

Continuously Revolutionizing Small-Arms Lethality

The Marine Corps' strategic opportunity is here

by the NCOs, SNCOs, and Officers of Weapons Training Battalion, Quantico

"Every Marine is, first and foremost, a rifleman. All other conditions are secondary."

**—Gen Alfred M. Gray, Jr.,
29th Commandant of the Marine Corps**

It's the year 2027. The Chinese People's Liberation Army (PLA) is in the process of a multi-pronged assault across the Western Pacific and Indian Ocean regions. Initial PLA movements suggest that the PLA intends to seize Taiwan while also establishing strong points astride key maritime terrain in the South China Sea and Strait of Malacca. Three platoons from Bravo Company, 3rd Littoral Combat Team are conducting reconnaissance and security patrols over a 30-by-30-kilometer area in support of a NMESIS battery and Air Control Battery on an island that appears to be one of the PLA objectives. The Marines' fused intelligence receivers indicate that PLA Navy Type 076 and Type 075 amphibious assault ships are now 60 nautical miles from the island and closing fast. NMESIS battery Marines launch a volley of naval strike missiles at both ships. Ten minutes later, the intelligence receivers indicate that both ships were successfully struck and are now dealing with numerous fires, although not before launching six assault support aircraft and four Type 726 landing craft.

These assault support aircraft and Type 726s are closing rapidly on the island, carrying two reinforced companies of PLA soldiers.

SSgt Luskey, the platoon sergeant for 1st Platoon, updates his squad leaders, Sgt Smith, Sgt Taylor, and Cpl Erhardt, on enemy movements as they are patrolling in and around an urban area that surrounds the three most likely PLA helicopter landing zones. The Marines subsequently conduct final pre-combat checks on their equipment, including their aerial sensing systems, loitering munitions, and recoilless rifles. SSgt Luskey reinforces to his squad leaders that they should remember their marksmanship training. They had spent hours with their Marines conducting dry-fire and live-fire exercises with the Joint Marksmanship Assessment Package (JMAP) in preparation for a situation like this—a relatively smaller Marine-sized formation having to destroy a PLA force of equal or greater number. SSgt Luskey next emphasized his confidence in the Marines' ability to destroy the PLA formations. He also emphasized that his confidence was not

based on myths or platitudes. Instead, it was based on their proven lethality, which they repeatedly demonstrated in training through JMAP's quantified lethality metrics.

As we write this article today, small-unit leaders across the Corps cannot objectively measure their Marines' small-arms lethality as described in the vignette above. This limits these leaders from being able to develop tailored training plans to progressively increase their Marines' lethality. This reality further prevents the Service from being able to provide fact-based, lethality-focused readiness data to Joint Force commanders to build their confidence in employing Marines in the types of scenarios that Navy and Marine Corps concepts have been built around for years now, such as *Expeditionary Advanced Base Operations*, *Littoral Operations in a Contested Environment*, and *Stand-in Forces*.

Fortunately, the Service now has a strategic opportunity to change this collective reality, which would result in the most revolutionary change in Service marksmanship in more than a century. To help explain the context behind this revolutionary potential, this article initially describes what this new reality could be—well before 2027. Next, the article describes the guidance documents and lessons learned that helped spark the opportunity, and finally the key revolutionary insights that are now available.

The Revolution in Execution

Present day, Quantico, VA.

“Shooter, stand by, BEEP!”

As the audio signal from the acoustic shot timer goes off, Sgt Luskey begins the Short-Bay Distance drill of the Infantry Marksmanship Assessment (IMA) on the first day of the Infantry Marksmanship Training Program (IMTP) Course. This drill has the shooter fire five rounds from the standing, then five rounds from the kneeling at a target 50 meters away. The shooter then conducts a mandatory reload while running to the 25-meter line and engages the same target with five more rounds. Next, the shooter executes a shooting-on-the-move drill, consisting of continuously moving from fifteen meters to three meters while firing a box drill at two targets and conducting a mandatory reload between shots. Once complete, the shooter executes a manipulation-and-recoil control drill, fired from seven meters and involving the shooter firing six rounds to the target’s chest, conducting a mandatory reload, and firing four more rounds to the target’s head. The final drill, which the shooter executes three separate times, is named Known Distance and Traverse, and is conducted using a barricade and requires the shooter to fire two rounds at a 100-meter, eight-inch steel disc to simulate a target in defilade, transitioning to a 200-meter lethal-zone target and engaging with two rounds, and lastly transitioning to the prone position and engaging a 300-meter lethal-zone target with two rounds. All this information, including how long it took



Figure 1. A screen capture of the JMAP interface and basic Hit Factor data from recent IMA drills conducted as part of IMTP Course 4-24 aboard Weapons Training Battalion, Quantico. (Figure provided by authors.)

to fire the first round, the total time to accomplish each drill—even down to the time between shots fired—along with all hits and misses on target, are recorded and used to calculate his Hit Factor in the JMAP interface. Throughout the remainder of the course, he, along with his instructors, continually refer to JMAP and its detailed measurement of his performance to identify ways to make him even more lethal.

The secret sauce behind IMTP’s success lies primarily with JMAP’s data collection capabilities. After executing

the course of fire (COF), the Marine has access to his score, as shown in Figure 1. This score is a comparative assessment, taking in the point value based on the lethality of the shot placement of each round and dividing it by the time it took to accomplish the COF, equaling the Hit Factor, which is also referred to as a Marine’s Lethality Factor. This information can be instantaneously compared to other shooters who have likewise fired the IMA to show a direct comparison in lethality. Using this comparative assessment, JMAP enables any instructor and small-unit leader to understand the Lethality Factor of their individual Marines and provides the detailed metrics to enable them to determine how to best tailor training to improve their individual and unit marksmanship lethality. JMAP is currently being used at the Weapons Training Battalion, Quantico, and the Schools of Infantry as a result of a multi-year research and development effort with the Office of Naval Research (ONR) to develop a way for human performance science and data analytics to tangibly transform how the Marine Corps thinks about, measures, and improves individual Marine, unit, and total force small-arms marksmanship lethality. This includes deliberately designed, measured, and lethality-focused COFs such as the IMA, along with the associated Rifle Marksmanship Assessment, that are now executed by all entry-level Marines at Marine Combat Training and The Basic School. Never in our Corps’ history has a Marine had access to such



Students conduct IMA drills at IMTP course. (Photo provided by authors.)



IMTP instructors provide marksmanship and lethality data feedback using JMAP. (Photo provided by authors.)

quantifiable, combat-focused lethality data.

What Led to This Revolutionary Opportunity

In both the FY2017 and FY2018 Combat Marksmanship Symposiums, symposium members identified the need for a:

Dedicated Marine Corps rifle marksmanship initial capabilities document (ICD) to gain synergy along the lines of effort represented by rifle marksmanship doctrine; ranges, facilities, and targets; weapons and equipment systems; and training.¹

The symposium outputs reinforced guidance from the Corps' 37th Commandant, Robert B. Neller, who at the time had been increasingly directing a greater focus on modernizing the service's infantry formations.² Additionally, in February 2018, then-Secretary of Defense, James N. Mattis, directed the creation of the Close Combat Lethality Task Force (CCLTF). In the memorandum directing the CCLTF establishment, Secretary Mattis wrote:

I am committed to improving the combat preparedness, lethality, survivability, and resiliency of our Nation's ground close-combat formations. These formations have historically accounted for almost 90 percent of our casualties and yet our personnel policies, advances in training methods, and equipment have not kept pace with changes in available technology, human factor science, and talent management best practices.³

One of the CCLTF's foremost focuses of effort included ensuring "infantry squads will be expertly trained for offensive and defensive operations and will prevail in first contact with the adversary."⁴ In other words, Secretary Mattis focused the CCLTF on ensuring squads would have much greater lethality such that they could thrive and win in the most challenging combat environments, such as the one envisioned in the article's opening.

Concurrent with the creation of the CCLTF, the FY2018 Combat Marksmanship Symposium recommendations led to the Deputy Commandant for Combat Development and Integration

commissioning the Marine Corps Rifle Marksmanship Lethality Capabilities-Based Assessment (CBA) to assess the current capabilities of Marines with their service rifles and to assess their overall combat marksmanship lethality. In the final CBA report, which was published in November 2018, the authors concluded:

The current Marine annual rifle training Tables 1 and 2 of the Marine Corps Combat Marksmanship Program, as defined in Marine Corps Order 3574.2L, fail to accurately represent both the current threat environment and future operating environment.⁵

Throughout the nearly 100-page CBA, the authors described many factors contributing to this problem. For example, the Service had no concrete or measurable definition of lethality, nor did it have a standard set of quantifiable metrics for Marines to leverage to help them understand how lethal they are with their weapons in the current state. This, then, prevented them from developing aspirational and quantifiable future state goals to work toward. Overall, the CBA report included a Prioritized Capabilities Gap List, which identified 109 marksmanship-related tasks the Service needed to prioritize to increase individual marksmanship lethality. These ranged from acquiring targets at distances from 3–300 meters in varying levels of defilade or cover to engaging moving targets while the shooter is moving from 3–300 meters. They also included a variety of measurable training progression recommendations. Most importantly, the CBA acknowledged that efforts to assess and

provide improvements to marksmanship lethality would be temporary without a new way to quantify and assess enterprise-level marksmanship lethality. To this end, the report emphasized:

Without data, the benefits of this CBA will be short-lived and the idea of continuously adapting to a thinking enemy will once again be relegated to anecdotal assertions rather than quantifiable capabilities.⁶

Both the CBA and CCLTF directives subsequently had a direct impact on the development of the new Annual Rifle Qualification (ARQ). The Service began implementing ARQ across the FMF in 2021. ARQ replaced Annual Rifle Training Tables 1 and 2, which had been the core of the service-rifle qualification training since 1907. ARQ incorporates shooting positions that are more realistic in combat while emphasizing achieving lethal effects. Unlike Annual Rifle Training, ARQ allows Marines to gain support by using bipods, resting magazines on the deck, and using assault packs while in the prone position. Barricades are also available to use as support as part of the 100- and 200-yard parts of the qualification. Additionally, the ARQ includes close-bay engagements at ranges between 15 and 25 yards and doubles the number of rounds, from 50 to 100, that Marines shoot at the 500-yard line. Importantly, the ARQ target is based on lethality zones, as recommended in the CBA and illustrated in Figure 2.⁷ This new target and COF reinforce marksmanship on the basis of lethality because only shots that fall in a lethal zone are scored.

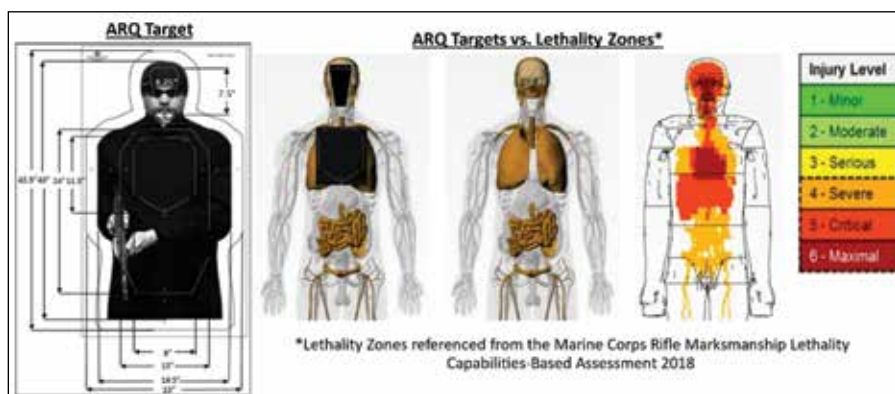


Figure 2. The ARQ destroy target. (Figure provided by authors)

Near simultaneous with the Service beginning to implement the ARQ, ONR was working on a research project focused on understanding deadly force decision making. Based on the project's initial data collection results, the CBA insights, and increasing Marine Corps focus on marksmanship lethality, ONR decided to pivot its research to collecting marksmanship data to better understand how to improve infantry

assessment of how each Marine improved and how they performed relative to Marines from other SOI companies.

When reflecting on JMAP's multi-year development, it is important to reinforce that the S.P.E.A.R. model is focused on measured performance in lethality as a quantifiable number. That number is a factor in comparing at least two attributes of lethality, such as accuracy and time. The S.P.E.A.R.

adaptability, and risk exposure are not measured. Thus, while ARQ does qualify Marines more realistically and measures precision as a component of lethality, it does not by itself measure a quantifiable increase in lethality.

JMAP's Key Revolutionary Analysis

By comparison, the IMA (and associated Rifle Marksmanship Assessment), when scored by JMAP, does assess lethality as a quantifiable number by measuring speed, precision, executive control, and adaptability. Every round is accounted for in terms of both speed and precision. This is achieved by using JMAP's acoustic shot timer to determine the amount of time taken to fire each round, the time between shots fired, and the total time to execute the drill. Additionally, each round is scored, with higher point values being assigned to hits in lethal zones on the target. The total points accrued during the COF are divided by the total time in seconds or lethality factor. On top of measuring a Marine's overall lethality factor, JMAP also measures critical sub-components of speed, namely time to first shot and time between rounds. In terms of precision, not only is each round scored but the probability of achieving a lethal hit is measured in percentage. Executive control is quantified by determining if a shooter was able to adapt his or her shooting technique as measured by time and accuracy across the different marksmanship tasks from near to far as well as easier to more difficult. Adaptability is measured by the time it takes to conduct a reload instead of firing. By measuring speed, precision, executive control, and adaptability, JMAP measures and quantifies lethality, and in so doing, addresses the core problem identified in the CBA.

When it comes to unit-level marksmanship training, JMAP enables an individual Marine's lethality factor to be compared across shooters who all perform the same drill. For example, Shooter 1 completes the IMA's short-bay distance drill in 25 seconds, and by focusing on precision, achieves a perfect score of 75 by firing all rounds into the destroy area. The Marine was exceptionally accurate, although not

In terms of precision, not only is each round scored but the probability of achieving a lethal hit is measured in percentage.

marksmanship training. Next, ONR, in coordination with the Naval Health Research Center and Marine Corps Training and Education Command, established a definition of lethality and a model to quantify lethality. The definition and model were described in a paper entitled, "S.P.E.A.R. Model of Lethality."⁸ The paper authors defined lethality as:

The repeatable capacity of a system—composed of an individual, weapon, and ammunition—to incapacitate enemy combatant/s through a physiological stop which is likely to result in death.⁹

They also quantified lethality using five attributes: speed, precision, executive control, adaptability, and risk exposure.¹⁰ Additionally, the authors described ways to quantifiably measure each attribute. Along with this understanding of the definition of lethality and the elements it, ONR developed a simulation based on these measurements to determine a comparative assessment of lethality across units. For the simulation inputs, ONR identified and leveraged commercially available shot-timer technology to capture marksmanship-related data, leading to the development of what we now know as JMAP. Finally, ONR by leveraging JMAP, quantified the lethality of every infantryman upon graduation from SOI as well as captured a comparative

paper authors explained, "'realism' is a byproduct of the model—not a goal. An overemphasis on realism can lead to a focus on aesthetics rather than performance, which, in turn, compromises the validity of the measure."¹¹ ARQ, for example, is more realistic than legacy marksmanship training. Marines execute the COF while wearing equipment that they would be expected to wear in combat. ARQ is fired from realistic positions such as magazine-supported prone and barricade-supported kneeling or standing. Marines also fire at human silhouette targets, and only lethal shots are scored. However, while ARQ has a time limit, the scoring methodology does not compare marksmanship in terms of time. In the context of the S.P.E.A.R. paper, this, then, means that ARQ is a more realistic marksmanship COF than what was previously shot, although not necessarily a better metric of lethality as defined above. It does measure the skill of precision as a component of lethality, and it measures this component under more realistic conditions than the legacy training did. As a result, while ARQ was a much-needed advance in the annual qualification COF, it did not—and does not—provide a quantifiable increase in lethality, as measured by the S.P.E.A.R. model. The only lethality attribute measured of the five in the ARQ is precision, which is measured by shot placement and value. Speed, executive control,



IMTP student executes MRC drill under supervision of Sgt Goslin. (Photo provided by authors.)



Sgt Goslin provides instructor feedback using JMAP. (Photo provided by authors.)

very fast, resulting in a lethality factor of 3. Conversely, shooter 2 prioritizes speed and completes the drill in 15 seconds, although only accrues 45 points. By focusing on speed without accuracy, his lethality factor is the same, at 3. He was 10 seconds faster but much less precise. Shooter 3 is an experienced instructor. He has learned how to best balance speed and accuracy. He fires the drill in 16.25 seconds and achieves 65 points. His lethality factor is 4, which is 33 percent more lethal than either shooter 1 or shooter 2. By balancing speed and accuracy, this shooter is the most lethal in a quantifiable way. This comparison gives small-unit leaders and instructors immediate feedback as to their Marine's lethality related to marksmanship. Combat marksmanship coaches (CMCs) and combat marksmanship trainers (CMTs) can use this informa-

tion to craft deliberate training plans to increase the lethality of the Marines in their respective units. For example, a CMC or CMT can take this data and compare the time and accuracy of each shooter to determine what would be the most effective use of the unit's training time on the range or in dry fire. Based on an initial IMA, a CMT might want to prioritize dry-firing reloads because he sees that his shooters have a significantly slower reload time than other platoons. The CMC or CMT might

also use the same assessment as reason to work on another drill for another platoon because this unit struggles in another area. The CMT could then after one week of focusing in a certain area require his Marines to shoot the drill again, at which point he would have a quantifiable measurement of how the unit's lethality has improved.

One other major advantage of JMAP when it comes to thinking about incentivizing Marines to want to become more lethal is that the Lethality Factor

... this competitive environment approach can be leveraged across the entire Marine Corps by uploading IMA scores ... into the Marine Corps Training Information Management System.



An IMTP student refines her marksmanship based on IMTP instructor feedback and JMAP analysis. (Photo by Capt Philip Williams.)

USMC Percentile	% Best in Class	Avg HF	Time	Points	Zero	300 BM
99	100.00%	4.22	51.01	378.70	Pass/2.5	0.00%

Drill Breakdown											
SBD - COMPLETE			SCM - COMPLETE			MRC - COMPLETE			RDT - COMPLETE		
Percentile	% Class	% Team	Percentile	% Class	% Team	Percentile	% Class	% Team	Percentile	% Class	% Team
91	88.62%	80.75%	95	90.67%	55.47%	99	100.00%	69.34%	98	100.00%	73.47%
HF Factor	2.70	21.27	HF Factor	3.06	8.18	HF Factor	8.36	5.68	HF Factor	2.78	15.06
Points	57.50		Points	25.00		Points	47.50		Points	43.33	
Draw/1st shot	1.39		Draw/1st shot	1.01		Draw/1st shot	0.77		Avg 100 1st shot	3.46	
AVG 50yd split	0.83		AVG chest split	0.42		AVG standing split	0.18		AVG 100 split	1.04	
Move to kneeling	2.11		Transition chest	0.93		Speed Reload	3.03		AVG 100 hit probability	100%	
AVG kneeling split	0.83		Speed reload	4.14		AVG head split	0.32		AVG 200 transition	2.43	
Moving reload	8.32		Headshot transition	1.25		Destroy probability head	75.00%		AVG 200 split	1.02	
AVG 25yd split	0.69		Destroy probability head	100%		Head reload	3.03		AVG 200 hit probability	66.67%	
Destroy Probability	86.87%								AVG 300 transition	5.84	
									AVG 300 split	2.09	
									AVG 300 hit probability	50.00%	

Figure 3. The Hit or Lethality Factors from a post-IMA comparison for the most recent IMTP class. (Figure provided by authors.)



IMTP Marines evaluating each other using JMAP. This helps the students begin to understand how to implement marksmanship changes to affect their future Marine's lethality. (Photos by Capt Philip Williams.)

has no maximum score. Because time is included in measuring one's lethality factor, a Marine always has the potential to execute the drills faster and therefore become more lethal. This leads to an inherently competitive marksmanship training environment. Further, this competitive environment approach can be leveraged across the entire Marine Corps by uploading IMA scores captured with JMAP into the Marine Corps Training Information Management System. Additionally, in the spirit of our 29th Commandant's emphasis that "Every Marine is, first and foremost, a rifleman," a Marine's Lethality Factor can be used to replace or augment the ARQ score in the Junior Enlisted Performance Evaluation System. Incentivized by promotion, Marines can then continuously compete with one another, which would make them even more lethal marksmen.

At the battalion or regimental level, JMAP provides opportunities to revolutionize how the Service quantifies and assesses true readiness and lethality, which will likely become increasingly essential as service leaders seek to determine which units are truly trained and ready to execute missions such as the one described in the article's opening. The CBA highlighted this current deficiency when stating:

Despite the foundational idea that Marines must have the ability and confidence to deliver lethal fires under combat conditions ... Marine Corps leadership from Iraq and Afghanistan

have drawn this ability into question. Currently, these observations lack quantitative, analytical support.¹²

JMAP allows commanders to know quantitatively the lethality of a Marine as well as unit. They can input their unit's IMA data via JMAP into the S.P.E.A.R. simulations to determine how lethal they would perform in combat. This information, which has never been available previously, can also be used alongside performance results from other training and readiness events, such as unit performance executing various offensive or defensive-related tasks, to accurately determine overall unit capability. For example, for a platoon attack, while zeroing their weapons in their preparation for the combat phase, the Marines can also

be evaluated on executing the IMA. The unit's Lethality Factor can then supplement the training and readiness evaluation and further highlight the platoon's readiness. This means that the commander can trust that his or her Marines will be quantitatively more lethal even over a numerically superior force. Before JMAP, commanders were only able to make assumptions about their lethality based on qualification scores and the fact that they had completed a pre-deployment work-up. Now, commanders can know that their unit has proven and demonstrated their lethality. They can therefore now trust that the unit can be self-supporting and require less logistical support in terms of ammunition because each round is going to be used with lethal effects.

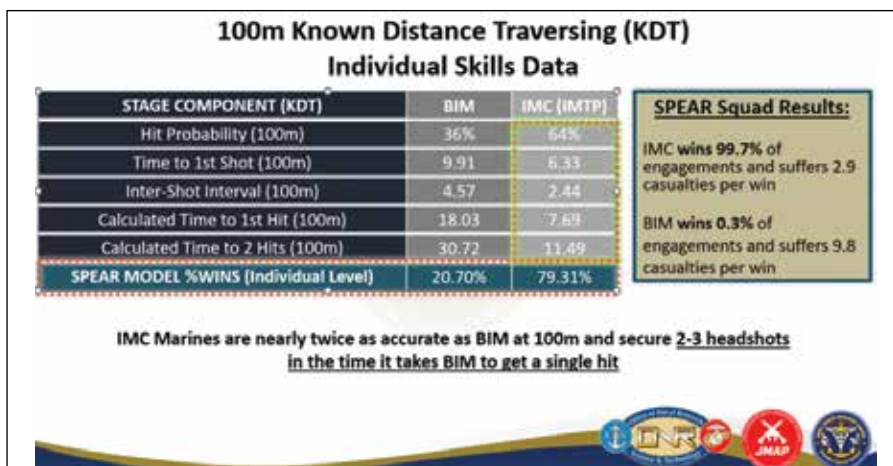


Figure 4. JMAP facilitated the comparative study between IMC and Basic Infantry Marine, highlighting the increase in lethality which led to the decision to implement IMTP into IMC. (Figure provided by authors.)

Finally, JMAP can revolutionize our institutional ability to adapt to emerging technologies and even training approaches. Because JMAP enables a data-centric approach to decision making, the Service no longer needs to make assumptions as to whether a new weapon, holster or any other individual equipment or training curriculum has a performance advantage relative to another. We can instead give the new equipment, weapon, or training to a group of Marines and rapidly know quantitatively whether it produces positive or negative results. In other words, JMAP facilitates decision makers to have instant access to realtime

the island via assault support aircraft. What now lays directly before them are 150 lifeless bodies strewn across the helicopter landing zone exit routes. Their squad drones, loitering munitions, and 84mm recoilless rifle gunnery skills played a key role in destroying at least half of the PLA unit. Ultimately, however, it was the lethal individual marksmanship of each of their Marines that contributed the most to destroying their numerically superior adversary. After reporting the enemy's destruction to their higher headquarters and setting in defense positions, SSgt Luskey and Cpl Erhardt treated and evacuated their casualties. They then reflected upon their training, particularly how they were

Because JMAP enables a datacentric approach to decision making, we no longer need to make assumptions as to whether a new weapon ... has a performance advantage ...

performance data to make data-driven decisions. This benefit is exactly what led to the creation of IMTP in the first place. *As per the information described in Figure 4 (on previous page), by leveraging JMAP, ONR unequivocally demonstrated that a squad of IMTP-trained IMC graduates would win against a squad of legacy Basic Infantry Marine graduates 99.7 percent of the time.* JMAP's data collection methodology is what enabled that assessment to be made.

Revolutionary Potential Realized

On an island in the Indo-Pacific, 2027: Off on the horizon two amphibious assault ships burn brightly at twilight. SSgt Luskey and Cpl Erhardt don their PVS-31s after a two-hour-long firefight and survey the carnage for any remaining opposition. The Marines had just finished a meeting engagement with part of the PLA infantry company that landed on

able to ensure before deploying that every round fired by a Marine was able to effectively incapacitate an enemy promptly, and marveled that their unit still had more than half their ammunition after the battle. SSgt Luskey then, remembering how much different and less impactful his small-arms lethality training had been before his first three deployments, shared with Cpl Erhardt that it was the measured lethality-oriented training facilitated by the data in JMAP that proved most critical to their unit's success.

3. Office of the Secretary of Defense, *Establishment of the Close Combat Lethality Task Force (CCLTF)*, (Washington, DC: March 2018).

4. Ibid.

5. Headquarters Marine Corps, *2018 Marine Corps Rifle Marksmanship Lethality Capabilities-Based Assessment*, (Quantico, VA: November 2018).

6. Ibid.

7. Ibid.

8. Office of Naval Research, *S.P.E.A.R. Model of Lethality*, (San Diego, CA: February 2021).

9. Ibid.

10. Ibid.

11. Ibid.

12. Headquarters Marine Corps, *2018 Marine Corps Rifle Marksmanship Lethality Capabilities-Based Assessment*, (Quantico, VA: November 2018).

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Notes

1. Headquarters Marine Corps, *2018 Marine Corps Rifle Marksmanship Lethality Capabilities-Based Assessment*, (Quantico, VA: November 2018).

2. Hope Hodge Seck, "M27s and 'Head-to-Toe' Gear Overhaul on the Way for Marine Grunts," *Military.com*, January 5, 2018.