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MARINE CORPS FIELD ARTILLERY: A PATH TO
RENEWING RELEVANCE IN 21ST CENTURY WARFARE

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Executive Summary

Title: Marine Corps Field Artillery: A Path to Renewing Relevance in 21st Century Warfare

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Thesis: Marine artillerymen have overseen the evolution of their community to create a force that can mass accurate artillery fires in support of major combat operations, but their failure to fully embrace the realities of the current operating environment and the implications of the information age has set it on the path to irrelevance.

Discussion: From the interwar period to start of Operation IRAQI FREEDOM, the Marine artillery community has created a force capable of providing a fire support function unmatched in the Marine air ground task force (MAGTF): providing all-weather, persistent, massed, timely and accurate fires. Marine artillery has been the destructive force to clear way for advancing maneuver forces. During most of the twentieth century, the incredible destructive force of artillery was synonymous with fire support. However, as the Global War on Terror led to counterinsurgency fights in Iraq and Afghanistan, and the information age swept the globe, the MAGTF needed new kinds of lethal and non-lethal fire support and effects to influence the enemy forces and human terrain of the battlefield. The community made advances in accordance with its organizational culture by improving the range and accuracy of cannon and rocket munitions. Ultimately, it failed to fully embrace the expanding fields of information operations and its information-related communities, leading to today's community that is out of step with the needs of the MAGTF as it operates across the range of military operations. This study seeks to employ Schein's model to analyze the organizational culture of the Marine artillery community, compare and contrast it with the needs of the MAGT, and propose the community's long-term goals to make Marine artillery more relevant on the 21st century battlefield in the information age.

Conclusion: The artillery community must be willing to challenge some of its culture's underlying assumptions in order to take the drastic action to truly be the premier lethal and non-lethal fire support and effects providers to the MAGTF. The community must fully leverage automated capabilities, flatten its mission clearance and processing structures, and fully commit to a secondary role in IO.

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DISCLAIMER

THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND AND STAFF COLLEGE OR ANY OTHER GOVERNMENTAL AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

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Preface

When I attended Expeditionary Warfare School (EWS) as a student in 2011-2012, I heard speakers from Plans, Policies, and Operations (PP&O), the Marine Corps Combat Development Command, and the EWS staff explain how artillerymen were on a mission to take their rightful place as the premier fire support experts in the ground combat element. One of the results of the Force Structure Review Group was to replace the first lieutenant battalion liaison officer with a post- career level school captain battalion fire support officer, capable of serving as the battalion fire support coordinator (FSC). Upon returning to an artillery battalion, I found that the audio in Quantico did not match the video in the operating forces. With nearly every manpower decision, the unit made fire support staffing the bottom priority. I was the exception: the artillery battalion transferred me to the supported infantry battalion on a temporary additional duty status for a nine-month work-up and the following six-month unit deployment program deployment to Okinawa, Japan. The long duration's binding transfer (complete with fitness report responsibilities) enabled the supporting commander to make me his FSC and eventually one of his rifle company commanders. I learned that the artillery community could achieve its goal for a price. Unfortunately, no other fire supporters received the same opportunities for the remainder of my tour in that artillery battalion.

Upon reporting to Command and Staff College in 2015, I was passionate about advocating the practices to help enable artillerymen serve as infantry battalion FSCs throughout the Marine Corps. When I asked PP&O for updates to its position in the matter, the fires advocate admitted that it was no longer a priority. Upon reviewing products from the 2015 Artillery Operational Advisory Group conference, I learned that the leaders of the artillery community had no interest in the "premier fire support experts" agenda of 2012. Furthermore,

there was an acknowledgement that the community leadership wanted fresh ideas to innovate in order to remain relevant on an evolving security environment. This paper is an attempt to provide those fresh ideas. I do not expect it to be popular. However, if it can provide the leadership a new perspective and a willingness to challenge some of the community's underlying assumptions, then I will consider it a success.

As I began to articulate my initial ideas, I realized that I was digging a deep research hole. I want to thank Dr John Gordon and LtCol Edward Debish for helping me shape my initial arguments and guiding me along the way in this paper. LtCol Jarrod Stoutenborough and Dr Bruce Gudmundssen were valuable sounding boards, confirming or denying my assumptions before I chose to commit hours of research to dead ends. I want to thank the dedicated civilians at the Gray Research Center Archives for their patience and assistance. Other valuable sources of input and feedback were CWO4 Joseph Welch, Capt Jonathan Ritchey, Capt Richard Bitanga, Capt Shawn Burkhart, Capt Michael Wish, and Maj Jody Cooley. I was also lucky enough to take an elective course on system theory, taught by LtGen Paul VanRiper, LtCol Andrew Del Gaudio, and Dr Anne Louise Antonoff; the material that they taught inspired my approach to my research. I would like to thank Col Wayne Sinclair for encouraging me to change my topic to write for the advancement of the artillery community. Finally, I want to thank LtCol Thomas Wood. Because of his willingness to take a chance on me as his FSC, I had the vantage point to realize that we artillerymen are a part of a large, incredible team, working together to help the infantry achieve its objective.

Introduction

During Operation IRAQI FREEDOM I (OIF I) in 2003, the Marine artillery community proved its worth by massing battalion and regimental fires on conventional enemy forces in all weather conditions in support of an advancing maneuver force. However, over the following eight years of counterinsurgency (COIN) operations, artillery battalions replaced the regiment, and under-employed batteries eventually replaced the battalions, often with only one or two fire capable weapons. With an aversion to collateral damage and the fielding of 155mm precision EXCALIBUR and guided high-mobility artillery rocket system (HIMARS) rockets, high-level fire supporters meticulously integrated each mission. In spite of these advanced capabilities, the Marine artillery community is no longer meeting the needs of the Marine Air-Ground Task Force (MAGTF) in the current operating environment (COE). In the post-Operation ENDURING FREEDOM (OEF)/OIF drawdown, the artillery community experienced disproportionately high losses. Meanwhile artillery commanders, no longer supporting unit rotations to combat, eagerly get "back to basics" to focus on the capabilities that are only needed in the opening weeks of years-long campaigns. The community's senior leadership contemplates the size, mobility, and range requirements of the next howitzer in an attempt to find a "sweet spot" that will re-ignite a demand for artillery support.[1] The methodical evolutionary process that has made an area fire weapon remarkably accurate will not keep the artillery relevant through the 21st century. The Marine Artillery community is experiencing a crisis of identity. Their failure to fully leverage the capabilities of the information age and acknowledge the current operating environment will keep it on the path to irrelevance unless they are willing to make drastic changes to their community.

The Crisis of Identity

In World War I, artillery support was synonymous with fire support and effects. Artillery provided long-range, all-weather, massed fires on enemy concentrations and enabled maneuver elements to penetrate enemy lines at the decisive point. Commanders were not concerned with collateral damage, and the demand for direct support artillery capability could be calculated by the width of the infantry's frontage and the capabilities of the weapons systems. Precision fires applied only to bolt-action rifles, and offensive air support was in its infancy.

Nearly one hundred years later, artillery has lost its monopoly in fire support and effects to the infantry, aviation, IO, and other information-related communities. Infantry officers have replaced artillery officers as the fire support experts within the infantry battalion.[2] Air Officers (AirOs) assigned to infantry battalions and regiments and the Marine division have made their primary fire support training synonymous with tactical air control party (TACP) exercises.[3] The Air Naval Gunfire Liaison Companies (ANGLICOs) focus on terminal controls at the expense of overall fire support integration and planning. Artillery officers do not have any formal presence, let alone leadership positions, in the communities that drive the non-lethal effects on the battlefield.[4]

Over the course of thirteen years of war from 2001 through 2014, the ground combat element (GCE) employed massed artillery for the forty-four days of liberation phase of OIF I.[5] Outside of this period, the GCE employed individual batteries widely-dispersed on the battlefield, often seldom-used, with only two weapon systems fire capable at each location. Meanwhile, artillery units continued to maintain a high operational tempo, supporting missions ranging from provisional civil affairs (CA) to military police to fixed-site security forces.

Artillery units hollowed out officer leadership at the battalion and regiment level sourcing individual augments in military transition teams, police transition teams, and in regimental combat team/MAGTF fire support/targeting cells.[6]

The lessons of the Global War on Terror (GWOT) and the post-GWOT interwar period (so far) tells the artillery community that the character of warfare has changed. Although artillery must stand ready for the conventional threat, the United States will achieve victory in future conflicts with its actions throughout the campaign, including the stability and transition phases.[7] America's enemies have learned from the example of Iraqi insurgents, Taliban fighters, and Al Qaida terrorists to fight the United States in the gray area between war and peace where cutting edge technology and overwhelming destructive power are not decisive: phase IV operations.[8] Marine General James Mattis famously told Iraqi tribal leaders in 2003 following OIF I, "I come in peace. I didn't bring artillery. But I'm pleading with you, with tears in my eyes. If you fuck with me, I'll kill you all."[9] This quote clearly illustrates that the presence of artillery has a chilling effect on stability operations. If the artillery community desires to contribute to the full range of military operations (ROMO), it must leverage all effects capabilities or continue to slip into obscurity.

The artillery community responded with precision munitions, capable of striking the irregular threat without wonton destruction. The precision and accuracy of EXCALIBUR and global positioning system (GPS)-guided HIMARS rounds provided the means to provide strikes previously only provided by aviation-delivered ordnance, but artillery could do it at any time in any weather. The trade-off was laborious clearance procedures and range limitations. Commanders dispersed artillery units across the battlespace to ensure that key locations were accessible to the effects of these munitions. The artillery community added structure to the firing

battery to enable the employment of autonomous platoons; they added structure to fire support teams[10] to provide the means to fill gaps in infantry battalions created when weapons company commanders assume control of battlespace as maneuver commanders. Instead of making the artillery community a more effective provider of lethal and non-lethal fire support an effects, it became more efficient at its basic task; in phase IV operations, an RCT only required a cannon battery instead of an artillery battalion. When the 2010 Force Structure Review Group (FSRG) gathered to trim the force after a decade of combat, the artillery community lost more structure proportionately to the maneuver forces they support.[11] The artillery community provided the capability that the GCE/MAGTF demanded to fight OIF/OEF, and the FSRG penalized it without regard to the utility of massed artillery during major combat operations.

The artillery community has lost its foothold in fire support and effects in spite of advances in the range, accuracy, and variety of weapons systems. The community's changes have been a series of evolutions vice innovations, and the artillery campaign plan continues the evolution to greater range and accuracy (and renewing current munitions capabilities).[12] Continued development along these lines did not protect the artillery community from the 2010 FSRG and will not protect it in future competition for limited resources. Unless the community examines itself critically, subordinates its cultural self-interest to the needs of the GCE/MAGTF, takes full advantage of the opportunities of the information age, and acknowledges the realities of warfare in the current operating environment, the artillery community will sentence itself to ultimate obsolescence.

Self-Analysis

With the community's increasing irrelevance on the changing battlefield of the 21st century, artillery cannot simply regain its role by fielding a new weapon system. In order to bridge the gap between what the artillery community of today provides and what the GCE/MAGTF requires, all options must be available. Nothing can be sacred. The community must be willing to part with any aspect of its culture that detracts from its effectiveness. In order to find the gap between the services required and provided, this paper will first analyze the organizational culture of the Marine artillery community using Schein's Model. Then it will use key planning documents to look critically at the needs of the GCE/MAGTF. This paper will then investigate the community's shortfalls and propose solutions to provide the best lethal and non-lethal fire support and effects for the GCE/MAGTF in the future operating environment.

Assessing Organizational Culture

If artillerymen acknowledge that they need to embrace some type of innovation to be relevant on the 21st century battlefield, they must carefully investigate the factors that have come together over the course of the last century to create the organizational culture of today's community. It is entirely possible that some factors that were critical in another kind of conflict with less sophisticated technology are no longer relevant and may be discarded. Likewise, the community may know that it needs to make changes, but subconscious cultural factors may hold it back.

Schein's Model

Schein's Model analyzes organizational culture through three layers, often likened to an iceberg (see figure 1[13]).

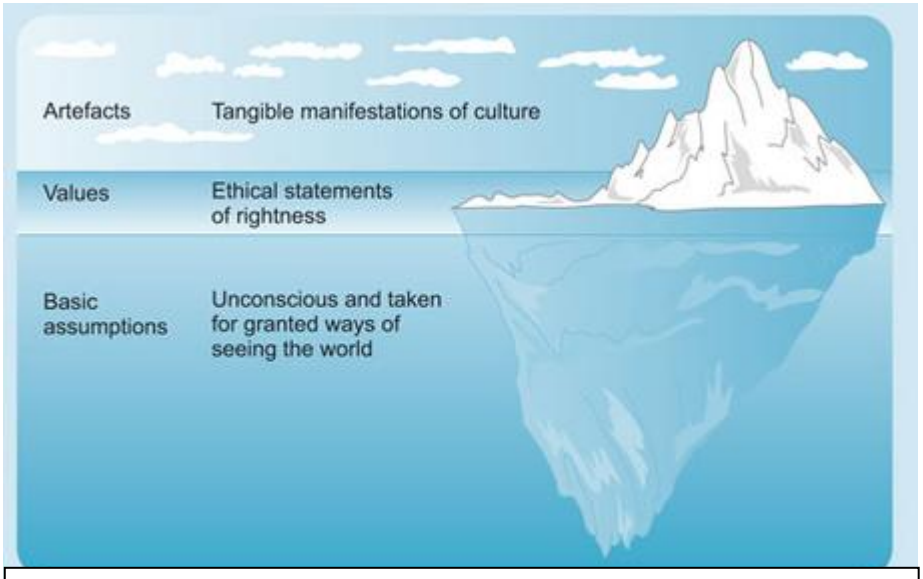


Figure 1: Schein's Iceburg Model to assess organizational culture

The first aspect of organizational culture is the visible artifacts: the constructed environment, technology, resourcing decisions, visible or audible behaviors, and public documents. The visible artifacts help the observer describe how a group constructs its environment and the behavior patterns among its members, but the artifacts do not directly explain why the group behaves the way it does. Like the iceberg, the rest of the organizational culture remains out of view beneath the surface. The second level is the organization's values that govern behavior. Values represent the espoused values of a culture; they focus on what people say is the reason for their behavior, what they ideally would like those reasons to be, and what are often their rationalizations for their behavior. The third and final level of organizational culture is the most deeply concealed: the underlying assumptions. These assumptions are the concealed or unconscious ideals that actually determine how group members perceive, think, and feel.[14] This paper will assess underlying assumptions by comparing the artifacts to the values. Where they

are in agreement, the values and the underlying assumptions are one and the same. Where there are disagreements, the artifacts reveal the true underlying assumption. One cannot effect fundamental change in an organization without fully understanding its culture and taking action to affect the underlying assumptions. For the purpose of brevity, this paper assumes that the reader has a working understanding of the Marine artillery community and does not require detailed descriptions of the community's artifacts or espoused values.

Artifacts:

The Marine artillery community is rife with artifacts that define the culture. To simplify the analysis, when referring to staffing and career progression matters, this paper will avoid trends that apply to individual enlisted artillery military occupational specialties (MOSs) and focus instead on artillery officers because they hold positions that correlate with each enlisted MOS throughout their careers. These artifacts include the formal process to gain a leadership position in the community, how they tell their story and remember their history, how they perform their duties in training and combat, and how they spend their limited monetary and human capital.

To become a leader within the artillery community, artillery officers must perform strongly throughout their careers with a particular emphasis on "key billets." Key billets differ from one community to the next. Monitors decide when officers execute orders based on their previous completion of key billets. For artillery officers, lieutenants and captains must lead Marines in each grade in the operating forces, and majors must hold the billet of battalion executive officer (XO) or operations officer (OpsO).[15] For lieutenant colonels, performance in key billets, including regimental XO, regimental OpsO, and battalion command determines

competitiveness for promotion to colonel and selection for regimental command. Units rotate officer billets internally, carefully ensuring that those with the most promise gain sufficient experience in key billets.[16]

The Marine artillery community tells its story in two main ways: the annual observance of Saint Barbara's Day and the unit command chronology. Each winter, artillery units (including other service and nations) gather to celebrate the "traditional brotherhood of stonehurlers, archers, catapulters, rocketeers, and gunners."[17] The ceremony includes the story of Saint Barbara, naming of old and new members of the Trusted and Ancient Orders of Saint Barbara and Molly Pitcher, mixing the artillery punch, making toasts, presenting skits (there is always a skit about the "Genesis of the Field Artillery"[18]), reading the legend of "Fiddler's Green", and remarks from the unit commander and the guest of honor.[19] Twice each year, artillery units record everything from manning to maintenance to operations into a command chronology. The unit leadership describes the unit as it would like to be seen. They include what is important and exclude the superfluous. This record goes through the chain of command and ends up at the Archives Branch, Marine Corps History Division, Quantico, VA. There, archivists scan and store the documents for future reference by Marines and scholars alike.[20] The celebration of Saint Barbara's Day and the production of unit command chronologies are perhaps the most visible artifacts of the story of the Marine artillery community.

Marine artillerymen follow a strict set of procedures to create devastating effects on the battlefield; the artifacts of these procedures are the regulations and doctrinal publications that dictate individual and unit actions in training and combat. In training, two of the most prominent documents outside the unit's standard operating procedures (SOP) and local range regulations are the Marine Corps Artillery Safety SOP and the training and readiness (T&R) manual. The

former carefully dictates individual responsibilities with a focus on the position commander, position officer in charge, fire direction officer (FDO), operations chief, section chief, and range safety officer (RSO).[21] The procedures ensure that multiple command safety certified personnel confirm firing data to ensure that the unit does not fire rounds outside the designated safety box. The T&R manual lists everything from the detailed requirements of the individual/section to the general overarching requirements of batteries, battalion, and regiments.[22] In combat, units have a large selection of doctrine for employment guidance. Unit SOPs fill in the gaps where doctrine does not keep up with new technology, new employment methods, and non-linear battlespace. All of these artifacts of tactics, techniques, and procedures are incredibly valuable to illustrate what the community regards as important to sustain readiness, necessary to ensure safety, and most effective in supporting the GCE/MAGTF.

Perhaps the most illustrative artifact for any organizational culture is how it spends its limited human and monetary capital. Internal to its artillery units, the community periodically provides input for updates to its tables of organization to reflect the ideal unit (if its staffing goal were one hundred percent).[23] Outside artillery units, artillery officers serve in designated billets where their expertise is essential. For tangible micro-level artifacts, the real-time records of manning decisions are available online via Marine Online.[24] Monetarily, the artillery community plans its acquisitions to ensure that they meet the future needs of the GCE and the materiel realities of aging equipment. Especially in a fiscally-constrained environment, they must direct limited resources to the most critical programs. The Artillery Operational Avisory Group, composed of the artillery Regimental Commanders, the Commander of the Marine Detachment, Fort Sill, their senior enlisted artillery counterparts, and key leaders from Plans, Policies, and

Operations (PP&O) and Marine Corps Combat Development Command (MCCDC), publishes these resource decisions and publishes them in the GCE Fire Support Campaign Plan.[25]

All of these artifacts provide incredible insight into the organizational culture of Marine artillery, but they are just the proverbial tip of the iceburg. In an ideal, transparent organization, the artifacts should directly reflect the espoused values of the culture.

Values

The artillery community cultivates a set of values to sustain its organizational culture. These are the espoused ideas that the community shares to maintain its unique identity. These values include the drive for statistical perfection (chasing the mil), for providing persistent all-weather indirect fires from a variety of platforms to support maneuver forces in any clime or place, for producing well-rounded MAGTF officers (versed in tactics, logistics, maintenance, and communication), for delivering massed responsive fires using an integrated digital fire support loop, for being the "utility infielder" for the MAGTF (having the flexibility to re-task units to contribute to the mission), for supplying the premier fire support experts for the GCE, and for integrating all lethal and non-lethal fires and effects to support the mission. This list is not all-inclusive, but it provides a cross-section of matters that underlie the culture's artifacts.

Chasing the mil. Artillerymen pride themselves on their meticulous approach to their duties. "Chasing the mil" is a common phrase artillerymen use to describe the mindset that everybody must be precise, down to the mil (an angle equivalent to 1/17.8 of a degree) to achieve effects on target. Artillerymen bring this mindset to everything from accountability to maintenance to training. Even with the fielding of automated fire direction systems such as the

Advanced Field Artillery Tactical Data System (AFATDS), artillerymen value the involvement of human subject matter experts in each mission to ensure precision and accuracy.

Timely and Accurate Fires. Artillerymen strive to achieve their own definition of timely and accurate fires for the GCE.[26] When some 155mm projectiles require two minutes time of flight from firing to impact after all computations and clearance procedures, up to eight minutes from target acquisition to first impacts meets the community's definition of timely.[27] Based off the fifty meter casualty radius of the 155mm projectile, rounds impacting ten meters from a target are considered accurate. The pursuit of accuracy takes priority over timeliness[28] because of the potential risk to friendly forces and the devastating effect on an unprepared enemy when engaged by an accurate first volley.

Any Clime and Place. The artillery community understands that the GCE/MAGTF has many options in fire support. However, artillerymen are secure knowing that they provide indirect fires 24 hours a day in all weather conditions. Artillery acquisitions initiatives have yielded three weapon systems with various capabilities and limitations. This value draws a stark contrast with aviation assets which can only remain on station for limited durations (due to fuel limitations) and require favorable weather conditions.

Massed/Digital Fires. Artillerymen claim a monopoly on massed indirect fires. Artillery units are organized and trained to mass their fires using the digital sensor-to-shooter loop. The Marine Corps ideally maintains one cannon battery (six howitzers) for each infantry battalion. However, through digital communications, an entire artillery regiment (up to 60 howitzers)[29] could mass effects in one infantry battalion's area of operations. Massing fires has an exponential, not linear effect: one volley (one projectile from each howitzer) from a regiment creates the same effect as 43 volleys from a single battery.[30] Massing fires drastically increases

the effects with significantly fewer resources. In order to quickly communicate mission data, synchronize effects, and reduce human error, artillery commanders place a high priority on exercising the digital loop during live fire exercises.

MAGTF Officers. The artillery community is unique in the way it closely integrates in with all elements of the MAGTF. From their earliest years of service, artillery officers serve in infantry units, integrate aviation capabilities, communicate through different means across great distances, and manage the movement and maintenance of a high volume of rolling stock. Artillery officers serve as their unit logistics officers at the battalion and regiment level.[31] They learn early on to think of the cascading effects of their decisions across warfighting functions. As a result, artillery officers pride themselves on being well-rounded.

Utility infielder. The artillery community acknowledges its role in fire support during OIF/OEF. It has mixed feelings about it execution of "in-lieu missions" such as CA, provisional infantry/fixed-site security, and military police tasks. The artillery community is proud of its success and flexibility, but it wants the GCE to see the community as artillery first. They do not want to be the proverbial working party of the Division. As a result, since the end of sustained combat operations in Iraq and Afghanistan, the artillery community has dedicated its training resources to conventional artillery operations at the battalion and regiment level.

Premier Fire Support Experts to the GCE. The community has desired to re-assume its roles as the (infantry) company fire support team (FiST) leader and (infantry) battalion FSC after losing them to infantrymen since the last publishing of FMFM 6-3, *Marine Infantry Battalion* in 1978.[32] This was the ultimate goal in replacing the first lieutenant battalion liaison officer billet with a more experienced post-career level school captain battalion fire support officer (FSO). The infantry battalion table of organization (T/O) still has an infantry captain weapons company

commander and first lieutenant weapons platoon commanders in each rifle battalion and company, respectively.[33] However, infantry battalion commanders now have the option to employ the weapons company/platoons as maneuver elements and leave fire support entirely to the FSOs from the artillery battalion.

Lethal/Non-Lethal Fires and Effects. The artillery community has learned from OIF I that Marine artillery still plays a decisive role on the battlefield during major combat operations. Furthermore, artillery is one of many lethal fires that commanders can mass at a decisive point. In order to mass fires from across the MAGTF, artillerymen train to integrate target acquisition, cannon, rocket, aviation, maneuver, and unmanned aerial systems (UAS) capabilities to achieve devastating effects. However, as General Mattis alluded,[34] the more effective way to conduct stability operations is through less obtrusive means of lethal/non-lethal fires and effects. At the intellectual level, artillerymen acknowledge the need to mass lethal and non-lethal effects such as IO, cyber operations, military information support operations (MISO), electronic warfare (EW), CA, and military deception to influence the enemy decision-making process.

This collection of espoused values has slowly developed over time from the Pacific campaign of World War II through the Cold War and into OIF/OEF. They held true in an age of enemy nation states and slide rules. As this paper looks deeper on the iceburg, it will consider if these values still hold true in the information age on a more ambiguous battlefield.

Underlying Assumptions

The underlying assumptions are the subconscious factors that drive an organization. To identify the underlying assumptions, this paper will compare the espoused values with the artifacts. When the artifacts correspond with the espoused values, then the underlying

assumption is consistent with the espoused value. However, if the community claims to value something but fails to resource it (evident in the artifacts), then the underlying assumption is that the stated value is a logical fallacy, or the community values that item less than other items that it resources. This paper will first confirm those values validated by the artifacts and then investigate those that present contradictions.

Any Clime and Place. The artillery community has lived up to its values in providing a capability that can function in all physical domains and mission settings. However, today's artillery community (as most of the Marine Corps) would struggle greatly in a future GPS-degraded environment or where the electromagnetic spectrum becomes contested. Additionally, a complete loss of digital fire direction capability would significantly reduce responsiveness.

Chasing the mil. Artillerymen do bring a meticulous approach to their duties, and their acquisitions reflect this value.[35] Target location error is perhaps the greatest source of error in artillery, but the community is in the process of acquiring new target acquisition hardware to replace the Vector-21B. The addition of GPS capability on each howitzer has improved the accuracy of firing unit location. The digital fire control system enables the M777A2 howitzer to quickly lay on a target with an accuracy of one tenth of a mil vice a whole mil, drastically improving accuracy at great ranges. New meteorological technology allows artillerymen to acquire accurate data, even in a blizzard or sandstorm where traditional pilot balloon (PiBal) methods were difficult. This driving desire, ironically, also makes artillerymen unwilling to use the full capabilities of AFATDS, the system that computes technical firing data. Army artillerymen working alongside Raytheon contractors created AFATDS to serve as the brain of the artillery FDC. It is capable of receiving a digital call for fire from an observer, creating a fire command based on guidances (entered by unit fire direction control men prior to an operation)

and the Joint Munitions Effects Manual (JMEM), and sending the fire command to the howitzer gun crews without any human involvement. However, due to an inherent distrust of the technology, Marine artillerymen use AFATDS as a calculator only to perform detailed computations to account for nonstandard conditions. AFATDS software is not perfect, but this inherent distrust prevents Marine artillerymen from aggressively seeking the software advances that would fully automate fire direction and from fully leveraging the potential of AFATDS. The ultimate pursuit of accuracy and precision would be the removal of human error from the technical fire direction process. Paradoxically, Marine artillerymen have lost the capability to conduct all-manual operations. There are not enough graphic firing tables and graphic site tables to provide all active component firing batteries with the capability to conduct independent checks in the FDC and the Battery Operations Center (BOC), the equivalent of the battery's forward FDC. Furthermore, the special plotting paper used for surveyed firing charts required for each battery to conduct 1000 to 6000 level T&R sustainment are no longer available through the supply system. The artillery community is in the cognitive "no man's land" between fully trusting AFATDS and being able to operate (at an acceptable speed) without it. In other words, the desire to "chase the mil" makes artillery less timely and accurate due to artificially inserted human checks and errors.

Timely and accurate. The artillery community has invested its acquisitions dollars in improving artillery's accuracy. From the examples listed above to the fielding of precision guided munitions (PGMs), such as the Guided Multiple Launcher Rocket System (GMLRS) rockets for use with HIMARS, ATACMS, the EXCALIBUR round for the M777A2, the precision-guidance kit (PGK) for use with non-GPS guided 155mm high explosive rounds, and GPS-guided munitions (under development) for the EFSS. However, timeliness still lags. The

fire support process is still cumbersome and unresponsive. The hierarchical de-confliction process in the GCE/MAGTF FSCC/FFCC are perhaps the main culprit, especially in a battlespace crowded with Marine, joint, and coalition fixed wing, rotary wing, and unmanned aircraft. The hierarchical mission processing procedures in the artillery battery/battalion/regimental FDCs also add to the responsiveness problems before they send the command to the gun sections to fire the mission. The artillery community's responsiveness issues are problematic when massing artillery with aviation fires from aircraft that can only remain on stations for relatively short periods of time. In the end, the artillery community has clung to its industrial-age mission clearance and processing practices at the expense of timeliness.

MAGTF Officers. The artillery community creates well-rounded officers versed across warfighting functions. However, it does place its greatest stress on artillery-specific operations. While staffing the battalion and regimental logistics officer billets with artillerymen ensures that artillerymen can apply corporate knowledge in that position, the unit arguably faces greater friction from cycling four to six artillery officers (without the intimate corporate knowledge of logisticians) through the billet over the course of two to three years than it would experience by getting experienced 0402 captains that would have to learn the nuance of artillery operations.[36] Battalions and regiments are not training aids for individual officers to learn about diverse career fields.

Utility Infielder. The artillery community resents that it had to perform the in-lieu of missions during OIF/OEF, and it has tried to prevent a repeat in the next major conflict by modifying its acquisitions to focus on precision artillery munitions and decentralized operations to facilitate supporting a widely-dispersed, low-CDE battlefield. During OIF/OEF, the

Commandant of the Marine Corps (CMC) formally tasked the Marine artillery battalions and regiments with the secondary mission of conducting Civil Military Operations (CMO).[37] The Marine Corps stood up active component civil affairs groups (CAGs) in each artillery regiment headquarters, but the Marine artillery community embraced the movement of the active duty CAGs to the Marine expeditionary force (MEF) headquarters groups (MHGs) where they currently reside.[38]

Premier Fire Support Experts: Manning. Artillery commanders do not value their fire support responsibilities to the GCE as much as they value other functions of their unit. This is clear in the manner that commanders man and train FSOs (see figure 2).[39] If the federal budget's allocation of limited tax dollars reflects the nation's values, then artillery commanders' manning decisions to allocate limited human capital reflects the community's values. Approximately half

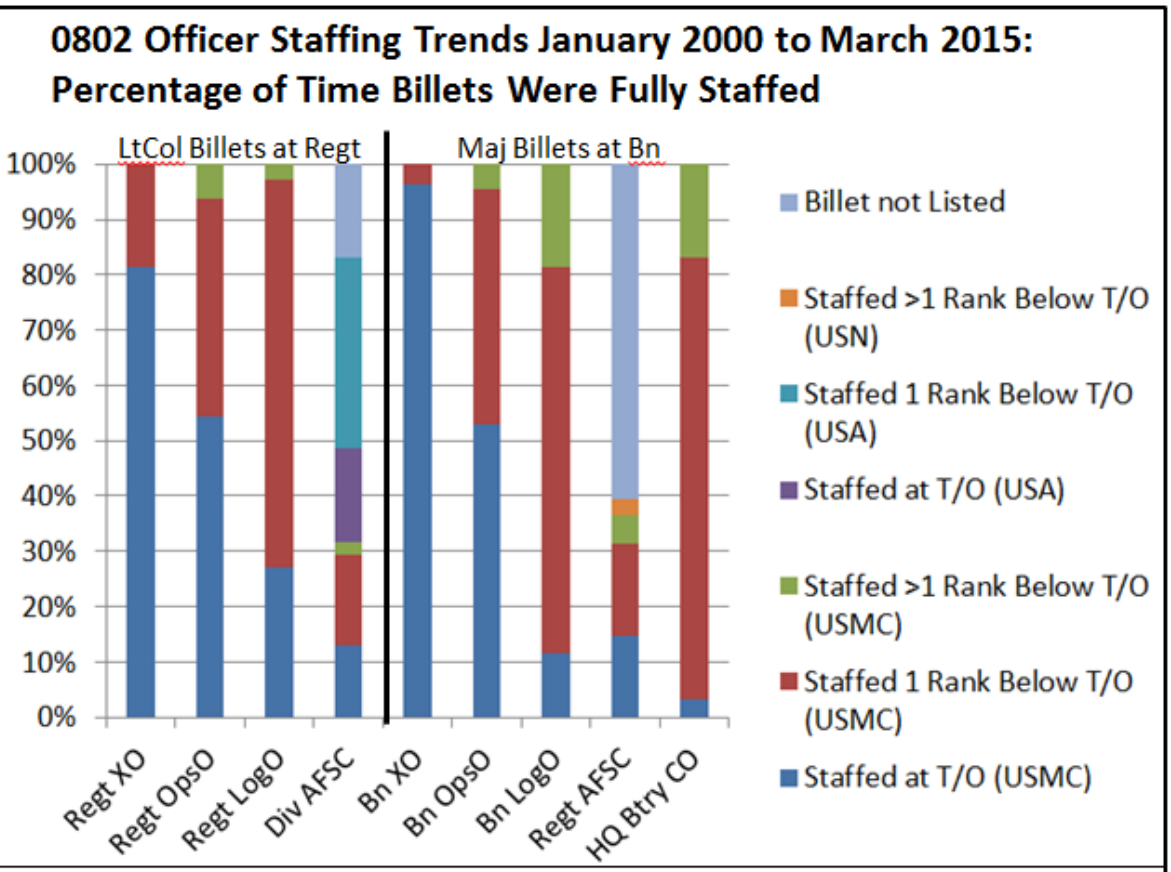


Figure 2: Percentage of Time 0802 Major and Lieutenant Colonel Billets Were Fully Staffed at the Artillery Regiment and Battalion

of the artillery unit command chronologies from 2010 to 2015 did not even name their senior fire supporter. Of those that did, the servicemember named was often below the T/O rank or a sister service member holding the billet in the absence of a Marine. Of note, the data does not reflect those who are selected for promotion serving in a billet intended for that next rank. The correlation between key billets and the assignment of promoted majors/lieutenant colonels shows the manning priority afforded to key billets over all other billets. During this same period, the regimental AFSC billets saw much more turnover within the artillery battalion when compared to all other majors billets (see figure 3). Furthermore, artillery battalions are more likely to gap these FSO billets or staff them with less experienced personnel than the T/O demands.[40] This did not apply at the artillery regiment because two US Army officers (both nearing retirement)

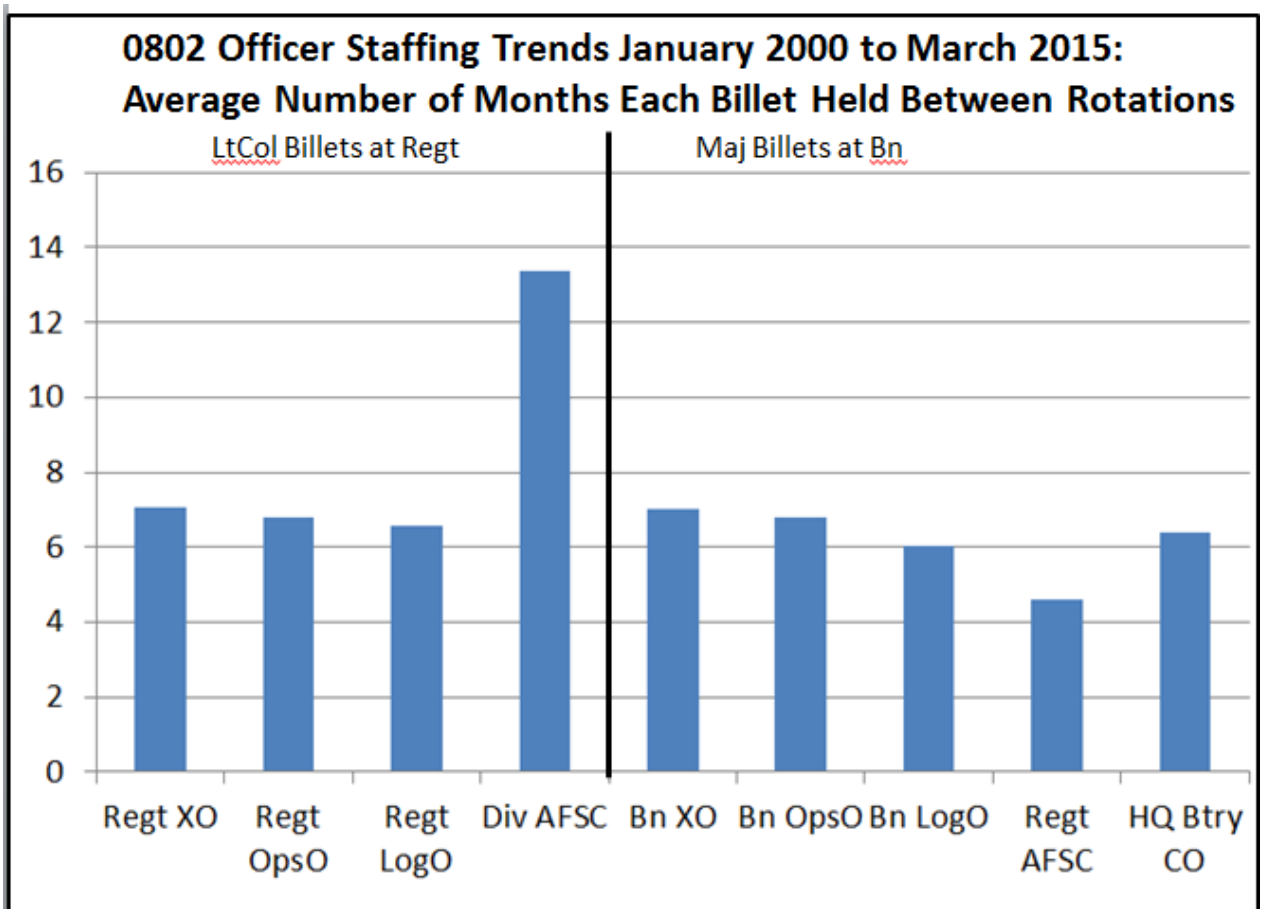


Figure 3: Average Number of Months 0802 Major and Lieutenant Colonel Billets Were Held Between Rotations

held the position for over three years each in their respective regiment. Of note, the data collection began on January 1, 2010 and ended on March 31, 2015. Officers assigned to these billets prior to the start of the data collection or beyond the end of the data collection accumulate to shorten the average time in billet. However, this affected the data collection for all billets. Therefore, the data reflects shorter averages than the actual billet tenures, but this source of error is reflected roughly uniformly across all billets. The data still offers statistically significant comparative value between billets. A snapshot of all active component field artillery officers assigned to the operating forces on January 11, 2016 shows that commanders gapped FSO billets more often than firing battery billets (see figure 4).[41] Across the community, there was a 25% excess of officers assigned to a battalion or regimental headquarters. Many of these excess

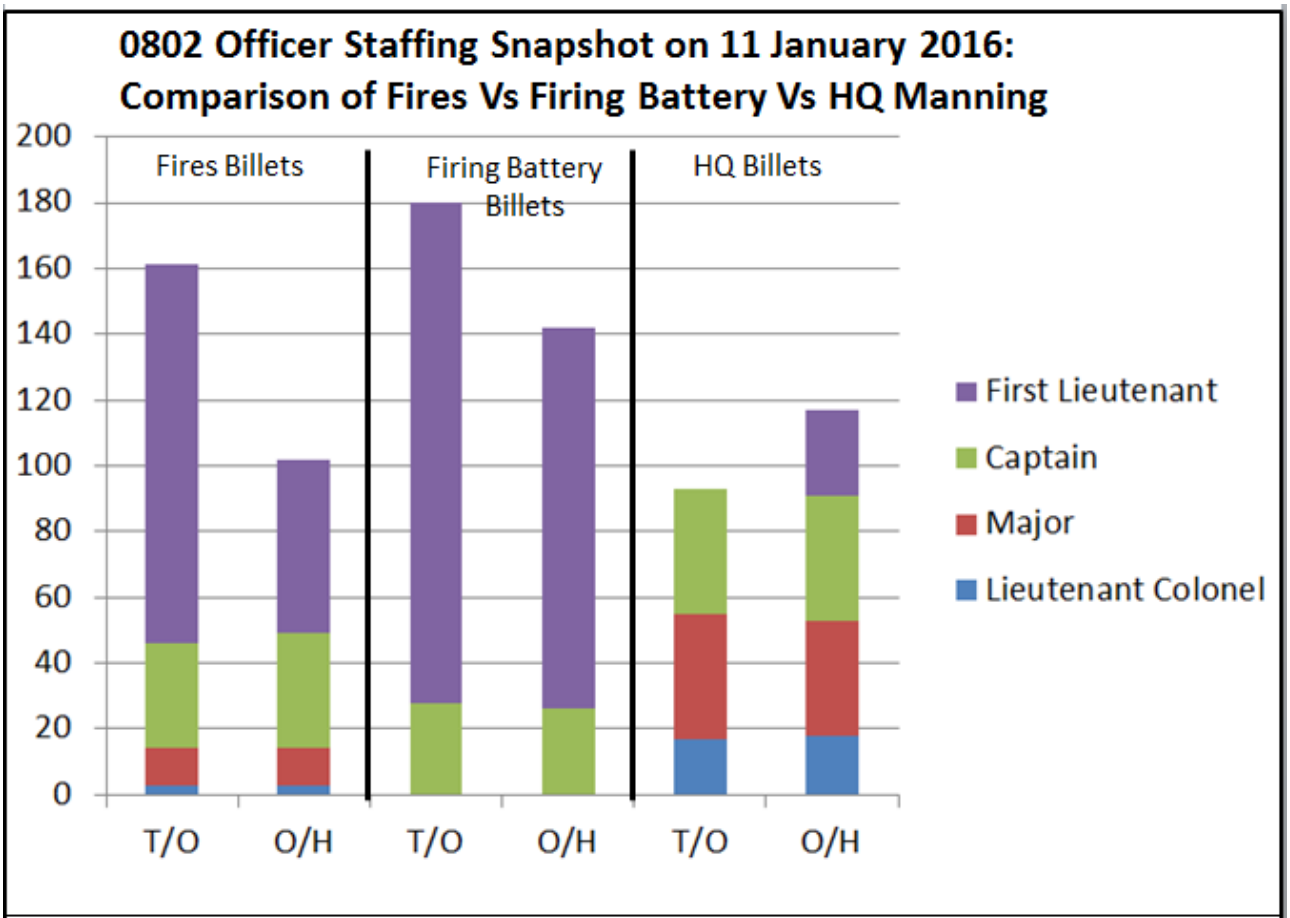


Figure 4: Comparison of Table of Organization Vs On-Hand for Fires, Firing Battery, and Headquarters for 0802 Officers in the Operating Forces

officers, mostly first lieutenants, are physically absent, serving as individual augments or in the fleet augmentation program (FAP) aboard their respective installation. However, the disproportionate impact on fire support billets sends a clear message. When faced with a resource-constrained environment, commanders accepted disproportionate risk in fire support staffing. This trend is attributable to two factors: career progression and training mindset. Since the company and battalion FSO billets are less important for career progression than the firing battery counterparts (due to number of Marines led), and the regimental AFSC billet is less important for career progression than the battalion OpsO and XO billets (AFSC is not a "key billet"), commanders are less likely to staff these fire support billets with top performers and are more willing to rotate them more frequently to optimize throughput in the key billets. The most tragic illustration of prioritizing artillery support over fire support is the manning relationship with the supported infantry unit. Artillery units resist attaching their battalion fire support teams (BFSTs) on a temporary additional duty (TAD) status prior to deployments (except in the case of MEU deployments). This lack of a solid habitual relationship is a great deterrent for maneuver commanders to commit to naming their artillery FSOs as the FiST leaders and FSCs. The cost of sending fire supporters to the supported maneuver unit with TAD assignments would be that artillery commanders may need to request the use of their own fire supporters to enable artillery unit training.

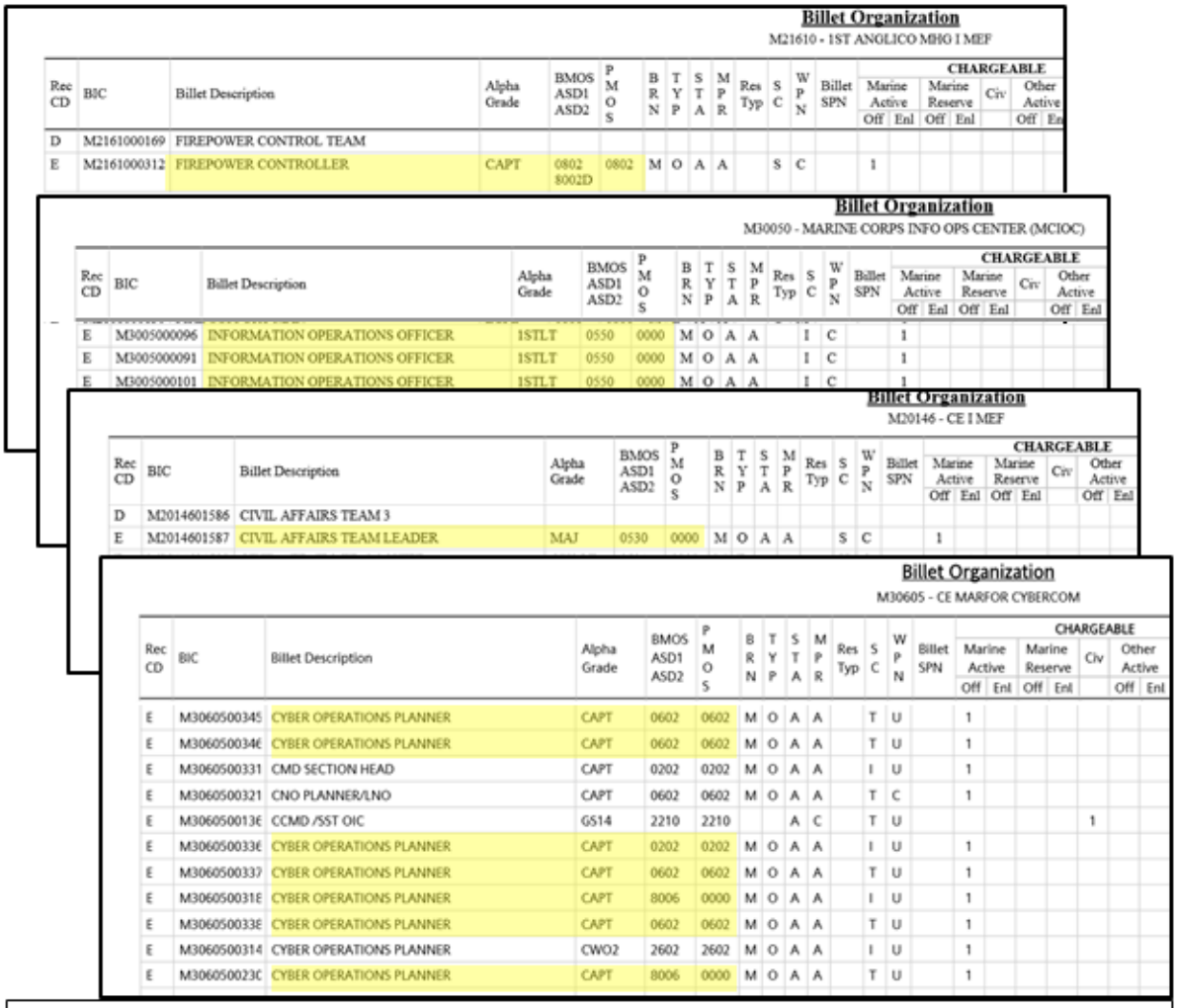
Fire Support Experts: Training. Regarding the community's training mindset, artillery commanders tend to interpret the intentionally ambiguous T&R manual similarly. When artillery units go to the field, the time is divided into a battery phase, a battalion phase, and a regimental phase (depending on the echelon of the exercise). This normally leaves little dedicated training resources for fire supporters to sustain maneuver and aviation-oriented

scenarios, such as quick fire plans in support of notional breaching operations. When fire supporters add these scenarios to the overall concept of fires, they face resistance to the realism of target refinement immediately prior to firing the associated group or series;[42] this is due to technical challenges associated with current AFATDS software and the confusion it causes within the FDCs. The Marine Corps Artillery Safety SOP even refers to the responsibilities of fire supporters under the title of RSO.[43] The term is appropriate, per DA PAM 385-63/MCO 3570.1B, Range Safety, but the SOP does not refer to howitzer section chiefs as position safety officers. The community's choice of wording reinforces the mindset that fire supporters exist to serve as training aids for artillery units. A notable omission from the Marine Corps Artillery Safety SOP is the lack of guidance for the clearance and integration of fires (ie, requirements to ensure the safety of maneuver forces and aviation assets employed in close proximity with artillery fires); the only references are the RSO's responsibility to call "check firing" if aircraft enter the danger area[44] and the FSC's responsibility to ensure that target locations do not threaten friendly forces.[45] DA PAM 385-63/MCO 3570.1B and local range regulations also do not provide any guidance. If an artillery round would strike an aircraft under the control of a JTAC, the unit commander would have a hard time explaining to an investigator how he expected his JTAC to ensure safe integration, unless it is included in the unit SOP. With leadership constantly under transition at the regimental FSCC or lacking Marine officer leadership at the division FSCC, these agencies struggle to ever progress to the "run" phase of training; they remain in the "crawl" and "walk" phases[46] where they send calls for fire as directed by the FDC. Although recent iterations of 10th Marines' Exercise ROLLING THUNDER[47] and 1st Battalion, 12th Marines' Exercise SPARTAN FURY[48] have included aviation and infantry integration, these have not been the norm. Events associated with a MEU workup and exercises like the fire

support coordination exercises (FSCEXs) within 2d Marine Division[49] or Exercise LAVA VIPER[50] are excellent examples of integrated fire support training, but they only employ individual artillery batteries. The artillery community claims to value fire support expertise, but it is unwilling to make compromises in artillery training to gain the expertise.

Lethal/non-lethal fires and effects. The artillery community claims to value non-lethal fires and effects, but manning artifacts undermine that assertion. During OIF/OEF, artillery officers routinely served as information operations (IO) planners, but during the FSRG, artillery leadership failed to lay claim to this developing community. The establishment of Marine Corps Information Operations Command (MCIOC), Marine Forces Cyber Command (MARFOR CYBERCOM), and active duty CA groups within the MHGs offered the artillery community an opportunity to establish formal ties to these non-lethal effects capabilities. The ANGLICO T/Os call for 0802s trained as 8002s (JTACs), but the CAG T/Os simply call for 0530s, the Marine Forces Cyber Command T/O calls for 8006s, and the MCIOC T/O calls for 0510/0520/0550s(see figure 5).[51] The MARFOR CYBERCOM T/O is the most illustrative in telling which communities took the interest in the rising field of cyber operations. Cyber operations planner billets are specifically allocated to MAGTF intelligence officers, communications officers, and unrestricted line officers (8006 MOS, which encompasses dozens of career fields, including artillery); there is only one active duty artillery officer serving as "Targeting Branch Head/Intelligence Officer" on the T/O.[52] Identifying communications officers to hold the preponderance of leadership positions in the cyber community due to their familiarity in computers is tantamount to making ordnance officers the leaders in the infantry due to their

familiarity with personal and crew-served weapons.



Billet Organization

M21610 - 1ST ANGLICO MHG I MEF

Rec CD	BIC	Billet Description	Alpha Grade	BMOS ASD1 ASD2	PMOS	BRN	TYP	STA	MPR	Res Typ	SC	WPN	Billet SPN	CHARGEABLE Marine Active Off	Marine Active Enl	Marine Reserve Off	Marine Reserve Enl	Civ	Other Active Off	Other Active Enl
D	M2161000169	FIREPOWER CONTROL TEAM																		
E	M2161000312	FIREPOWER CONTROLLER	CAPT	0802 8002D	0802	M	O	A	A		S	C		1						

Billet Organization

M30050 - MARINE CORPS INFO OPS CENTER (MCIOC)

Rec CD	BIC	Billet Description	Alpha Grade	BMOS ASD1 ASD2	PMOS	BRN	TYP	STA	MPR	Res Typ	SC	WPN	Billet SPN	CHARGEABLE Marine Active Off	Marine Active Enl	Marine Reserve Off	Marine Reserve Enl	Civ	Other Active Off	Other Active Enl
E	M3005000096	INFORMATION OPERATIONS OFFICER	1STLT	0550	0000	M	O	A	A		I	C		1						
E	M3005000091	INFORMATION OPERATIONS OFFICER	1STLT	0550	0000	M	O	A	A		I	C		1						
E	M3005000101	INFORMATION OPERATIONS OFFICER	1STLT	0550	0000	M	O	A	A		I	C		1						

Billet Organization

M20146 - CE I MEF

Rec CD	BIC	Billet Description	Alpha Grade	BMOS ASD1 ASD2	PMOS	BRN	TYP	STA	MPR	Res Typ	SC	WPN	Billet SPN	CHARGEABLE Marine Active Off	Marine Active Enl	Marine Reserve Off	Marine Reserve Enl	Civ	Other Active Off	Other Active Enl
D	M2014601586	CIVIL AFFAIRS TEAM 3																		
E	M2014601587	CIVIL AFFAIRS TEAM LEADER	MAJ	0530	0000	M	O	A	A		S	C		1						

Billet Organization

M30605 - CE MARFOR CYBERCOM

Rec CD	BIC	Billet Description	Alpha Grade	BMOS ASD1 ASD2	PMOS	BRN	TYP	STA	MPR	Res Typ	SC	WPN	Billet SPN	CHARGEABLE Marine Active Off	Marine Active Enl	Marine Reserve Off	Marine Reserve Enl	Civ	Other Active Off	Other Active Enl
E	M3060500345	CYBER OPERATIONS PLANNER	CAPT	0602	0602	M	O	A	A		T	U		1						
E	M306050034E	CYBER OPERATIONS PLANNER	CAPT	0602	0602	M	O	A	A		T	U		1						
E	M3060500331	CMD SECTION HEAD	CAPT	0202	0202	M	O	A	A		I	U		1						
E	M3060500321	CNO PLANNER/LNO	CAPT	0602	0602	M	O	A	A		T	C		1						
E	M306050013E	CCMD /SST OIC	GS14	2210	2210			A	C		T	U						1		
E	M306050033E	CYBER OPERATIONS PLANNER	CAPT	0202	0202	M	O	A	A		I	U		1						
E	M3060500337	CYBER OPERATIONS PLANNER	CAPT	0602	0602	M	O	A	A		T	U		1						
E	M306050031E	CYBER OPERATIONS PLANNER	CAPT	8006	0000	M	O	A	A		I	U		1						
E	M306050033E	CYBER OPERATIONS PLANNER	CAPT	0602	0602	M	O	A	A		T	U		1						
E	M3060500314	CYBER OPERATIONS PLANNER	CWO2	2602	2602	M	O	A	A		I	U		1						
E	M306050023C	CYBER OPERATIONS PLANNER	CAPT	8006	0000	M	O	A	A		T	U		1						

Figure 5: Comparison of MOS Assignments Between 1st ANGLICO and MCIOC/I MEF/MARFOR CYBERCOM

Although the contradictions of these underlying assumptions may sound alarming, they are not all necessarily the root causes of the previously-described identity crisis. To make that determination, the reader must next compare them with the needs of the GCE/MAGTF. Only then can the artillery community see where it falls short.

The Demands of the GCE/MAGTF

The artillery community does not win battles alone. It supports the GCE and the MAGTF as a whole and shares in its victory or defeat. In order to determine where the artillery community meets and falls short of the needs of the GCE/MAGTF, this paper will reverse-engineer those needs from key documents: Expeditionary Force 21, the Tactical Training and Exercise Control Group (TTECG) Battalion Fires Handbook, General Neller's CMC FRAGO 01/2016: Advance to Contact, and the results of the 2010 FSRG. Together, these documents provide explicit and implicit guidance for the future of Marine artillery and fire support and effects as a whole.

Report of the 2010 Force Structure Review Group

The most explicit description of the priorities of the Marine Corps was the results of the FSRG. As the service anticipated a force drawdown following OIF/OEF, it gathered senior leaders from across the force to determine where to cut structure and where to add it.[53] They carefully weighed the contributions of each community against their vision of the current threat. They determined that their decisions would provide a force capable of operating across the ROMO but tailored to conduct crisis response and power projection (see Figure 6).[54]

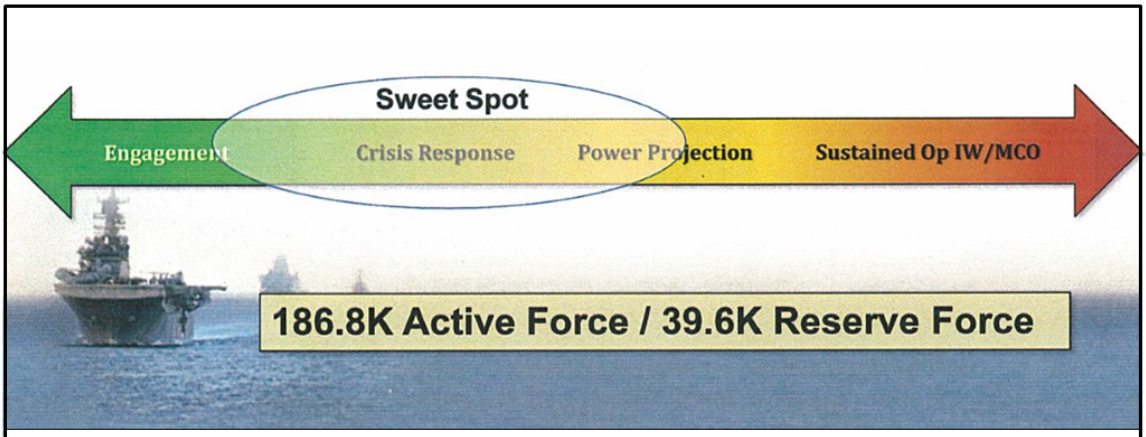


Figure 6: FSRG 2010 Assessment of the Current Operating Environment

In the process, the FSRG accepted risk in the event of the need to conduct two simultaneous major combat operations and campaigns. This resulted in a recommendation to cut twenty percent of cannon artillery and eleven percent of infantry units; the FSRG cut the artillery community at a proportionately higher rate than its maneuver counterpart. Meanwhile, the group called for increases in intelligence, surveillance, and reconnaissance; Marine Special Operations capability; cyber network defense, exploitation, and attack capabilities; an additional ANGLICO; and regionally-focused MEB command elements.[55] The FSRG decided that the Marine Corps of the future would need to trade conventional maneuver units and fire support for capabilities that would enable MEBs to quickly deploy, orient, act, and partner on an information age battlefield.

Expeditionary Force 21

The most comprehensive vision of the how the Marine Corps will operate in the future operating environment is captured in the Expeditionary Force 21 Capstone Concept written in 2014. It defines the environment as one of volatility, instability, and complexity in congested littoral regions around the world, with a focus on the littorals.[56] It makes repeated references to the service's ability to suffer the consequences or harness the benefits of the information age while operating across the ROMO.[57] With this tone, it is not surprising that the document only mentions artillery in relation to the use of precision missions. The twenty-three lines dedicated to fires in the forty-five page document stressed the importance of fire support coordination and responsiveness.[58] Expeditionary Force 21 guides the decisions that will shape the Marine Corps of the future; the Marine artillery community must find a way to complement this vision or face greater cuts in the future.

FRAGO 01/2016: Advance to Contact

Four months after becoming the 37th Commandant of the Marine Corps, General Robert Neller issued his guidance as a FRAGO to General Dunford's CMC guidance. In this document, he directed another deliberate review of the force structure to assess the capabilities of the Marine Corps. After observing the surfaces and gaps that emerged since the 2010 FSRG, General Neller only made a direct appeal to invest additional structure in the IO, EW, and cyber communities and provide a capability to the MEF and MARFOR commands.[59]

TTECG Battalion Fires Handbook

Perhaps the document that most succinctly describes the GCE's ideal vision of Marine artillery in a conventional operation is the TTECG Battalion Fires Handbook. This guidebook provides methods "for the application of fires for this conflict and the next, wherever that may be."[60] These methods are the standard by which TTECG evaluates maneuver battalions during their pre-deployment mission readiness exercise (MRX). Throughout the handbook, artillery is employed as a tool to enable something. It can shape an enemy before friendly forces maneuver, it can suppress air defenses to enable aviation freedom of movement, or it can suppress or obscure enemy forces to enable maneuver forces to close with their position. The cumulative effects of a combined attack are greater than the sum of its parts. This is evident by the emphasis on massing all available assets to employ the full package: aviation, artillery, mortars, maneuver, and direct fire systems.[61] Above all, artillery must be responsive and capable of firing in close proximity with these other assets in order to maintain tempo on the battlefield. This requires fire supporters that are experienced and confident in their ability to perform this highly-technical integration under simulated combat conditions. If the 2010 FSRG, EF-21, and CMC

FRAGO 001/2016 focus on the future operating environment's contingency operation "sweet spot", then the TTECG Battalion Fires Handbook is the reminder that the Marine Corps must always maintain its ability to dominate during major combat operations.

The Shortfall

Even a cursory comparison between the artillery community's underlying assumptions and the needs of the GCE/MAGTF reveals a large gap. The Marine artillery community's shortfalls generally fall into two categories: poor responsiveness and a failure to fully embrace the complex demands of the future operating environment. Whether the battlefield of the future includes major combat operations, contingency operations, or long-term stability operations, the GCE/MAGTF must fully drive the tempo of operations and leverage the capabilities of the information age to enable the commander's concept of operations.

Recommendations

With a clear understanding of the organizational culture of the artillery community, the needs of the GCE/MAGTF, and the gap between the two, this paper will next propose recommendations for the future. These recommendations should not be interpreted as an indictment of the abilities or judgment of today's artillery commanders or units. The artillery community is comprised of thousands of personnel trained to execute complicated procedures in a specific way under the most demanding, austere conditions. Some changes will sustain the organizational inertia of the community while others will be very disruptive to the fabric of the community. Some changes are possible with the stroke of a pen while others will require advances in current hardware and software. Some will be transparent to the members of the

community while others will change what it means to be an artilleryman. Humans resist change, especially when the current system may not seem to be broken. However, the proverbial frog in the pot of water on the stove does not think there is anything wrong with his situation even when the water starts to bubble; the results of the 2010 FSRG were the bubbles in the water for the Marine artillery community. Unless the community embraces true innovation, it will ultimately share the fate of the frog.

Continue the Evolution

The Marine artillery community has done an excellent job at overseeing a continuous evolution of its major systems, including the artillery pieces themselves, radars, personal target acquisition capabilities, digital fire direction hardware/software, munitions, prime movers, and meteorological data collection. This sustained effort over the decades has brought great precision and accuracy for an area fire weapon system. The returned focus to artillery battalion and regiment operations since OIF/OEF has reset the artillery community and put it in a better position to deploy and mass fires in major combat operations following years of in-lieu of missions. Without proficiency in this area, the artillery community would struggle to provide its unique 24 hour, all-weather, massed lethal fires that the entire MAGTF relies upon. By necessity, artillery has consciously made major combat operations its "sweet spot" and accepted risk elsewhere in the ROMO. The changes to the artillery battalion T/O to add key structure to the cannon battery to enable platoon operations on a widely-dispersed battlefield were important to sustaining operations in the future operating environment. The changes to commit greater structure to fire support billets indicated that the community recognizes its importance, even if commanders do not or cannot fully staff them. However, this evolution has stalled in the area of

timeliness, and the evolution only does so much after the artillery pieces return to CONUS following the highly lethal phase of the next major overseas campaign.

Fully Leverage Digital Fire Direction Capabilities.

Since the artillery community has improved its accuracy and precision in the three physical dimensions, it can now leverage the capabilities of AFATDS to drastically improve effectiveness in the temporal dimension. AFATDS performs technical fire direction with greater speed and accuracy than a manual FDC or today's digital FDC with numerous human interventions. With full access to the JMEM and all planning guidances, an autonomous AFATDS can perform tactical fire direction with greater speed and effectiveness than a human FDO. The artillery community commits immense human capital to micromanage the AFATDS's performance of these linear processes, at the peril of the supported GCE/MAGTF. The minutes expended on each mission by inserting human participation, utilizing hierarchical industrial age procedures to mass fires, and applying redundant checks at all levels add up to discourage artillery/aviation/maneuver integration, reduce tempo, and impose unnecessary friction into what is already a wicked problem playing out on the battlefield. Figures 7 and 8 show how mission processing time accumulates in the centralized and decentralized modes that the Marine artillery community currently employs.[62] Of note, the currently-prescribed method for centralized mission processing contains a logical fallacy. It assumes that the FSCC can approve a mission before sending it to the battalion FDC. However, in order to clear airspace, the FSCC requires the message to observer (MTO), which the FDC produces while processing the mission. The MTO designates the fire for effect unit and the adjusting unit;[63] each firing unit would present a different gun target line (GTL) with a different trajectory with a different

Artillery Mission Processing: Centralized

1. CFST transmits CFF to Bn FSCC.....1:00*
2. Bn FSCC relays CFF to the Bn FDC.....0:30
3. Bn FDC processes mission, ...1:00-2:00*
   transmits MTO to Bn FSCC,
   and transmits FO to Btry FDC DNL;
   Btry FDC processes mission 1:00-2:00*
   and transmits FC to gunline DNL;
   Gunline lays on target.....0:30*
4. Bn FSCC relays MTO to CFST
   Bn FSCC approves/modifies/denies.....TBD**
   mission
5. Bn FDC transmits order to fire to Btry FD.....0:05
6. Btry FDC transmits order to fire to gunline..0:05
7. Gunline fires mission, first volley.....0:20-2:00
   travels ballistic trajectory, impacts target

Total time from target ID to first impacts: **4:30-8:10**

*Time standard specified in T&R Manual
**Mission approval time depends on clearance requirements, indicated by dotted lines with Regt FSCC

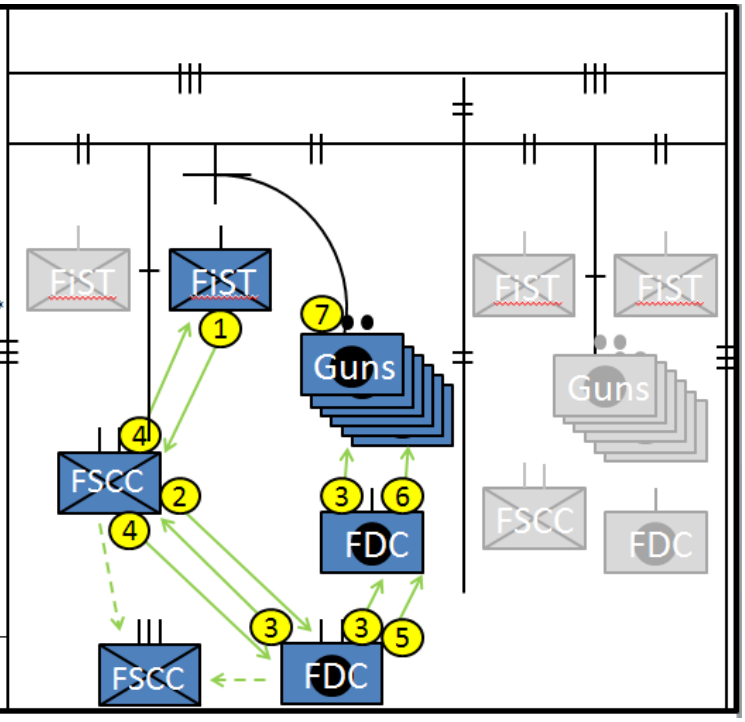


Figure 7: Artillery Responsiveness While Operating in the Centralized Mode

Artillery Mission Processing: Decentralized

1. CFST transmits CFF to Bn FDC.....1:00*
2. Bn FDC processes mission,.....1:00-2:00*
   transmits MTO to CFST, and
   transmits FO to Btry FDC DNL;
   Btry FDC processes mission 1:00-2:00*
   and transmits FC to gunline DNL;
   Gunline lays on target.....0:30*
3. Bn FSCC approves/modifies/denies.....TBD**
   mission
4. Bn FDC transmits order to fire to Btry FDC....0:05
5. Btry FDC transmits order to fire to gunline...0:05
6. Gunline fires mission, first volley.....0:20-2:00
   travels ballistic trajectory, impacts target

Total time from target ID to first impacts: **4:00-7:40**

*Time standard specified in T&R Manual
**Mission approval time depends on clearance requirements, indicated by dotted lines with Regt FSCC

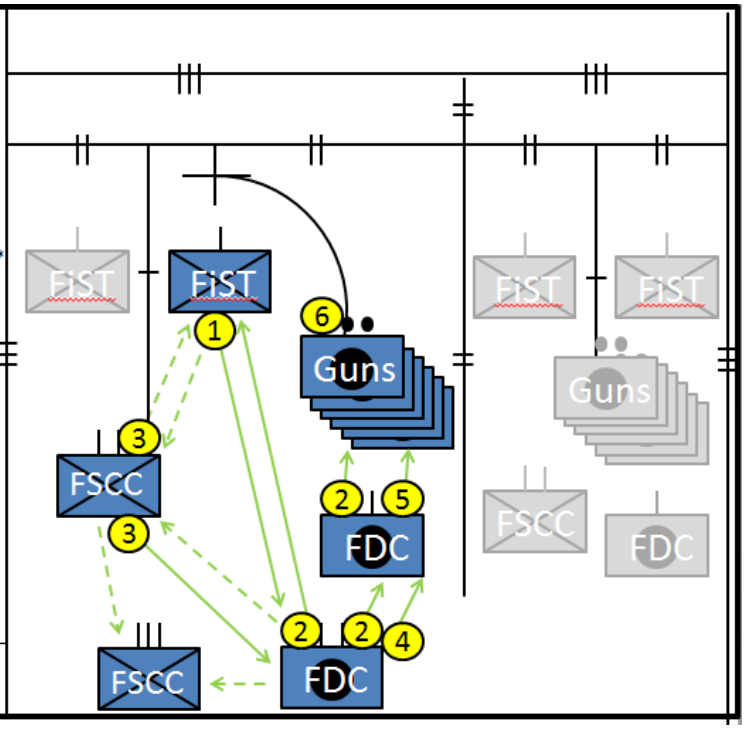


Figure 8: Artillery Responsiveness While Operating in the Decentralized Mode

maximum ordinate. Depending on which unit(s) the FDC employs to support the mission, the resulting GTL may or not be safe for friendly aircraft. Therefore, figure 7 depicts the compromise: the FSCC relays the unapproved mission to the FDC. The FDC processes the

mission and issues the fire order as a "do not load" (DNL) mission and sends the MTO to the FSCC for approval. Once the FSCC approves the mission (which may require time-consuming modifications), the FDC can issue the order to cancel the DNL special instruction and fire the mission. This process adds unnecessary steps, time, and confusion to an already complicated process. The FDC could better focus on ruthlessly maintaining the requirements for accurate predicted fire, coordinating with the battalion FDC or FSCC, and anticipating the next ammunition re-supply based on consumption rates. A full commitment to AFATDS would require some software updates to accommodate special mission types and the ability to automatically account for intervening crests. Also, the FSCC role in AFATDS would require the ability to view technical data like gun target line (azimuth), max ordinate, and charge to enable rapid approval. However, the ultimate results would be more simplified roles within the FDC and more timely, accurate fires for the GCE.

After the artillery community fully embraces automation to maximize speed and accuracy, it would logically rebalance its organization to weight its human capital in its fire support role. With battery, battalion, and regimental FDOs setting the conditions for precision by chasing the mil while AFATDS conducts fire direction, the fire supporters would serve a more critical role in the process. To use the "eyes/brain/muscle" metaphor common in the artillery community (the eyes are the fire supporters, the brain is the FDC, and the muscle is the gunline), this innovation would consolidate the eyes of the community with the brain at the FSCC, where they have the optimum vantage point to perform the observe, orient, and decide steps of Boyd's OODA (observe-orient-decide-act) loop.[64] This innovation would change what it means to be an artilleryman. To use another metaphor likening an artillery unit to a handgun, artillerymen assigned to firing units would go from being the metaphorical "finger on the

trigger" to simply being "cogs in the gun;" the fire supporters would go from people who "call for fire" to becoming the "finger on the trigger." Figure 9 depicts how this new flat method for mission processing would work in practice. The shift of power within the community would be drastic. After a long, steady evolution of capabilities chasing the mil across the five

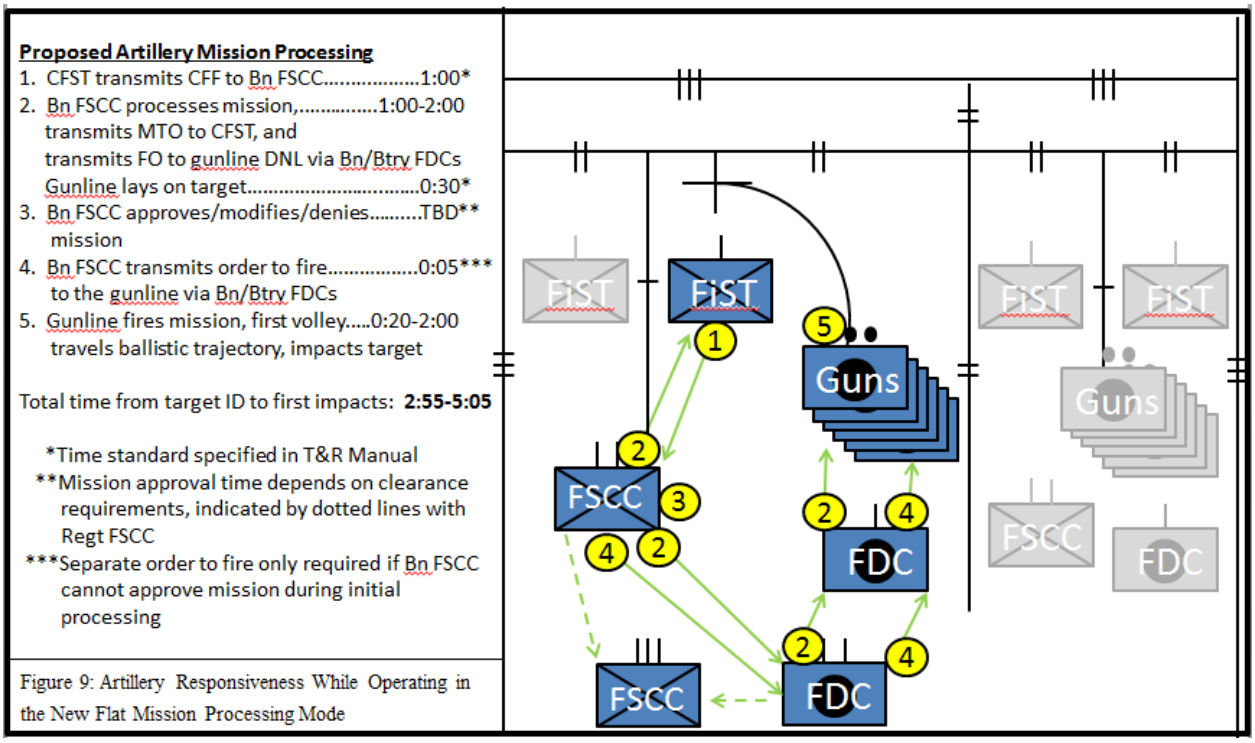


Figure 9: Artillery Responsiveness While Operating in the New Flat Mission Processing Mode

requirements for accurate predicted fire, consolidating the steps required to transform a decision into action would provide more timely and accurate fires in support of the GCE/MAGTF.

As a result, the artillery community must revisit its approach to fire support manning to weight those positions with personnel capable of the increased responsibility. First, the Regimental AFSC must achieve equal footing with the artillery battalion OpsO and XO. The Regimental AFSC must gain key billet standing for promotion and command consideration. This would not stand out as unusual across the service; many MOSs' key billets are primary staff positions other than OpsO.[65] This could be formalized via promotion board precepts (just as transition team positions were specified for consideration during OIF/OEF)[66] until the community fully embraces it. This elevated standing of the AFSC billet would also encourage

commanders to staff it with stronger performers and slow the rotation of officers through the position. Longer tenure in these billets, along with their more prominent role in the community would logically result in field exercises with a greater emphasis on true fire support integration training.

This proposed innovation raises many questions from artillerymen. The two most prominent concerns are ammunition management and the perception that the artillery community would surrender control of their unit to the supported unit. When maneuver units plan operations, their FSC (with the help of the subject matter experts in the FSCC) drafts the fire support plan. Within this plan, he specifies the essential fire support tasks (EFSTs). In these, he includes an allocation of resources such as aircraft sorties, naval gunfire rounds, and artillery rounds to achieve each task.[67] When the supporting artillery unit plans, the OpsO filters out the other supporting arms in the EFSTs and creates essential field artillery tasks that guide the artillery unit's concept of operations.[68] Essentially, fire supporters already drive ammunition management at the macro level through their fire support plan. This innovation would not change that. As artillerymen in the FSCCs manage the consumption of ammunition during execution, artillerymen in the battery positions would still coordinate and execute internal resupply operations to ensure uninterrupted support. This leads to the next argument of ceding control of the artillery unit to the supported maneuver commander. Since the artillery battalion commander is the FSC for the supported maneuver regiment,[69] he (or his representative) is ultimately responsible for the drafting EFSTs and therefore, how his battalion is employed. In this regard, he actually gains more direct control of his unit as a result of the proposed change. Sometimes, the artillery battalion commander does not take a hands-on approach to his FSC duties, delegating most of the responsibility to the Regimental AFSC. The proposed change

would demand greater involvement. This relationship between the artillery battalion and the supported maneuver regiment is mirrored with the artillery regimental commander and the Marine division. In the end, the transition to rebalance the artillery community may be challenging, but it would not relinquish the responsibility of ammunition management or the control of the artillery unit to the supported maneuver commander.

Integrate Developing Systems to Enable Rapid Integration

The full automation of technical and tactical fire direction may not result in more responsive artillery support if FSCCs cannot speed up clearance procedures for integrating fires. Today, an artillery fire mission creates a gun target line (GTL) from the firing unit to the target that the FSC must deconflict from ground forces and manned/unmanned fixed-wing/rotary-wing assets. The FSC can approve a mission where the aircraft flies above/below the projectile's trajectory (vertical deconfliction), does not cross the GTL at all (lateral deconfliction), or does not cross the GLT when there will be not projectile travelling along that line (deconfliction by time).[70] These methods of deconfliction are not difficult for an experienced FSCC, but the positive control requirement can significantly hinder responsiveness. In practice, an AirO tracks aircraft locations within the unit area of operations (AO) using push pins on a map, moving them based on the instructions he or an air controller gave the pilot. This becomes problematic when helicopters or UASs slowly transit from one control measure to the next as a dynamic target appears. The AirO may direct the aircraft to change direction or altitude in order to avoid a potential collision with a mortar or artillery projectile, or he may oversee the aircraft's attack of the target. Either way, it can be time-consuming to study the round's trajectory (possibly for multiple firing agencies), study the aircraft's flight path (possibly for multiple aircraft),

determine a safe flight path, provide instructions, and confirm compliance before the FSC can approve the artillery mission. All of this effort is to prevent an aircraft from winning the statistical lottery by passing through a parabolic soda straw of airspace (from the firing unit to the target) at the exact instant that a round travels along its trajectory. The new G/ATOR ground radar system under development will have the capability to acquire and track aircraft within the GCE/MAGTF AO.[71] If this tracking data could be displayed in real time on a common tactical picture, along with a three dimensional rendition of the artillery soda straw-shaped danger zone produced in AFATDS to replace today's crude GTL, then the integration process could take place quickly and intuitively. There is more than a multi-million dollar aircraft and pilot at risk in these situations; a call for indirect fire often means that there are Marines on the ground facing an imminent threat. Unlike the recommendation pertaining to flattening the mission processing procedures, this recommendation would demand continued hardware development in addition to system software integration to increase the responsiveness of fire support.

Formalize Information Operations as a Secondary Mission of Marine Artillery

Finally, the artillery community must fully embrace non-lethal fires and effects. When the artillery pieces return to CONUS after the decisive lethal portion of the next campaign, artillerymen can wait to see which in-lieu-of missions the GCE/MAGTF assigns, or it can stand ready to re-task its battalions to perform roles that are complementary to its primary mission and its espoused values. The artillery community is culturally well-equipped to execute missions in IO and information-related communities. This ability to execute this secondary mission would have an individual and a unit component.

The Marine Corps could formalize this by designating the secondary mission in an ALMAR, similar to when it designated civil military operations (CMO) as artillery's secondary mission in 2005.[72] Instead of maintaining a standing capability within the battalions and regiment, a portion of T/O billets across the Marine Corps for IO Marines (0510/0550/0551), MISO Marines (0520/0521), cyber team leaders (8006 billets), and CA Marines (0530/0531) would be coded for Marines with a primary MOSs of 0802/08XX. For example, in figure 4, the highlighted PMOS field would replace "0000" with an 08XX MOS. Artillerymen would serve in these units as B billets and return to the operating forces. Over time, artillery units would establish a base of experience at all levels of staff non-commissioned officer and officer leadership, capable of enabling a smooth transition of the unit to the secondary mission. When a Marine expeditionary force mobilizes for major combat operations with its organic artillery regiment, an uncommitted battalion outside that regiment receives training and MOS certification from trainers from the appropriate agency. That newly-trained information battalion would store its howitzers and fully commit to its new mission for approximately one year until another battalion would take its place. 2d Battalion, 11th Marines demonstrated how this would work in 2008 when it deployed as provisional CA in support of OIF.[73] As this experience permeates the community over time, this marriage between artillery and IO would yield an organization that provides better lethal and non-lethal fire support and effects to the GCE/MAGTF. It would also offer the Marine Corps a pipeline to man these IO-related billets and the ability to maintain a robust IO capability without committing large standing units that would likely be under-utilized outside stability operations. There is a possibility that, without this merging of artillery and IO, the Force Structure 2025 board could recommend to commit

structure to standing information battalions in each MHG (per the MCIOC Commander's recommendation)[74] by further cutting artillery.

Many artillerymen may wonder if artillery units could support such a specialized mission or if this marriage between communities could lead to the transition of artillery battalions into information battalions. To address the ability of an artillery unit to fill these roles, it is important to consider that most of the current units with these capabilities are composed of Marines with secondary billet MOSs. With the exception of certain enlisted MOSs and officer MOSs that require a graduate degree, most of these billets can be staffed by artillerymen with several weeks of MOS training. The more highly-specialized positions could reside in small detachments in the MHG; the merging of the capabilities at the MHG with the experienced IO Marines and the newly-trained personnel in the artillery battalion would complete the transformation of an artillery battalion into an information battalion. After all, the standing IO units have a similar composition of career IO specialists, experienced IO practitioners, and novices. As far as the possibility of the wholesale replacement of artillery battalion structure with information battalions, this is unlikely because of the relative importance of artillery and IO during different phases of a conventional campaign (see figure 10).[75] Up until the culmination of phase III (dominate) operations, artillery is the critical capability that the GCE/MAGTF must mass on the battlefield; meanwhile, IO capabilities can be consolidated at a higher echelon. During phases IV and V (stabilize and enable civil authority) operations, artillery can be employed sparingly and still achieve the desired effect. At this portion of the campaign, IO capabilities must be dispersed widely to the lowest possible level across the battlefield. These different missions will not be in direct conflict with each other within a campaign. These two reservations of most

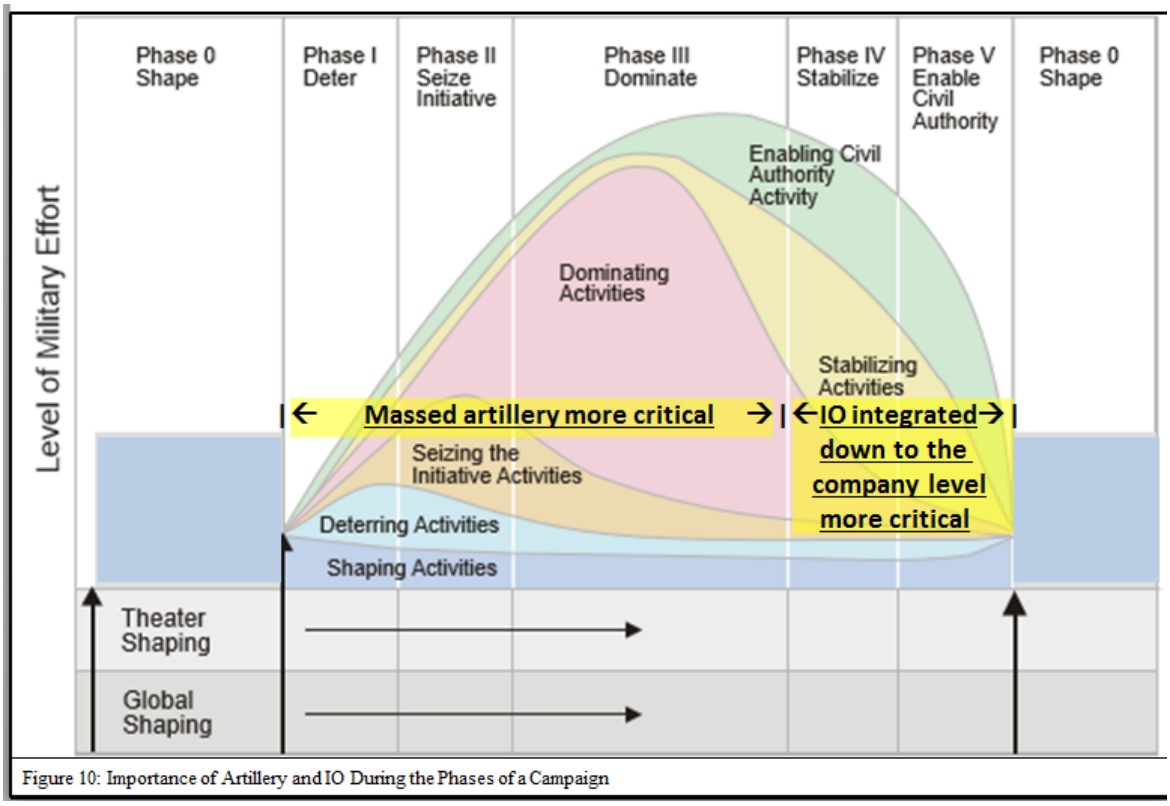


Figure 10: Importance of Artillery and IO During the Phases of a Campaign

artillerymen are understandable, but after closer investigation, they do not stand up to scrutiny

In the end, this secondary mission commits artillery to a critical task that corresponds to the mindset and the espoused values of the Marine artillery community. Furthermore, it guarantees the artillery community a critical role across all phases of the next campaign. For the Marine Corps as a whole, it ensures the longevity of two indispensable capabilities for the manpower price of one.

Conclusions

The Marine artillery community has evolved over the last century to play a critical role in how the service executes combined arms maneuver warfare. Phase III operations of OIF I demonstrated the culmination of that evolution. However, since that high point, the artillery community struggled to remain relevant, often leaving their artillery pieces in CONUS to serve

as provisional security forces, military police, and CA. In spite of the fielding of GPS-guided artillery munitions, dispersing smaller firing units across greater geographic areas, and executing a range of necessary in-lieu-of missions, the Marine Corps chose to deeply cut artillery during the 2010 FSRG.

A careful investigation of the organizational culture of the artillery community shows the artifacts, espoused values, and underlying assumptions that made it successful during its long evolution through OIF I. However, some its underlying assumptions are at odds with the developing needs of the GCE, the MAGTF, and the Marine Corps as a whole. In order to meet the overall needs of the service in the future operating environment, the Marine artillery community must be willing to innovate to provide more responsive fire support as well as institutionalizing the ability to contribute to the MAGTF's success on the information age battlefield.

First, the community must take the necessary steps to flatten the artillery mission processing procedures and make the mission approval process faster and more intuitive. Cultural norms currently hold the artillery community back from taking the necessary steps to slash minutes of response time from each mission. These steps include hardware and software developments as well as a reorganization that would change what it means to be an artilleryman.

Finally, the Marine artillery community must formalize and fully embrace a secondary IO mission. This would provide artillerymen with a meaningful role that coincides with the community's training and espoused values. This relationship between the two communities would provide structure and security to two capabilities that can each seem less-than-critical during certain phases of a campaign.

In closing, this assessment and its recommended solutions recognize the immense progress and contributions of the artillery community as well as the potential of artillerymen to play a decisive role in the future operating environment. Although the changes detailed in this paper would require the community to reconsider some aspects of its cultural identity, they are absolutely necessary to better support the GCE/MAGTF and guarantee the relevance of the community into the future.

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[2]Headquarters US Marine Corps, *Marine Infantry Battalion*, FMFM 3-55.5 (Washington, DC: Headquarters US Marine Corps, March 16, 1978), 336.

[3]The only Air Officer billets in Marine artillery reside in the three regimental headquarters batteries. In the 28 regimental command chronologies from January 2010 to March 2015 (listed in this paper's bibliography), the Air Officers consistently described his training accomplishments in terms of currency achieved at TACP shoots.

[4]Headquarters US Marine Corps, *Unit TO&E Report for Marine Corps Info Ops Center (MCIOC)*, Total Force Structure Management System, accessed on January 22, 2016, https://tfsms.mccdc.usmc.mil, 15.

[5]Headquarters US Marine Corps, *Awards Update*, MARADMIN 424/11 (Washington, DC: Headquarters US Marine Corps, July 27, 2011).

[6]Figure 2, drawn from the data in the 135 command chronologies listed in this paper's bibliography, shows that all five major billets in the artillery battalion were staffed with majors less than five percent of the time, and all four lieutenant colonel billets in the artillery regiment were staffed with Marine lieutenant colonels less than fifteen percent of the time. This assessment does not account for selected officers serving in a billet intended for the next higher rank.

[7]Joint Staff, *Joint Operations*, JP 3-0 (Washington, DC: Joint Staff, August 11, 2011), V-6.

[8]Joint Staff, *Joint Operations*, JP 3-0, V-9.

[9]Thomas D. Ricks, *Fiasco: The American Military Adventure in Iraq, 2003 to 2005* (New York: The Penguin Press, 2006), Chapter 14.

[10]The change in artillery manning within the cannon battery and the BFST is evident when comparing the following five unit T/O&E reports from this paper's bibliography: Btry A 1/11, HQTRS Btry 1/11, Fire Spt Tm 1/11, Btry A 1/11 (historical), and HQTRS Btry 1/11 (historical).

[11]Headquarters US Marine Corps, *Reshaping America's Expeditionary Force in Readiness: Report of the 2010 Marine Corps Force Structure Review Group* (Washington, DC: Headquarters US Marine Corps, March 14, 2011), 6.

[12]AOAG, *USMC GCE FS Campaign Plan*, 11-14.

[13]"Organizational Culture Models and Concepts," Tangient LLC, accessed on January 22, 2016, https://globalmba-oa-le2.wikispaces.com/OC+Models+and+Concepts; Figure 1 of this paper is from this site's rendition of Dr Schein's organizational culture "iceberg model."

[14]Edgar H Schein, "Coming to a New Awareness of Organizational Culture," *Sloan Management Review* 25, no 2 (Winter 1984): 3.

[15]Carey, Thomas Carey, Combat Arms Majors Monitor, telephone conversation with the author, January 20, 2016; Culbertson, Scott, MACS-20 (Monitor for Field Artillery Company Grade Officers), telephone conversation with the author, January 20, 2016.

[16]Staffing stats obtained from the 135 artillery command chronologies listed in this paper's bibliography show that the XO and OpsO billets are more often filled with officers of the T/O rank, compared to all other major billets within the artillery battalion and lieutenant colonel billets within the artillery regiment.

[17]Joseph Welch, *Sequence of Events for 1st Battalion, 12th Marines Saint Barabara's Day Celebration 2014*, (Marine Corps Base Hawaii, Kaneohe Bay, HI, December 19, 2014), 4.

[18]Joseph Welch, *Script for "Genesis of Artillery" Skit*, (Marine Corps Base Hawaii, Kaneohe Bay, HI, performed December 19, 2014), 1-3.

[19]Welch, *SOE for 1/12 St. Bab's Day Celebration '14*, 1-14.

[20]Headquarters US Marine Corps, *Manual for the Marine Corps Historical Program*, MCO 5750.1H (Washington, DC: Headquarters US Marine Corps, February 13, 2009), 5-4.

[21]Marine Field Artillery Regiment Commanders, *Marine Corps Artillery Safety Standard Operating Procedure*s, JRegtO P3570.1D w/ Ch 1 (Fort Sill, OK: Marine Field Artillery Regiment Commanders, November 15, 2011), II 1-3 to II 1-37.

[22]Headquarters US Marine Corps, *Artillery Training and Readiness Manual*, NAVMC 3500.7B (Washington, DC: Headquarters US Marine Corps, June 18, 2015), iii-iv.

[23]The fourteen artillery T/Os contained in this paper's bibliography include the ideal staffing information for every active component artillery unit in the Marine Corps. All artillery T/Os are current as of January 22, 2016.

[24]The five Rank/MOS reports pulled from Marine Online contained in this paper's bibliography were a snapshot of all active component artillery officer (second lieutenant to lieutenant colonel) current assignments on January 11, 2016 (the day the author pulled the reports).

[25]AOAG, *USMC GCE FS Campaign Plan*, 1-15.

[26]HQMC, *Artillery T&R Manual*, 8-3, 19-12.

[27]Headquarters US Marine Corps, *Fire Support Coordination in the Ground Combat Element*, MCWP 3-16 (Washington, DC: Headquarters US Marine Corps, November 28, 2001), 3-18; HQMC, *Artillery T&R Manual*, 8-3, 19-12.

[28]Marine FA Regt COs, *MC Artillery Safety SOP*, II 1-13 to II 1-14.

[29]HQMC, Unit TO&E Report for A 1/11 1st MarDiv, 4, 39.

[30]Headquarters, Department of the Army, *Tactics, Techniques, and Procedures for Observed Fire*, FM 6-30 (Washington, DC: Headquarters, Department of the Army, July 16, 1991), 1-3. This statistic is based on a US Army M109A3 regiment consisting of three battalions, each with three batteries, each with eight howitzers. This 8/72-gun battery/regiment is proportional to the 6/54-gun battery/regiment breakdown in today's 10th Marine Regiment.

[31]Headquarters US Marine Corps, Unit TO&E Report for Hqtrs Btry 11th Mar Regt 1st MarDiv, Total Force Structure Management System, accessed on January 22, 2016, https://tfsms.mccdc.usmc.mil, 4; HQMC, Unit TO&E Report for Hqtrs Btry 1/11 1st MarDiv, 7.

[32]HQMC, *FS in the GCE*, 1-5; HQMC, *Marine Infantry Battalion*, 336.

[33]Headquarters US Marine Corps, Unit TO&E Report for Rfl Co A 1/1 1st MarDiv, Total Force Structure Management System, accessed on March 26, 2016, https://tfsms.mccdc.usmc.mil, 8; Headquarters US Marine Corps, Unit TO&E Report for Wpns Co 1/1 1st MarDiv, Total Force Structure Management System, accessed on March 26, 2016, https://tfsms.mccdc.usmc.mil, 5.

[34]Ricks, *Fiasco*, Chapter 14.

[35]AOAG, *USMC GCE FS Campaign Plan*, 11-14.

[36]Staffing statistics obtained from the 135 command chronologies are listed in this paper's bibliography. The author added up the cumulative time covered across all command chronologies and divided that time by the number of officers listed. The average amount of time for an officer serving as the regimental logistics officer was 6.55 months, and the average amount of time for an officer serving as the battalion logistics officer was 6.03 months. Assuming a notional 0402 officer would serve a tour between two and three years, he would take the place of four to six artillery officers that would otherwise cycle through that billet over the course of that time.

[37]Headquarters US Marine Corps, *Assignment of Secondary Civil Military Operation Mission to the Artillery Regiments Battalions,* ALMAR 061/05 (Washington, DC: Headquarters US Marine Corps, December 5, 2005).

[38]Headquarters US Marine Corps, Unit TO&E Report for CE I MEF, Total Force Structure Management System, accessed on January 22, 2016, https://tfsms.mccdc.usmc.mil, 8-25.

[39]Staffing statistics obtained from the 135 command chronologies are listed in this paper's bibliography. The author cited the manning data in each document to determine whether majors billets at the artillery battalion and lieutenant colonel billets at the regiment were staffed at T/O, one rank below, more than one rank below T/O, or if the billet was held by a sister service officer for each unit for each month reported. Some billets were considered "gapped" when the unit submitted a command chronology, but failed to list the position in the manning section of the report.

[40]Staffing statistics obtained from 135 artillery command chronologies are listed in this paper's bibliography. The author cited the manning data in each document to determine the average tenure of officers serving in majors billets at the artillery battalion and in lieutenant colonel billets at the artillery regiment. The author calculated the values by adding up the cumulative number of months of billet data from the command chronologies and divided that value by the number personnel named for that billet. The quotient is the average number of months between turnover.

[41]Staffing statistics computed by comparing the cumulative number of T/O artillery officer billets (from the thirteen artillery T/O reports listed in this paper's bibliography) with the number of officers assigned to fire support, firing battery, and headquarters billets (as determined by unit names in five MOL rank/MOS reports, listed in the bibliography).

[42]Tactical Training and Exercise Control Group, *TTECG Battalion Fires Hanbook* (29 Palms, CA: Marine Air Ground Task Force Training Command, June 2012), 104.

[43]Marine FA Regt COs, *MC Artillery Safety SOP,* II 1-35 to II 1-37.

[44]Marine FA Regt COs, *MC Artillery Safety SOP,* II 1-36.

[45]Marine FA Regt COs, *MC Artillery Safety SOP*, F-1.

[46]"Systems Approach to URP," Marine Corps Training, Headquarters US Marine Corps, accessed on January 22, 2016, http://www.trngcmd.marines.mil/Portals/207/Docs/MCCSSS/T3S/Best%20Practices%20091110.doc, 17.

[47]U.S. Marine Corps Command Chronology Collection. Box 2677, Folder 20. 10th Marine Regiment, 2d Marine Division from 1 July to 31 December 2013. Archives Branch, Marine Corps History Division, Quantico, VA.

[48]U.S. Marine Corps Command Chronology Collection. Box 2740, Folder 27. 1st Battalion, 12th Marines, 3d Marine Division from 1 January to 30 June 2014. Archives Branch, Marine Corps History Division, Quantico, VA.

[49]The six 10th Marine Regiment unit command chronologies (listed in this paper's bibliography) covering the time from January 2012 to March 2015 includes twenty FSCEXs, each specifically supporting the fire support and integration training of 2d Marine Division maneuver battalions and regiments.

[50]The six 1st Battalion, 12th Marines unit command chronologies (listed in this paper's bibliography) covering the time from January 2012 to March 2015 includes eleven iterations of Exercise LAVA VIPER, each including a FSCEX including an artillery battery, an 81mm mortar platoon, and rotary-wing/fixed-wing aircraft in support of fire support and integration training of 3d Marines' subordinate infantry battalions preparing for upcoming deployments.

[51]Figure five includes highlighted excerpts from four T/O&E reports included in the bibliography of this paper: 1st ANGLICO, MCIOC, CE I MEF, and MARFOR CYBERCOM. The author modified the excerpts to place the billets of interest immediately below the page header in order to clearly present the information.

[52]Headquarters US Marine Corps, Unit TO&E Report for CE MARFOR CYBERCOM, Total Force Structure Management System, accessed on January 23, 2016, https://tfsms.mccdc.usmc.mil, 14.

[53]HQMC, *Report of the 2010 Marine Corps FSRG* , ii.

[54]HQMC, *Report of the 2010 Marine Corps FSRG*, 2.

[55]HQMC, *Report of the 2010 Marine Corps FSRG*, 6.

[56]Headquarters US Marine Corps, *Expeditionary Force 21 Capstone Concept* (Washington, DC: Headquarters Marine Corps, March 4, 2014), 8.

[57]HQMC, *EF 21*, 35-36.

[58]HQMC, *EF 21*, 33.

[59]Headquarters US Marine Corps, *FRAGO 001/2016: Advance to Contact* (Washington, DC: Headquarters US Marine Corps, January 19, 2016), 4-5.

[60]TTECG, *TTECG Bn Fires Handbook*, 1.

[61]TTECG, *TTECG Bn Fires Handbook*, 4, 8, 70.

[62]HQMC, *FS in the GCE*, 3-18; HQMC, *Artillery T&R Manual*, 8-3, 19-12.

[63]Headquarters US Marine Corps, *Field Artillery Manual Cannon Gunnery*, MCWP 3-1.6.19 (Washington, DC: Headquarters US Marine Corps, April 23, 1996), 5-15.

[64]Robert Coram, *Boyd: The Fighter Pilot Who Change the Art of War* (New York: Bay Back Books, 2002), 344.

[65]Carey, telephone conversation with the author, January 20, 2016; Culbertson, telephone conversation with the author, January 20, 2016.

[66]Headquarters US Marine Corps, *Precept Convening the Fiscal Year 2017 U.S. Marine Corps Major Promotion Selection Board and Captain Continuation Selection Board* (Washington, DC: Headquarters US Marine Corps, August 19, 2015), Encl (1), 4.

[67]HQMC, *FS in the GCE*, 3-7 to 3-9, D-1 to D-3.

[68]HQMC, *FS in the GCE*, 10-1 to 10-2.

[69]HQMC, *FS in the GCE*, 1-4.

[70]HQMC, *FS in the GCE*, 5-16 to 5-19; TTECG, *TTECG Bn Fires Handbook*, 106-117.

[71]John Karlovich and Abraxas Patton, "Ground/Air Task Oriented Radar (G/ATOR AN/TPS-80): MAGTF Fires OAG Program Overview and Status," PowerPoint presentation. (Headquarters US Marine Corps, Washington, DC, December 2015).

[72]HQMC, *Assignment of Secondary CMO Mission to the Artillery Regiments Battalions.*

[73]"2d Battalion, 11th Marines History," 2d Battalion, 11th Marines, Headquarters US Marine Corps, accessed on January 22, 2016, http://www.1stmardiv.marines.mil/Units /11THMARINEREGT/2ndBattalion/History.

[74]Drew Cukor, "Marine Corps Information Operations" (Lecture, Marine Corps Command and Staff College, Quantico, VA, March 4, 2016).

[75]Joint Staff, *Joint Operations*, JP 3-0, V-6; Figure 10 of this paper is a modified version of figure V-3 on page V-6.

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U.S. Marine Corps Command Chronology Collection. Box 2421, Folder 16. 12th Marine Regiment, 3d Marine Division from 1 January to 30 Jun 2010. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2421, Folder17. 12th Marine Regiment, 3d Marine Division from 1 July to 31 December 2010. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2573, Folder 5. 12th Marine Regiment, 3d Marine Division from 1 January to 30 Jun 2011. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2573, Folder 4. 12th Marine Regiment, 3d Marine Division from 1 July to 31 December 2011. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2626, Folder 3. 12th Marine Regiment, 3d Marine Division from 1 January to 30 June 2012. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2626, Folder 4. 12th Marine Regiment, 3d Marine Division from 1 July to 31 December 2012. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2679, Folder 1. 12th Marine Regiment, 3d Marine Division from 1 January to 30 June 2013. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2679, Folder 2. 12th Marine Regiment, 3d Marine Division from 1 July to 31 December 2013. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2740, Folder 22. 12th Marine Regiment, 3d Marine Division from 1 January to 30 Jun 2014. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2740, Folder 25. 12th Marine Regiment, 3d Marine Division from 1 July to 1 March 2015. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2422, Folder 14. 1st Battalion, 12th Marines, 3d Marine Division from 1 January to 30 June 2010. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2422, Folder 25. 1st Battalion, 12th Marines, 3d Marine Division from 1 July to 31 December 2010. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2573, Folder 8. 1st Battalion, 12th Marines, 3d Marine Division from 1 January to 15 April 2011. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2573, Folder 9. 1st Battalion, 12th Marines, 3d Marine Division from 16 May to 15 Jun 2011. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2573, Folder 10. 1st Battalion, 12th Marines, 3d Marine Division from 16 June to 15 July 2011. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2573, Folder 11. 1st Battalion, 12th Marines, 3d Marine Division from 16 July to 15 August 2011. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2573, Folder 12. 1st Battalion, 12th Marines, 3d Marine Division from 16 August to 15 September 2011. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2573, Folder 13. 1st Battalion, 12th Marines, 3d Marine Division from 16 September to 15 October 2011. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2573, Folder 14. 1st Battalion, 12th Marines, 3d Marine Division from 16 October to 31 December 2011. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2626, Folder 6. 1st Battalion, 12th Marines, 3d Marine Division from 1 January to 30 June 2012. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2626, Folder 7. 1st Battalion, 12th Marines, 3d Marine Division from 1 July to 31 December 2012. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2679, Folder 4. 1st Battalion, 12th Marines, 3d Marine Division from 1 January to 30 June 2013. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2679, Folder 5. 1st Battalion, 12th Marines, 3d Marine Division from 1 July to 31 December 2013. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2740, Folder 27. 1st Battalion, 12th Marines, 3d Marine Division from 1 January to 30 June 2014. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2740, Folder 28. 1st Battalion, 12th Marines, 3d Marine Division from 1 July to 31 March 2015. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2422, Folder 23. 3d Battalion, 12th Marines, 3d Marine Division from 1 January to 30 June 2010. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2422, Folder 24. 3d Battalion, 12th Marines, 3d Marine Division from 1 July to 31 December 2010. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2573, Folder 16. 3d Battalion, 12th Marines, 3d Marine Division from 1 January to 30 June 2011. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2573, Folder 17. 3d Battalion, 12th Marines, 3d Marine Division from 1 July to 31 December 2011. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2626, Folder 8. 3d Battalion, 12th Marines, 3d Marine Division from 1 January to 30 June 2012. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2626, Folder 9. 3d Battalion, 12th Marines, 3d Marine Division from 1 July to 31 December 2012. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2679, Folder 6. 3d Battalion, 12th Marines, 3d Marine Division from 1 January to 30 June 2013. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2679, Folder 7. 3d Battalion, 12th Marines, 3d Marine Division from 1 July to 31 December 2013. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2741, Folder 1. 3d Battalion, 12th Marines, 3d Marine Division from 1 January to 30 June 2014. Archives Branch, Marine Corps History Division, Quantico, VA.

U.S. Marine Corps Command Chronology Collection. Box 2741, Folder 2. 3d Battalion, 12th Marines, 3d Marine Division from 1 July to 31 March 2015. Archives Branch, Marine Corps History Division, Quantico, VA.

Welch, Joseph. Script for "Genesis of Artillery" Skit. Marine Corps Base Hawaii, Kaneohe Bay, HI, performed December 19, 2014.

Welch, Joseph. Sequence of Events for 1st Battalion, 12th Marines Saint Barabara's Day Celebration 2014. Marine Corps Base Hawaii, Kaneohe Bay, HI, December 19, 2014.