	0.04	1.40
No accessories		constant		
Burst[a]		8.85	0.01	
Semi	-0.65	6.99	0.01	0.53
Burst	-0.33	1.45	0.23	0.72
Automatic		constant		
Components most susceptible to damage from environment		29.31	0.00	
Trigger group	0.23	0.18	0.67	1.30
Magazine/belt	0.95	3.96	0.05	2.60
Ammunition	1.12	5.95	0.02	3.10
Bolt/operating rod	0.86	3.65	0.06	2.40
Gas/cylinder/piston assemblies	1.28	5.77	0.02	3.60

Table 11: Logistic regression predicting reports of weapon stoppages

Predictor	B	Wald x2	p	Odds ratio
Don't know	-0.14	0.08	0.78	0.87
Feeder assembly			constant	
Cleaning kit issued (1=Y)	-0.37	9.07	0.00	0.69
Quick-clean frequency	0.16	6.91	0.01	1.20
Slow-clean frequency	0.07	0.93	0.33	1.10
Lubrication frequency	0.33	12.71	0.00	1.40
Lubrication amount	-0.06	0.28	0.60	0.94
Army or non-Army lube		0.97	0.62	
Army issue	0.23	0.43	0.51	1.30
Non-Army issue	0.32	0.80	0.37	1.40
Don't know			constant	
Qualification level		5.41	0.07	
Expert	0.39	2.51	0.11	1.50
Sharpshooter	0.12	0.23	0.63	1.10
Marksman			constant	
Trained in environment comparable to theater	0.25	2.80	0.10	0.78
Lubrication type		0.80	0.85	
Wet	-0.02	0.01	0.93	0.98
Dry	-0.16	0.30	0.58	0.85
Don't know	0.00	0.00	1.00	1.00
Other			constant	

a. Does not apply to M9 users.

Table 12: Logistic regression predicting confidence in weapon reliability

Predictor	B	Wald x2	p	Odds ratio
Accessory attachment method		11.50	0.02	
Duct tape	-0.01	0.00	0.96	0.99
Dummy cord	0.04	0.05	0.82	1.04
Zip cord/parachute cord	0.22	0.75	0.39	1.25
Rails	-0.34	5.44	0.02	0.71
No accessories			constant	
Burst[a]		11.00	0.00	
Semi	-0.62	6.80	0.01	0.54
Burst	-0.21	0.66	0.42	0.81
Automatic			constant	
Components most susceptible to damage from environment		11.50	0.07	
Trigger group	0.04	0.01	0.94	1.04
Magazine/belt	0.23	0.28	0.60	1.23
Ammunition	0.46	1.20	0.27	1.58
Bolt/operating rod	0.64	2.50	0.11	1.90
Gas/cylinder/piston assemblies	0.42	0.70	0.40	1.52

Table 12: Logistic regression predicting confidence in weapon reliability

Predictor	B	Wald x2	p	Odds ratio
Don't know	0.30	0.50	0.48	1.35
Feeder assembly			constant	
Cleaning kit issued (1=Y)	-0.04	0.12	0.73	0.96
Quick-clean frequency	0.01	0.06	0.80	1.01
Slow-clean frequency	0.00	0.01	0.95	1.00
Lubrication frequency	0.03	0.12	0.73	1.03
Lubrication amount	0.02	0.02	0.88	1.01
Army or non-Army lube		2.95	0.23	
Army issue	-0.22	0.64	0.42	0.80
Non-Army issue	-0.41	2.02	0.16	0.66
Don't know			constant	
Qualification level		12.60	0.00	
Expert	-0.51	7.80	0.01	0.60
Sharpshooter	-0.65	12.60	0.00	0.52
Marksman			constant	
Trained in environment comparable to theater	-0.39	8.40	0.00	0.68
Lubrication type		9.60	0.02	
Wet	0.11	0.18	0.67	1.11
Dry	0.10	0.12	0.73	1.10
Don't know	0.63	4.50	0.04	1.87
Other			constant	
Stoppage (1=stoppage)	-1.50	138.70	0.00	0.22

a. Does not apply to M9 users.

Figure 12. Percentage of common parts between M4 and M16

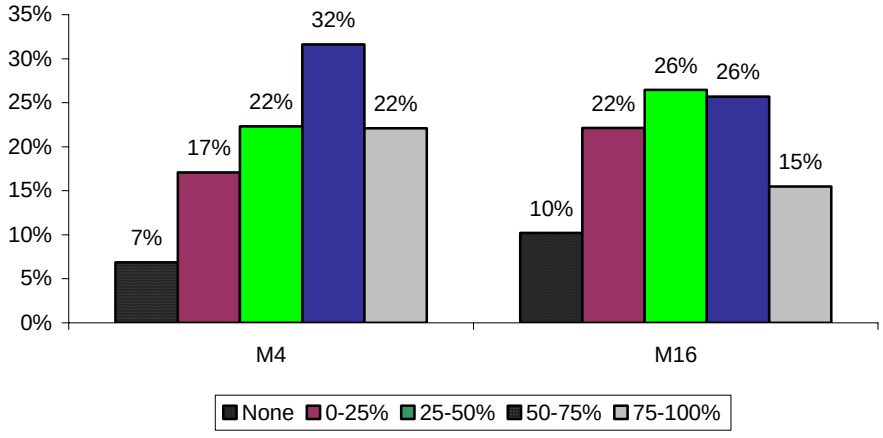
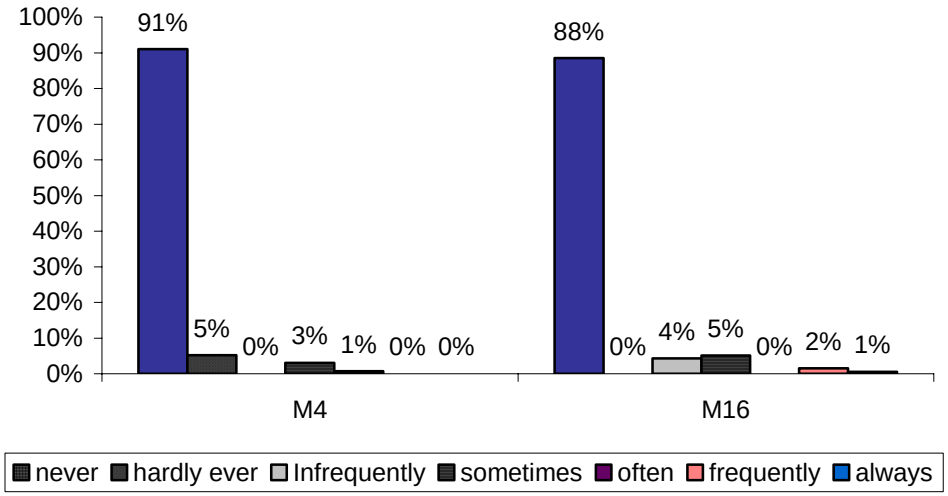


Figure 13. Frequency of swapping parts between the M4 and M16



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