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14. ABSTRACT

The M1A1 Main Battle Tank has evolved into the Marine Corps most efficient tank killing machine. Tank development since World War II has focused primarily on increasing the tanks ability to fight another tank and win. However, in the history of Marine armor Marine tanks have only rarely engaged enemy tank formations, instead they have been primarily used to enable infantry operations. As the Marine Corps enters the complex and disbursed operating environment of the 21st century, a piece of equipment only designed to destroy tanks will have limited practicality on the battlefield. While remaining relevant as a direct fire weapon, without significant attention to its communication, digital, surveillance, and networking capabilities, the M1A1 will find itself with minimal options for employment. Going forward, the Marine Corps must reevaluate its tank development and bring the focus back to how best to enable the infantry. This paper advocates a more balanced approached to the tanks most dangerous mission of fighting other tanks versus its most likely mission of supporting the infantry. The time has come for the Marine Corps to develop capabilities for its tank that will better enable it to perform in its role as an infantry support platform.

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MASTER OF MILITARY STUDIES

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The M1A1
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Executive Summary

Title: The M1A1, Maintaining Relevance for the Marine Corps Most Survivable and Lethal Infantry Support Platform

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Thesis: Marine Corps tank development must broaden its focus to more than just firepower in order to maintain the tanks relevance into the future as an enabler for infantry operations.

Discussion: The M1A1 Main Battle Tank has evolved into the Marine Corps most efficient tank killing machine. Tank development since World War II has focused primarily on increasing the tanks ability to fight another tank and win. However, in the history of Marine armor, only on very rare occasions have Marine tanks ever engaged enemy tank formations. Marine Tanks have primarily been used to enable infantry operations. As the Marine Corps enters an even more complex and disbursed operating environment in the 21st century, a piece of equipment only designed to destroy other tanks will have limited practicality on the battlefield. While remaining relevant as a direct fire weapon, without significant attention to its communication, digital, surveillance, and networking capabilities, the M1A1 will find itself with minimal options for employment. Going forward, the Marine Corps must reevaluate its tank development and bring the focus back to how best to enable the infantry. Nothing in this paper suggests Marine tanks should not maintain their primary role of tank destruction, it merely advocates a more balanced approached to the tanks most dangerous mission of fighting tanks versus its most likely mission of supporting the infantry. The time has come for the Marine Corps to develop capabilities for its tank that will better enable it to perform its role as an infantry support platform.

Conclusion: The M1A1 remains the most lethal tank in the world. Instead of continuing to invest resources to achieve minimal gains in its direct fire capability, the Marine Corps should focus on widening the capabilities of the tank that better contribute to its historical and future role as an infantry enabler.

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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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The M1A1 Abrams main battle tank has evolved into the Marine Corps most efficient tank killing machine. Tank development since World War II has focused primarily on increasing the tanks ability to successfully fight another tank. The United States has produced tanks that are lethal and survivable; as Lieutenant General Herbert Raymond McMaster stated, "if you are commanding tanks, use them to take the brunt of the battle and advance aggressively."[1] *Marine Corp Warfighting Publication (MCWP) 3-12,* Tank Employment, focuses primarily on the tanks offensive capabilities as it provides the Marine Air Ground Task Force (MAGTF) commander the ability to attack, disrupt, and destroy enemy forces through armor protection, shock effect, rapid maneuver, and precise long-range direct fires.[2] With capability development focused on destroying enemy tanks, the M1A1 has found itself with excellent cross-country mobility, enhanced day and night target acquisition, lethal firepower to defeat enemy mechanized platforms, precision lethal effects and highly effective armor protection. The Marine Corps has a premier weapon to destroy other enemy tanks.[3] According to *MCWP 3-12*:

> The Marine commander's ability to employ Marine tanks effectively has provided him with a devastating direct fire capability. Today, Marine M1A1 Abrams tanks are the most lethal direct fire and survivable weapon system within the arsenal of the ground combat element.[4]

The Marine Corps continues to upgrade the M1A1 with a focus heavily on improving the tanks ability to quickly engage targets at even greater distances.[5] Currently, the Marine Corps has no plans to replace the M1A1 in the near future and it will continue to have a role out to 2050 as a direct fire weapon required to defeat any threat tank on the battlefield.[6] Taking a historical look at Marine tank employment as well as its potential use in the future, this paper will discuss how Marine Corps tank development remains primarily focused on improving conventional tank capabilities at the detriment of other infantry enabling options. On only very rare occasions have Marine tanks ever engaged enemy tank formations, yet a majority of tank development remains

focused on this extremely unlikely occurrence. In those rare occurrences of tank on tank combat, Marine tanks have exhibited extreme dominant overmatch, putting into question how much more focus needs to be put into increasing that capability? Throughout its history, and more recently the final ten years in Iraq and the later stages of Afghanistan, the Marine Corps Main Battle tank has enabled infantry operations by not destroying enemy tanks, but by providing armored protected firepower to its supported units.

Recent counterinsurgency operations have shown that the Main Battle Tank can provide an important and responsive direct fire and support role to units on the ground in the current battlefield. However, as the Marine Corps enters an even more complex and disbursed operating environment in the 21st century, a piece of equipment that only shoots and moves will have limited practicality on the battlefield. *MCWP 3-12* even mentions that "Tank units involved in stability operations emphasize their psychological effects more than the offensive capabilities of the tank."[7] If the tank is not shooting, what else could it be doing to enable the infantry's mission? While remaining relevant as a direct fire weapon, without significant attention to its communication, digital, surveillance, and networking capabilities, the M1A1 will find itself with minimal options for employment. Going forward, the Marine Corps must reevaluate its tank development and bring the focus back to how best enable the infantry. The Marine Corps has an opportunity to develop the M1A1 into an armor protected command and control platform that not only retains its lethality overmatch, but uses digital, satellite networking, data capabilities, and Unmanned Aerial Vehicle (UAV) connectivity to further enable the infantry.

This paper will not necessarily address a material solution, instead, it will discuss a concept of employment and modification to development that will increase the Marine Air Ground Tasks Forces ability to operate on the future battlefield through its armored platform

while maintaining a tank that has relevance during any aspect of a future war. Where the ability to communicate and surveil may be more important than direct fire capability, the tank has the potential to provide armored protected communications for units operating in the future complex environments. Marine Corps tank development must broaden its focus to more than just firepower in order to maintain the tanks relevance into the future as an enabler to infantry operations.

Marine Corps tank development has entirely focused on what the armor community perceives as the most dangerous course of action; armored tank formations fighting against enemy armored tank formations. Since the first tanks rolled across no man's land at the Battle of the Somme in World War I, tank design has focused on survivability and lethality. More armor, bigger guns, and increased maneuverability have been at the forefront of tank development. However, the most likely course of action executed by Marine Corps armor has tanks in a direct infantry support role and only very rarely engaging other enemy tanks. The tank must be more than a piece of equipment that can take a hit and deliver precision firepower, providing shock and awe to the supported ground units.

The M1A1 main battle tank faces the possibility of being phased out in the future operating environment if it cannot provide relevance across the range of military operations. The Marine Corps identifies the problem as detailed in the 2016 *Marine Corps Operating Concept (MOC)*:

> The Marine Corps is currently not organized, trained, and equipped to meet the demands of a future operating environment characterized by complex terrain, technology proliferation, information warfare, the need to shield and exploit signatures, and an increasingly non-permissive maritime domain.[8]

The developmental upgrades of the M1A1 mirror this and the problem statement could be rewritten to read; the M1A1 is not equipped to meet the demands of a future operating

environment as an infantry support platform. The authors own experience in Iraq and Afghanistan saw M1A1 tank crews improvising various ways to relay information and communicate when working with distributed infantry in the field. The communications of the M1A1 have been neglected in order to field the most lethal tank on the battlefield. A tank must be lethal and survivable; therefore, this paper does not advocate for a light tank. The Marine Corps attempted a light tank in World War II and discovered it lacked the survivability and lethality necessary to destroy enemy bunkers and enable the infantry.[9] Instead, the tank needs to have enough survivability and lethality to destroy enemy tanks while being able to provide communications, networking, surveillance, and digital connectivity to the infantry it traditionally supports.

A historical analysis shows how the Marine Corps traditionally employs their tanks. Since the first Marine Tank Platoon was established in 1922, Marine tanks have primarily supported the infantry. Marine armor employment typically follows the style of post World War I Britain and France, task organizing tank units to directly support infantry units.[10] In World War II Marine light tanks that came ashore on Guadalcanal and Tarawa functioned primarily to defeat machine gun emplacements and enemy infantry formations.[11] Seldom did Marine tanks engage in tank on tank action.[12] These battles saw the idea of a light tank die as the Marine Corps also discovered in this war that their tanks must be heavy enough to provide ample destructive capability while being survivable enough to support the infantry effectively. This war also marked one of the last times tank development focused on how best to support the infantry with the adoption of flame thrower tanks.

Entering the Cold War, the development of the tank shifted to defeating enemy tanks. With the Army taking the lead and concerned with the Soviet Union and massive tank

formations driving across Europe, the development of US tanks took the approach of how best to counter Soviet tanks. In Korea, Marine tanks outclassed and destroyed several Korean T-34's at the outset of the war, but principally operated in direct infantry support for the majority of the conflict.[13] As Col Walter Moore, a Marine tank company commander stated, his customers were the infantry, yet the current tank design hampered his ability to communicate with Marines on the ground as his tanks were primarily built to destroy Soviet tanks.[14] This singularly focused tank design forced Marine tankers to place individuals on the ground in order to communicate with the infantry. A direct wired line had to be set up and run to the infantry due to the unreliability of tank communications. It took effort, creativity, and improvisation from the tankers in order to support the infantry in their mission because their tanks were not developed for that role.[15]

The US military exhibited reluctance in sending tanks to the Vietnam War because of the pervading mentality that tanks have the singular purpose of fighting other tanks. The Marine Corps; however, introduce the first armored units into the country to support their infantry. The Marine Corps task organized its tank companies to support infantry battalions in a direct support role throughout Vietnam.[16] The firepower of the tanks proved its worth in Operation Starlight when Marine Armor helped the infantry defeat the Vietcong in the Da Nang Area. In Khe Sanh, tanks provided mobile fire support as the infantry cleared the city. During the Battle of Hue City, the tanks destroyed the entrenched enemy and provided cover fire for the infantry.[17] Following the Vietnam War, the idea of the tank primarily as an anti-tank platform continued to permeate throughout the military, even though the Marine Corps never experienced the classic tank versus tank battles from the World War II European theater.[18] Tank development never

built upon the success Marine armor achieved supporting infantry in a counter-insurgency role or addressed the shortcomings tanks had in communicating with the infantry it supported.[19]

Transitioning to a modern battlefield and the Gulf War of the 1990's saw the only time in its armored history where Marine Tank formations actually fought other tank formations in a classical World War II armored mindset. Operation Desert Storm finally verified the overwhelming lethality of a tank developed solely to destroy other tanks and demonstrated the significant impact of armor formations maneuvering across the battlefield in a classical sense.[20]

The Marine Corps entered the Gulf War with only one company operating on the brand new M1A1 and the rest of their battalions operating on the considered obsolete M60. The new M1A1, designed strictly to destroy enemy tanks, had the most modern optics and firing systems of the day because in a tank battle, the tank that usually shoots first, wins.[21] The only Marine unit equipped with M1A1 Abrams tanks, Bravo Company, 4th Tank Battalion, destroyed 35 Iraqi Republican Guard tanks in less than 90 seconds in the biggest and fastest tank battle in United States Marine Corps history. Bravo company, even struggling with an inadequate training package for the new tank, went on to destroy a total of 59 enemy tanks, 32 APCs, 26 non-armored vehicles, and an artillery gun during the war.[22] The M1A1 completely outclassed the Soviet made T-72.[23] M1A1 crews declared that a good crew could not miss using service ammunition. Even in the rare case of a missed shot, the M1A1 could fire at least three rounds to every one of a T-72 due to the latter's slow autoloader.[24] The success of Bravo company and the equal success of Army M1A1's demonstrated that armored development focused heavily on tank versus tank battles had yielded a tank unmatched by any other tank in modern warfare.[25]

The majority of Marine tanks in the Gulf War were the M60 Patton, developed in the 1960's. In the lead up to the Gulf War, M60's had issues establishing a zero for their main gun

and found they usually lacked first round kill capability due to inaccuracy. The Marines would need multiple rounds in order to destroy even stationary targets.[26] Even with these limitations and operating with just minor upgrades on 30-year-old technology, the M60 also completely dominated in tank on tank engagements. Marine M60's destroyed 250 T-55/62s and 70 T-72 tanks during the Gulf War and lost zero tanks to enemy tank fire.[27] So although the technologically superior M1A1 completely dominated the T-72, the obsolete and old M60 also proved capable enough of dominating in a tank on tank battle.

In Operation Iraqi Freedom in 2003, 1st Tank Battalion, operating in a Task Force Tank construct with attached infantry, led 1st Marine Divisions attack north. Most vehicle combat occurred in the push up to Baghdad, but only a small number of tanks were engaged and destroyed at a loss of no M1A1's. The priority of support remained to the infantry. The only real tank versus tank engagement occurred on the US Army side when Army M1A1's destroyed 16 T-72's. Ambushed from a deliberate, prepared, dug-in hull down defense by the best tank crews in the Iraqi Army, the elite Republican guard, the M1A1's destroyed all the T-72's within 10 minutes at ranges less than 1000m with not a single M1A1 hit.[28] This engagement in a modern conflict demonstrated the sheer dominance of the current Abrams tank.

In the Battle of Fallujah, Marine tanks continued to exist solely to provide armor fire support for the infantry's attack through the city as an enabler for their operations.[29] With the exception of a very few tank engagements during the initial push to Baghdad, the last 10 years of tank operations in Iraq have been used for counter-insurgency purposes and supporting infantry operations, with zero tank on tank battles or even opportunities.

Similar to Vietnam, the Marine Corps hesitated to deploy tanks into Afghanistan due to terrain considerations and the lack of enemy tanks to fight. However, General Mills decided his

forces needed the increased firepower offered by the tank and requested a company of M1A1's.[30] Finally deploying a company of tanks into Afghanistan in 2011, the tanks proved decisive in their support of the infantry. Attached to the regimental combat team, the tank company dispersed platoons throughout the area of operations in southern Helmand to support the infantry's counter-insurgency operations.[31] Throughout the history of Marine Corps tank employment, the primary role of tanks has been to enable the infantry through armored firepower. Only a small fraction of that enabling has been against other tank formations. Although history never repeats, it offers good insight on the future employment of Marine Tanks.

The Marine Corps premier tank killing platform, the M1A1 has only been used to kill tanks in extremely rare occurrences. As the Marine Corps looks at its future Marine Air Ground Task Force (MAGTF), the Marine Operating Concept (MOC) details how a 21st century unit will blend maneuver warfare and combined arms to generate combat power for disbursed operations in austere and complex environments.[32] The Marine Operating Concept also lists several ways the Marine Corps will look at executing operations in this future environment:

The Marine Corps Operating Concept

How an Expeditionary Force Operates in the 21st Century

5.1 Executing the Concept

Our ability to successfully execute the concept will depend greatly on the extent to which we have:

- Integrated as a full partner with the Navy, Special Operations Forces (SOF), and the Joint force – *because Marines both contribute and benefit from unique and complementary capabilities across the ROMO and across all five domains*.
- Devised and refined an approach to operate from more diverse platforms and expeditionary advanced bases as part of a Naval campaign – *because fighting at and from the sea was, is, and will remain a core competency that the Nation requires*.
- Exploited the ability of our largest MAGTF, the Marine Expeditionary Force, to serve as a reservoir of capability from which to tailor the force at every level – *because the Marine Corps is unique in its ability to task-organize for any situation.*
- Mastered the implementation of 21st century combined arms as our means to conduct maneuver warfare across all domains – *because we will exploit every opportunity to gain an advantage.*
- Organized, trained, and equipped all echelons to integrate information warfare as a combination of creative thinking and advanced technology – *because conducting information warfare is what we all do, every day.*
- Designed and protected our C2 and ISR networks as a multi-source information sharing architecture that reliably serves disparate MAGTF elements – *because distributing actionable information keeps operations in chaotic environments from becoming chaotic operations.*
- Configured the MAGTF to fight and win when it fluidly distributes and concentrates elements – *because maneuver warfare and combined arms create combat power at any scale.*
- Enabled small units to achieve greater effects – *because they can leverage the full combat power of the MAGTF and Naval/Joint forces*
- Redesigned our logistics to support distributable forces across a dynamic and fully contested battlespace – *because iron mountains of supply and lakes of liquid fuel are liabilities and not supportive of maneuver warfare.*
- Learned how to use unmanned systems and automation at all echelons and in every domain – *because mastering the man-machine interface offers a revolution in military operations.*
- Set the mental and physical standards for Marine infantry through a mission-driven perspective that fully recognizes the demands on foot-mobile forces conducting operations in austere environments – *because superior infantry is a Marine Corps asymmetric advantage.*
- Developed leaders at all echelons who know how to fight in the complex terrain of densely populated urban environments and understand the power of information and information warfare – *because "fighting hard" and "fighting smart" are not mutually exclusive.*
- Designed and implemented manpower systems, policies, and processes to attract, develop, retain, and support highly qualified Marines and civilian employees prepared for the rigors of 21st century expeditionary operations – *because we are in a fight for the best and brightest talent.*
- Overcome the enduring obstacles to leveraging and sustaining "commercial-off-the-shelf systems" – *because affordable "70%" solutions now are better than outdated solutions 10 years from now.*

Figure 1 Marine Operating Concept 2016, pg 9.

The M1A1, with its focus on tank versus tank combat, will currently only be able to fill a niche role in the future operating environment due to its obsolete communications, lack of networking, and lack of UAV integration. According to the MOC, the Marine Corps wants to:

> Evolve our approach to information sharing and information availability to ensure units large and small, operating dispersed or concentrated, have the awareness to employ the full range of combined arms at a tempo enabled by the distribution of timely and actionable information. Drive innovation by combining a mission perspective with commercial developments that allow information providers to collaborate on a situationally dependent architecture that lets information user's opt-in to access or create tailored data streams. Better integrate all forward-deployed and garrison MAGTF elements into the globally netted ISR architecture to increase awareness, preparedness, responsiveness, and effectiveness.[33]

Based on the historical record of tank employment, the M1A1 currently has no ability of achieving this goal other than providing security for someone else. The proliferation of not just weapons, but technology and networking access by non-state actors will cause MAGTFs to come under more electronic warfare and cyber-attacks than ever before as well as an increase in surveillance capabilities through off the shelf drones. Marine command and control will be under attack anywhere in the world, redundant and thorough communications and data networking will be required to operate in these environments. The ability of a unit to control their electronic emissions while maintaining connectivity during distributed maneuver and incorporating all aspects of the joint fight will be necessary for every operation. This environment will require an increase in not only situational awareness, but the use of advance battlefield technology and integration and connectivity to Intelligence, Surveillance and Reconnaissance (ISR) capabilities.[34]

As the MOC describes its key drivers of change for the future operating environment, the M1A1 remains singularly developed to function only in a direct fire role. Where the MOC discusses that "we must also be prepared to simultaneously fight, keep the peace, and provide

humanitarian assistance – the familiar "three-block war" – and on every block conduct information warfare to protect friendly forces and networks, deceive the enemy, and create a cognitive advantage,"[35] the M1A1 will fall into its familiar role of providing security for the infantry. The MOC also discuss the proliferation of technology and that "precision-guided munitions, armed and persistent unmanned aerial systems (UAS), networked ISR and targeting systems, and surface-to-air missiles – all once the province of only the most modern militaries – are becoming commonplace."[36]

The tank faces survivability concerns with increased technology proliferation while not having any type of technology or asset to combat and enable troops to deal with enemy UAS and technology. The tank has no ability to utilize UAV's in the future environment and provide access for units on the ground to utilize all aspects of the joint fight. The MOC also discuss the future battle of signatures, detailing that "tomorrow's fights will involve conditions in which "to be detected is to be targeted is to be killed."[37] Short of completely turning of its radios and going silent on the communication network, the M1A1 has no ability to control its digital signature. The Marine Corps wants its future units to operate networked;

> Units must sense, make sense, and act first to detect and target whether conducting rapid counter-battery and defensive fires or engaging in quick-response offensive fires missions. Shorten the kill chain at the tactical edge by linking distributed forces to sensors and fires with the agility to rapidly provide precision and massed effects. Develop layers of persistent, armed, multi-spectral, and beyond line of sight (BLOS) UAS above our units to produce responsive intelligence and targeting information, extend our C2 across a shifting battlespace, and deliver non-kinetic and kinetic fires in support of MAGTF operations. Develop and employ persistent sensors above, on the flanks, and, at times, below our forces – perhaps even at the individual level – to provide early warning and targeting information.[38]

Shortening the kill chain and increasing capabilities for the infantry do not exist for the M1A1 outside of providing immediate tank gun fire. As an enabler for infantry operations, the tanks role will continue to diminish if it only focuses on direct offensive action and neglects the cyber

and surveillance aspect of supporting infantry operations. If Marine Corps tanks are truly enablers of infantry operations, then they must provide a larger complement of capabilities in the future then armored firepower. In disbursed environments, communication and surveillance will be critical.

Even though the focus of Marine tanks has been in supporting the infantry, the tanks face several shortcomings in performing that role into the future due to their developmental focus on tank pure warfare. After Action Reviews (AAR's), which drive lessons learned and call out problems of the current force in the fight ahead, constantly detail the failings of the tanks ability to coordinate and work with the infantry. The M1A1 faces severe problems with its current communication architecture. As the rest of the MAGTF increases its digital and networking capability to prepare for the future fight, the M1A1's outdated communication suite does not facilitate or coordinate with the MAGTF's network. Infantry and artillery battalions, leaning forward into the future fight, have no issues with these larger communication networks; however, a tank company has no ability with its organic assets to integrate into those networks.[39]

Current Marine tanks also do not possess an organic UAV capability or the ability to interface with UAV's. When tanks have been given a UAV asset during training exercises, they have proven to be an invaluable asset in the conduct of operations. However, those UAV assets required outside support as the tank company does not possess the internal capability to operate a UAV.[40] Numerous AAR's constantly discuss the failure of Very High Frequency (VHF) retransmit sites resulting in severely degraded capabilities. Disbursed units had the inability to reach back and lacked communication with higher commands due to the unreliability of retransmit sites, rendering them ineffective.[41] An AAR from 2nd Battalion 7th Marines

discusses the failure of the communication architecture in enabling forward units to pass on information to combat operation centers in the rear.[42]

Multiple AAR's cover the theme of communication failures and obsolescence of the M1A1 communication suite. These AAR's detail a gap in command and control that could be filled by a platform well suited to be positioned forward where the need for communication remains greatest. Tanks often find themselves as the sole relay of radio traffic due to their power amped radios and high antennas. However, not properly equipped for this function, this role becomes a burden on the tank crew that takes away from other responsibilities. In OIF, tanks would often have to figure out how to manually relay information from supported units to battalion operation centers, supporting aircraft, and gunlines, as the tanks were often the only assets on the ground capable of reaching back. The tank crews would improvise a solution, often to the detriment of time, accuracy and neglect of other mission roles, causing increased friction in a rapidly changing environment.[43] These shortcomings will only continue unless the Marine Corps takes steps to address them.

After looking at the historical employment of Marine tanks and the shortcomings that continue to limit the tank and hamper its usefulness into the future operating environment, this paper will now address how the Marine Corps currently plans to move forward with the development of its tanks. Marine tank development should be driven by the role Marine tanks perform as an infantry support platform. However, the truth remains, the Marine Corps still focuses on improving the tanks ability to destroy another tank. As it stands, the current modification plan for the M1A1 does not address the future operating environment as the Marine Corps pursues expensive performance specifications to improve firepower for only marginal performance returns. With the future threat laid out, and severe issues discussed through after-

action reviews, the current Marine Corps modernization program for the M1A1 focuses primarily on lethality and survivability, leaving the communication gap unfulfilled.

According to Combat Development and Integration Command (CD&I), the mission of the M1A1 modification program states to "manage the overall modification and sustainment for the Marine Corps' M1A1 Main Battle Tank (MBT), to improve mobility, lethality and survivability to provide the MAGTF expeditionary, all-weather, day, night, CBRN capable armor protected firepower and shock effect, able to operate across the full range of military operations."[44] Lethality improvements in the program include an Integrated Display and Targeting System (AIDATS), a slew-to-cue function, a consolidated control handle for the tank commander and an ammunition data link to fire next generation ammunition.[45] For a tank that already boasts arguably the best sights in the world and main gun ammunition that has no rival, the focus continues to remain on making the tank better at shooting instead of communication and coordination.

For survivability, the tank program looks to improve turret armor and add an active protection system. The requirements summary of the program:

> Lethality: Provides long range, precision direct fires on the move with main gun, coaxially mounted machine gun and stabilized commander's weapon station. Near term upgrades will decrease engagement times, increase crew situational awareness and provide ability to fire next generation of main gun ammunition. FO/FAC kit maintains ability to integrate supporting fires.
> Protection: Planned modifications of Improved Turret Armor and Active Protection Systems will provide layered protection against current and emerging anti-armor weapon systems.[46]

These upgrades will shave a few seconds off of engagement time while ensuring the tank remains the most survivable platform in the Marine Corps. That survivability must be leveraged into capabilities that lend itself to wider mission sets then engagement with the tank main gun.

As Military.com summarized, these upgrades to the weapon systems will give the tanks “a trio of upgrades to the tank commander's weapon station that will give tank commanders and gunners a "hunter-killer edge" over the enemy. The millions of dollars spent on these upgrades has resulted in preliminary test results showing engagements times going from six seconds to three seconds. This testing of course relates to the tanks ability to engage other tanks quickly and efficiently, implying that a tank that can shoot and kill targets fast and far can best support the infantry.

This paper does not argue that speed and efficiency are not important to tank operations, merely what would be fast enough to provide infantry support while being able to provide other capabilities. The Marine Corps plans to modernization the tank radios in the 2025 timeframe but only looks to replace the obsolete radios that have been in service since the 1990’s. Currently there are no funds to actually pursue this initiative, with funding priority going to the lethality of the system. This radio upgrade is also being forced onto the tank community due to DoD and NSA compliance standards having to be met by a fiscal year 2024 deadline.[47] The Marine Corps continues to develop the tank with a focus on lethality; however, as demonstrated, the M1A1 already remains the most lethal tank in the world but severely lacks communication and integration capabilities to assist the infantry. For the future operating environment, the M1A1 will continue to out class any threat tank but at the risk to its ability to operate in the digital environment.

The Marine Corps M1A1 must develop capabilities to properly operate in the future operating environment. It has an opportunity to address the shortfalls discussed above and place itself in a position as a real combat multiplier for the infantry that will prove invaluable on the battlefield. Holding firm as the most survivable asset in the inventory, the M1A1, if equipped

with the right communications suite, stands in a key position to act as a mobile command and control HUB for forward disbursed units. Marine tanks, at a minimum, need the capability of voice communications over of VHF, HF, UHF, Satellite Communications (SATCOM) and Advanced Networking Wideband Waveform (ANW2). Since a Regimental Combat Team (RCT) or Regimental MAGTF will typically have a Tank Company in support, digital communication assets must be a part of daily life in a tank. The old radios currently in the tank are on a communication island in regard to the rest of the MAGTF and severely limited for operating in a future environment.[48]

The M1A1 provides the possibility of teaming increased recon and surveillance capabilities with the supported infantry in an integrated fashion. If done correctly, the seamless integration of the M1A1 as a communication HUB will provide the MAGTF and its disbursed units a new competitive advantage.[49] The tank will be leveraged to provide nodes for ground level information operations, collections, and overarching network connectivity while maintaining continuous reach back and pass through capability that can be sustained during combat operations. The obsolete radios must be replaced with the future multi-channel radio family of systems that enables information pass through so the tank can act as a mobile retransmission sight. The middle-man of the tank crew having to relay information can be removed. Retransmission at the point off friction will be a huge combat multiplier for the infantry units. Also, integration of satellite connectivity will allow infantry units to tap into the tanks digital network to expand their reach back into other capabilities. There will be limitations on bandwidth that must be considered as well as the potential for an increased electromagnetic signature that must be managed. Communication pass through utilizing the tanks architecture

needs to be sought after to enable disbursed units and squads on the ground the ability to reach back to higher headquarters and supporting elements.

Drones need to be an integrated part of the M1A1 going forward. Rotary-wing UAVs such as quadcopters, though having limited mobility and payload, are able to move in any direction as well as to stay stationary in the air. A quad-copter UAV can follow a tank, staying hundreds of meters in the air outside of direct fire range, and provide UAV-aided wireless communications. UAV wireless communications can enable the tank and supported infantry to relay their communications directly to operations centers or transmit to persistent UAV's in the area that can relay.[50] This capability will allow the tank to better enable the infantry by giving them the ability to operate in more disbursed environments while maintaining communications.[51] The below diagram demonstrates how UAV's flown by M1A1's can integrate and enable communications.

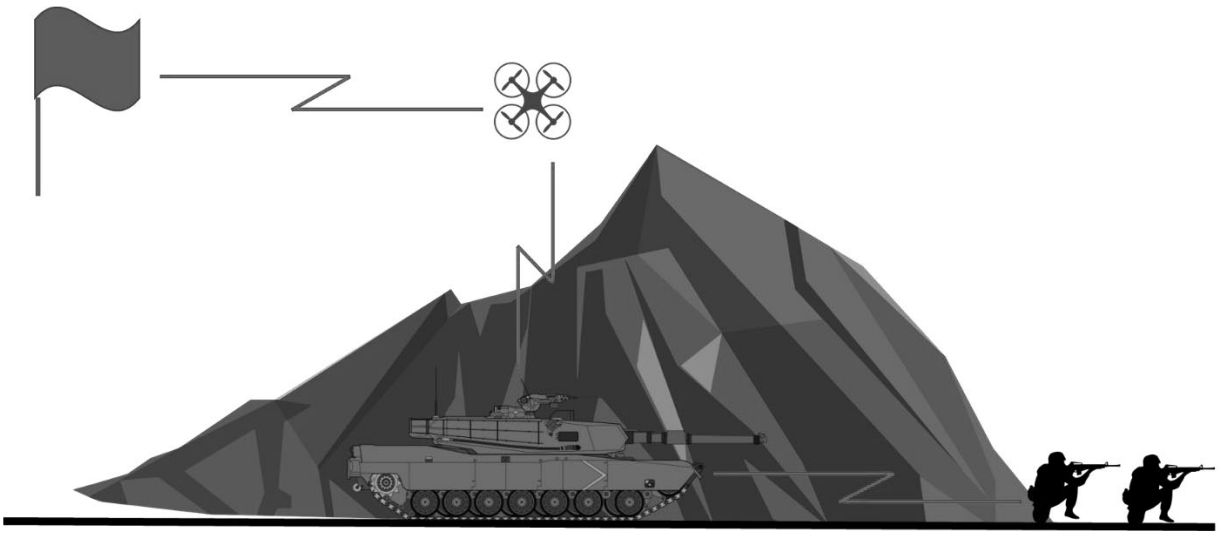

Figure 2, Using Tank and UAV pass through to enable infantry communication

Or:

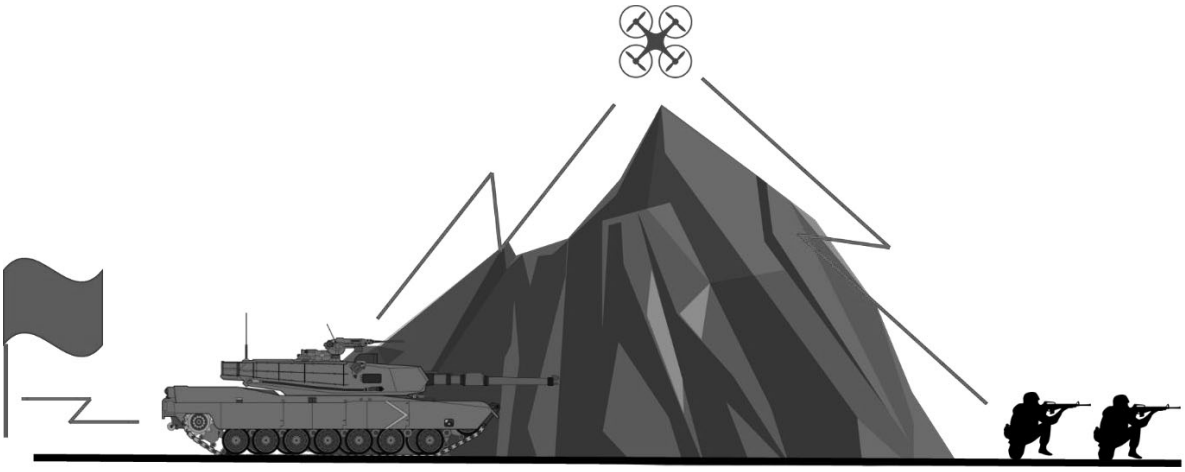

Figure 3 UAV-aided communications relay[52]

Although any vehicle asset can carry a UAV, the Marine tank typically finds itself on the forward edge of battle directly supporting the infantry and offers the most survivable platform to maintain persistent UAV coverage. Putting a UAV in a tank will not be without its challenges. First, besides the normal communication links already in a UAV, the requirement of communications and even digital passthrough will require a robust UAV with a dedicated software package. The tank will also need an appropriate communications suite to enable the communications pass through from the infantry, with increased security requirements and safety functions to ensure the survivability and autonomy of the UAV.[53] Current commercial off the shelf quad copters are too small in size and payload with limited flight endurance. The infantry remains restricted to these types of assets due to the weight and size of carrying these around. These types of UAV's only offer limited ISR capable to ground units. A tank does not face the same size and weight restrictions as the infantry they support. A more robust and larger quad copter with longer endurance and increased payload can deploy from the tank while UAV batteries can be charged directly from the tanks, leading to near persistent overhead coverage.[54] A UAV hovering above the tank can also increase the tanks situational awareness. A tank

operating with its hatches closed has extremely limited awareness on activities directly outside the tank. A UAV can provide an overhead picture for the tank for them to better coordinate movement and security with the infantry on the ground. Bigger UAV's are possible on the M1A1 to enable longer endurance and increase mission success.

Why does the Marine Corps continue to develop their tanks in a cold war mindset when history has shown, and the future environment forecasts that Marine tanks will deploy in direct support of the infantry? In 1990, the M1A1 as fielded took the mantle as the most dominant tank on the battlefield. The M60 that it replaced, held the position as the second most dominant tank on the battlefield. The Marine Corps needs to finally decide how lethal its main battle tank needs to be and actually develop the tank for the role it plays in the MAGTF.

The Marine M1A1 is more than capable of destroying any enemy threat tank. The latest upgrades to improve lethality were not even inspired by any specific threat.[55] Unfortunately the Marine Corps, and specifically the Marine Corps tank community always focuses on the shooting part of shoot, move, and communicate. An AAR of the Gulf War dedicated just a small paragraph about communications when discussing the entirety of armor operations.[56] *MCWP 3-12*, Tank employment, spends more time talking about how to lift an infantry squad on top of a tank then it does to the communication ability of the tank.[57] Marine Tank officers attend the US Army tank school and trained from day one on how the Army employs tanks as maneuver units of tank formations. A Marine Lieutenant Colonel in charge of the Marine detachment at Fort Knox, KY firmly believed that Marine tanks should perform a similar role as Army tanks, strictly as a tank on tank force, ignoring the historical realities of Marine tanks and the expectation of the future operating environment.[58] Even training at Marine Tank battalions focuses heavily on gunnery. Everything a tank crew does remains focused on how fast a tank

crew can acquire and kill a target, often to the neglect of how best to work with infantry. The mindset remains that a tank that can shoot quickly and accurately will best support the infantry.

The tank community must realize that the future operating environment will require a multi capable platform that provides capability across the range of military operations. The service must develop and equip the tank to fulfill that multipurpose role into the 21st century or the tank may lose its relevance going forward. A vehicle that continues to develop itself to execute an operation rarely done in Marine Corps history, tank versus tank, will slowly find itself without a role.

Nothing in this paper suggests Marine tanks should not maintain their primary role of tank destruction, it merely advocates that the M1A1 should remain capable enough of performing its most dangerous mission, while shifting the priority of upgrade and resourcing to focus on capabilities for the tanks most likely mission of supporting the infantry. The Marine Corps should not adopt the Army's Mobile Protected Firepower Vehicle concept as that vehicle will not have the capability to fight enemy tanks. As demonstrated in the Gulf War, even the M60 proved more then up to the task of destroying enemy tanks.[59] In a future environment where the lethality aspect of the tank may not be used, the need for communications, networking, and surveillance will always exist. It is time for the Marine Corps to develop capabilities for its tank that will better enable it to perform its primary role as an infantry support platform. The tank can become that survivable and lethal vehicle that can provide communications and networking for disbursed infantry squads.

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