

Data-Enabled Assessments: What Factors Correlate with Gunnery Excellence in ABCTs?

by LTC Brian W. Bifulco

Basic gunnery – the ability of a tank or Bradley crew to accurately engage targets – is the foundational skill of armored units. If crews cannot perform this task effectively, little else the unit does will matter.¹ Over the past 40 years, *ARMOR* and *Infantry Magazines* have published extensively on the significance of gunnery training doctrine, its evolution, and recommendations for improvement. Despite this robust literature, empirical analysis of gunnery training outcomes has remained limited. Most articles have been primarily descriptive or anecdotal, lacking statistical rigor and the ability to isolate the relationship between specific variables of gunnery performance. As a result, well-intentioned recommendations have often lacked empirical validation, and conclusions have frequently been confounded by unmeasured factors such as crew experience, platform readiness, or range difficulty. This deficiency impairs leaders' ability to prioritize resources, shape training conditions, and ensure crews are best prepared to excel.



U.S. Army photo by SPC Brandi Frizzell

	Bradleys					Tanks				
	(1) 4-9 CAV (SQDN)	(2) 1-5 CAV (IN CAB)	(3) 1-8 CAV (AR CAB)	(4) 1-9 CAV (AR CAB)	(5) 2ABCT (Total)	(6) 4-9 CAV (SQDN)	(7) 1-5 CAV (IN CAB)	(8) 1-8 CAV (AR CAB)	(9) 1-9 CAV (AR CAB)	(10) 2ABCT (Total)
<i>Qualification Type</i>										
% Distinguished	13.9	50.0	50.0	21.1	32.0	42.9	26.7	22.2	48.1	34.9
% Superior	27.8	18.8	25.0	36.8	26.2	7.1	33.3	33.3	14.8	22.9
% Qual. (Q1)	33.3	21.9	25.0	36.8	29.1	42.9	20.0	22.2	37.0	30.1
% Qual. (Q2)	25.0	9.4	0.0	5.3	12.6	7.1	20.0	22.2	0.0	12.0
<i>Qualified Engagements (first attempt)</i>										
Table III	7.6 (2.3)	8.9 (1.0)	9.8 (0.4)		8.5 (1.9)	8.7 (1.2)	8.0 (1.1)	8.6 (1.1)		8.4 (1.1)
Table IV	4.8 (3.6)	5.3 (2.4)	5.8 (2.5)		5.2 (3.0)	5.1 (2.0)	5.4 (1.5)	6.7 (2.0)		5.9 (2.0)
Table V	4.3 (2.8)	7.4 (1.7)	5.7 (2.5)		5.8 (2.7)	4.1 (1.3)	5.1 (1.4)	6.0 (1.9)		5.2 (1.8)
Table VI	7.3 (1.6)	8.4 (1.6)	8.6 (1.2)	7.8 (1.0)	7.9 (1.5)	7.9 (1.4)	8.1 (1.6)	7.6 (1.5)	8.3 (1.2)	8.0 (1.4)
<i>Overall Score (first attempt)</i>										
Table III	862 (73)	892 (82)	953 (29)		891 (78)	875 (64)	849 (48)	870 (61)		865 (59)
Table IV	689 (200)	658 (169)	588 (221)		655 (193)	585 (173)	647 (124)	653 (235)		632 (189)
Table V	560 (168)	805 (107)	621 (232)		666 (196)	570 (108)	643 (105)	607 (193)		607 (149)
Table VI	773 (125)	871 (98)	899 (55)	821 (81)	832 (111)	849 (88)	840 (104)	800 (106)	871 (70)	839 (95)
N	36	32	16	19	103	14	15	27	27	83

Table 1. Crew Performance - Proportions and Means (Standard Deviations)

In “A Data-Centric Approach to Increasing Crew Lethality: Proposing ‘Moneyball for Gunnery,’” the authors begin to address this deficiency by employing statistical modeling to identify factors that may wield outsized influence on gunnery outcomes for Stryker-mounted machine guns and grenade launchers.² They find that Table III performance and unit culture strongly correlate with Table VI outcomes for these weapon systems. Our analysis innovates on this approach in three key ways. First, we extend similar statistical modeling techniques to focus on tanks and Bradleys; second, we include the complete gunnery table progression in our analysis; third, and most importantly, we expand the set of predictors to include factors that can be influenced by leaders from company to division and installation level.

Doing so provides data-informed insights that enable leaders at echelon to set conditions more effectively for gunnery excellence. Crucially, this analysis focuses on factors that transcend specific training regimens, ensuring

relevance as the Army continues to reform and standardize gunnery training programs. In this way, the research buttresses ongoing initiatives such as Transformation in Contact (TiC) and gunnery readiness level (RL) progression to ensure our tank and Bradley crews are best prepared to win every future fight.

A Review of Gunnery Results and Data Collection

Table 1 shows the results of 2d Brigade Combat Team (Black Jack), 1st Cavalry Division’s gunnery results, decomposed by battalion and platform, conducted from January to May 2025 at Fort Hood for all available tank and Bradley crews. Black Jack achieved first-attempt qualification (Q1) for 88.0% of tank crews and 87.4% of Bradley crews, with average Table VI scores of 839 for tanks and 832 for Bradleys.

As a TiC-designated brigade, Black Jack has focused on fielding new equipment

and implementing novel concepts to inform the Army’s continuing transformation of armored brigade combat teams (ABCTs). As part of this effort, Black Jack seized an opportunity during its gunnery qualification to undertake an ambitious data collection effort. This effort enabled a detailed analysis to pinpoint the underlying factors that contribute to readiness, assess their relative importance, and ultimately provide leaders with actionable recommendations for improving crew lethality.

From official Army systems, we compiled individual-level data on crewmembers, including Armed Services Vocational Aptitude Battery (ASVAB) composite scores, time in position, time in service, age, and whether they were suspended from favorable personnel actions (“flagged”). We complemented this with data we felt were relevant to training outcomes but were not available in existing Army data stores, including time since last gunnery qualification attempt, number of previous qualification attempts, results

of most recent qualification attempts, whether the individual was part of multiple crews (e.g., “jump” crews), hours spent in the simulator, and performance during gunnery skills testing (GST). Finally, we augmented individual-level data with unit-level data at the platoon, company, and battalion level, including retention performance and the number of assigned Troopers, flagged Troopers, non-commissioned officers (NCOs), master gunners (by platform type), and mechanics (by platform type). This consolidated data set provided an invaluable source of detail to identify what factors have outsized influence on tank and Bradley crew performance.

Modeling Performance: Turning Conjecture and Data into Actionable Insights

To evaluate the determinants of gunnery performance, we estimate two statistical models using regression. Regression is a statistical method to identify how changes in one factor are associated with changes in another,

while holding other factors constant. This makes it a powerful tool for isolating which factors may have the greatest impact on outcomes and helping leaders make assessments that are based on evidence rather than opinion or speculation. Not all relationships identified by regression are strong or reliable. Correlations that are not statistically significant are more likely to be due to chance rather than a true relationship. To determine statistical significance, regression uses a measure called a p-value. A small p-value (commonly below 0.10) suggests that the relationship reflects a meaningful underlying correlation.

The first model, the Table Model, aligns closely with the prior research in “Moneyball for Gunnery” and isolates the predictive value of the gunnery table progression itself. The second, the Factors Model, expands the analysis to include individual-level, unit-level, and environmental factors that are more readily influenced by leaders at echelon. Each model is estimated using both linear and logistic regression, depending on the outcome of interest. We focus on two outcomes: a crew’s overall Table VI score, which reflects a

crew’s ability to demonstrate any degree of proficiency, and a classification of whether a crew achieved Q1 qualification or not, reflecting a crew’s ability to survive in combat.

Table Model

“Moneyball for Gunnery” models Stryker Table VI scores as a function of practice table scores (Tables III through V), weather conditions, and unit culture. Building on this approach, our Table Model similarly includes practice table scores, but it also includes performance measures for Table I (number of first-time passes at GST stations) and Table II (number of hours in the simulator) to fully capture the complete doctrinal training progression. We proxy unit culture with company-level retention percentage, which serves as a plausible surrogate for organizational cohesion and leadership climate. We omit weather conditions as weather variation was minimal during the training window and tank and Bradley platforms – unlike Strykers – use advanced fire control systems that mitigate some weather effects through automated ballistic corrections. Table 2 reports the results.

Column (1): Total Score. In this column, the numbers are the change in Table VI score corresponding to a one-increment increase in the listed variable. For example, each additional percentage point that a company achieves in its retention mission corresponds to a 1.5-point increase in the Table VI scores for each crew in that company, on average. This finding is consistent with “Moneyball for Gunnery” that unit culture positively correlates with gunnery performance. Although difficult to quantify directly, retention rates may serve as indirect indicators of cohesion, professionalism, and command climate – factors that plausibly influence gunnery outcomes. Leaders may be able to better identify crews that are at risk if they observe wide variations in unit-level retention performance.

Column (2): Qualification Probability (Q1). We next examine the probability of qualifying Q1 using a logistic regression. In this column, the numbers are the percentage point changes (in decimal form) of qualifying Q1 due to a

Table 2: Table VI Outcomes (Table Model)

Note: The asterisks and pound sign indicate the level of statistical significance. Results with neither an asterisk nor a pound sign are not statistically significant. The numbers in parentheses are the standard errors used to calculate statistical significance.

	(1) Total Score	(2) Prob(Q1)
Table V Score	0.107 (0.057)	0.000 (0.000)
Table IV Score	0.083 (0.049)	0.000*** (0.000)
Table III Score	0.131 (0.078)	0.000 (0.001)
Table II (Simulator Hours)	-5.485* (1.597)	-0.018** (0.007)
Table I (# of First-Time Gos)	2.005 (1.743)	0.007# (0.005)
Retention % (CO)	1.482# (0.672)	0.003# (0.002)
Tank (Base: Bradley)	-33.528 (31.930)	-0.095*** (0.023)
N	139	139
$p <:$ # 0.2, * 0.1, ** 0.05, *** 0.01		

	(1) Total Score	(2) Prob(Q1)	(3) Prob(Sup./Dist.)
<i>Personal Characteristics</i>			
Average ASVAB Score	1.416*** (0.514)	0.001 (0.002)	0.005** (0.002)
Tank (<i>Base: Bradley</i>)	-46.511** (18.327)	-0.205*** (0.074)	-0.058 (0.092)
<i>Skill Factors</i>			
Master Gunner	16.103 (30.160)		0.087 (0.188)
Previous Sup./Dist.	38.395** (18.669)		0.214** (0.098)
<i>Experience Factors</i>			
First Attempt	-26.557# (17.763)	-0.138** (0.055)	0.028 (0.083)
# of Previous Attempts	3.052* (1.645)	0.006 (0.007)	0.013# (0.008)
<i>Environmental Factors</i>			
# of Master Gunners (BN)	4.334 (3.669)	0.011 (0.016)	0.013 (0.019)
# of Mechanics (BN)	3.723** (1.566)	0.019*** (0.007)	0.001 (0.008)
Retention % (CO)	0.637# (0.450)	0.003# (0.002)	0.005** (0.002)
Flagged % (CO)	-0.187 (1.284)	-0.013# (0.008)	-0.008# (0.006)
# of NCOs (PLT)	8.160* (4.202)	0.010 (0.018)	0.044** (0.018)
N	139	139	139

$p <:$ # 0.2, * 0.1, ** 0.05, *** 0.01

Table 3: Table VI Outcomes (Factors Model)

Note: The asterisks and pound sign indicate the level of statistical significance. Results with neither an asterisk nor a pound sign are not statistically significant. The numbers in parentheses are the standard errors used to calculate statistical significance.

one-increment increase in the listed variable. For example, every additional Table I GST station passed by a crewmember on the first attempt corresponds to a 0.7% increase in the probability of that crew achieving a Q1 qualification. This underscores the foundational role of individual-level proficiency and hands-on skills training in determining final gunnery outcomes. Battalion-level leaders should strongly consider centralizing training and testing of gunnery skills to ensure each crewmember is meeting rigorously-enforced performance standards before proceeding with the remaining training progression.

Platform type is also statistically significant. Tank crews are 9.5% less likely to qualify Q1 than their Bradley counterparts. This may be due to tanks having larger crews or more complicated engagements, such as the simultaneous

engagement that requires striking targets with three different weapons systems. Tank companies should strongly consider pre-Table IV live fire training that focuses on machine gun-specific marksmanship and crew coordination for complex engagements.

Despite some statistically significant relationships, the Table Model provides limited insight into factors that drive crew lethality and therefore provides leaders with limited options to improve gunnery performance. The Factors Model addresses the shortcomings of the Table Model.

Factors Model

Gunnery performance may vary considerably due to differences in individual, unit, or environmental characteristics – factors that can be shaped by leaders at echelon before training commences. The Factors Model

incorporates these sources of variation and offers relevant insights to better position subordinate units for success.

Table VI performance is modeled as a function of personal characteristics, previously demonstrated skill, gunnery experience, and the training environment. Table 3, Column (1) reports changes in overall Table VI scores, Column (2) reports changes in the probability (in decimal form) of qualifying Q1, and Column (3) reports changes in the probability (in decimal form) of qualifying at least Superior.

Personal Characteristics. Higher cognitive aptitude, as measured by the composite ASVAB score, is positively associated with performance. A one-point increase in the average ASVAB score between the vehicle commander (VC) and gunner is associated with a 1.4-point increase in that crew's Table VI score and a 0.5% increase in the

probability of qualifying at least Superior. A higher cognitive aptitude may better enable rapid mastery of platform complexity, troubleshooting under stress, and adapting quickly during live-fire scenarios. Often, units have allocated incoming personnel primarily by balancing military occupational specialty and rank across their subordinate units. However, these results suggest additional gunnery gains can be realized by tracking, allocating, and balancing incoming personnel by cognitive potential (through ASVAB scores, civilian education, certifications, or even language proficiency) as well.

Skill Factors. A crew that has previously demonstrated a high degree of proficiency is likely to continue doing so. A crew where either the VC or gunner has previously shot at least Superior scores 38.4 points higher on Table VI and is 21.4% more likely to do so again. Notably, if either the VC or gunner is master-gunner qualified or has previously shot at least Superior, then that

crew qualified Q1 100% of the time.

Experience Factors. Inexperience substantially correlates with degraded performance. Crews with either a first-time VC or gunner score 26.6 points lower on Table VI and are 13.8% less likely to qualify Q1 relative to their experienced peers. Further, each additional Table VI attempt the VC and gunner have taken in their careers corresponds to 3.1-point increase on Table VI and 1.3% increase in the probability of qualifying at least Superior.

Environmental Factors. Organizational metrics strongly correlate with gunnery outcomes. Mechanics have a significant correlation with gunnery scores. Each additional mechanic in a battalion corresponds with a 3.7-point increase in Table VI scores and a 2.6% increase in the probability of qualifying Q1. A deficit of mechanics may reduce platform availability for training and increase the time crews spend on maintenance rather than gunnery

preparation, training, and rest.

Similarly, the number of flagged Troopers in a unit correlates negatively with performance. Each additional percentage point of a company that is flagged corresponds to a 2.1% reduction in the probability of that company's crews qualifying Q1 and a 0.8% reduction in the probability of qualifying at least Superior. This effect likely operates through two mechanisms: reduced individual motivation and increased leader demands due to administrative burdens associated with misconduct management (e.g., counseling, legal processes, inspections, appointments, etc.). For those flagged Troopers pending separation, leaders can reduce these additional demands by surging legal services at key times to accelerate resolution of these cases and promote more focused attention on foundational training events.

NCOs are essential to coaching, validating training, and enforcing

Table 4: A Bradley Fighting Vehicle from B Co., 3rd Battalion, 15th Infantry Regiment, 2nd Armored Brigade Combat Team, fires at a target during gunnery at Fort Stewart, Ga., Aug. 14. (U.S. Army Photo by SPC Jordyn Worshek)



discipline and accountability throughout the training progression. Each additional NCO in a platoon corresponds to that platoon's crews scoring 8.2 points higher on Table VI and improves the probability of qualifying at least Superior by 4.4%. Leaders and strength managers often prioritize fill of Troopers in concert with a deployment cycle, with a unit being the priority to receive Troopers as it approaches a deployment and then deprioritized as it approaches the end of its deployment. NCO shortages have a disproportionate impact on training outcomes that will likely continue to propagate throughout the remainder of a unit's collective training progression. These results suggest that prioritization of fill may be better organized around when units are conducting foundational skill training, such as crew gunnery, regardless of the unit's placement in a deployment timeline.

Predicting Performance and Customizing Training

The Factors Model is valuable not only for understanding the drivers of crew lethality but also for providing insight to where additional training interventions may be warranted. All predictor variables in the Factors Model are known prior to the start of training, allowing leaders to assess qualification risk before a crew even begins the training progression. A natural question is how accurately the model predicts subsequent performance. Using model-predicted probabilities, we classify crews as Q1 if their predicted probability to qualify Q1 is greater than 50% and as Q2 if their predicted probability is less than 50%. Based on this threshold, the model correctly classifies crews – as Q1 or Q2 – 87% of the time. In other words, leaders can predict – nearly nine times out of 10 – which crews are most at risk of not qualifying on the first attempt before training begins.

Further incorporating Table I and Table II results raises the probability of correct classification to 93% providing leaders with an accurate assessment of which crews are prepared to continue on to live-fire training. This has immediate utility for company and

battalion-level leaders. When resources such as range time, targeted coaching, simulator availability, remedial training, and competing non-gunnery requirements must be prioritized, the model serves as an additional analytic tool – complementing leaders' experience, intuition, and instinct – to ensure resource and training efforts are both targeted and customized for each crew to produce the greatest effect.

Conclusions and Recommendations

Individual, experiential, organizational, and environmental factors have a significant relationship with gunnery performance among tank and Bradley crews. Higher cognitive aptitude, previously-demonstrated gunnery skill, number of previous Table VI attempts, unit culture, and the number of NCOs and mechanics on hand has a positive and significant correlation with gunnery performance. The percentage of flagged Troopers and crews with first-time VCs or gunners correlate with degraded performance.

These results also provide actionable insights that leaders at echelon can leverage to maximize gunnery performance and crew lethality. Further, they underscore that Table VI success is the result of not only fidelity to a specific training regimen and its associated performance standards, but also a myriad of factors controlled or influenced at echelons from company to division and installation. It also demonstrates how robust data collection efforts, statistical modeling, and machine algorithms can converge to unlock novel insights and anticipate future performance. By integrating personnel data, unit characteristics, and environmental considerations into gunnery performance modeling, leaders can significantly influence crew lethality and training outcomes.

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NOTES

1 Chuck Bies and Gary Kurtzhals, "Establishing the Foundation of Success – The Gunnery Training Program," *ARMOR* 136, no. 1 (2024): 6–13.

2 Jonathan Bate et al., "A Data-Centric Approach to Increasing Crew Lethality: Proposing 'Moneyball for Gunnery,'" *Infantry* 113, no. 4 (2024): 63–65.

3 Dan Cannon and John Nimmons, "Readiness-Level Progression: Certifying Expertise in Lethality as a Subset of the Armor Standardization and Training Strategy 2030," *ARMOR* 139, no. 3 (2022): 5–10.

4 Frank Czerniakowski et al., "Attaining Readiness by Developing a Data-Centric Culture: Lessons Learned from the 4th Infantry Division's Approach to Data-Driven Decision Making," *Military Review Online* (2024): 1–13.

5 Thomas Feltey, "Armor Standardization and Training Strategy," *ARMOR* 139, no. 3 (2022): 2–3.

6 Anthony Keller, Jonathan Bate, and Brendon Wamsley, "Taking a Data-Centric Approach to Unit Readiness: Leveraging Analytics in a Brigade Combat Team," *Military Review Online* (2024): 1–9.