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The Army's success in future battles on the front lines will be based on the logistical foundation upon which it is supported. The continued improvement in the tactical logistical soldier rather than the sole dependency on emerging technology will be the determination of a successful outcome versus a catastrophic failure in supporting the fight. Innovation has become the driving force in the elimination of tactical logistics. The Army has placed emphasis on technology driven applications that could potentially remove logistical soldiers from the front lines rather than foster an atmosphere for the development of tactical logisticians. The Army's logistical success on any future battlefield cannot solely rest on the shoulders of technological innovations alone. Instead the Army must continue to develop and improve the tactical logistic soldiers themselves. The Army can do this by meshing technology with soldier capability, while incorporating innovation and enhancing tactical training for logistical soldiers while matching the Army's growing modernization priorities.

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Title: The Lost Art of Tactical Logistics

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Thesis: The Army's success in future battles on the front lines will be based on the logistical foundation upon which it is supported. The continued improvement in the tactical logistical soldier rather than the sole dependency on emerging technology will be the determination of a successful outcome versus a catastrophic failure in supporting the fight.

Discussion: Innovation has become the driving force in the elimination of tactical logistics. The Army has placed emphasis on technology driven applications that could potentially remove logistical soldiers from the front lines rather than foster an atmosphere for the development of tactical logisticians. The Army's Logistics Branch has tipped the balance in favor of technology rather than the art of logistical employment. In recent years there has been an increase in technology advancements like autonomous vehicles that could replace logistical soldiers from the battlefield. These innovations have caught the attention of senior leaders because it removes some human risk from the battlefield. The Army has decided that technology driven logistical support is the way of the future. The Army has already reduced the modified table of organization and equipment (MTOE) for logistical personnel and equipment within the Brigade Combat Team (BCT) when the Army introduced BCT 2020. Further modifications potentially create a void in the tactical logistical support structure of the BCT. History supports the need for innovation because it is critical for organizational development, but is it the solution to overall success? The idea of replacing soldiers with technology is a dangerous approach. As the Army trains to fight in a complex world with technology advancements on both sides playing a key role in competitive advantage on the battlefield, we must remain focused that the critical piece of any ground battle is the soldier who is fighting on it. In addition, current lessons will show that the type of ambiguous situations that are encountered by tactical logistical soldiers can't be dealt with through technological applications. This paper will explore the suggestion that implementing certain technology advancements will improve the capabilities of logistical support on the battlefield. What are the advantages and disadvantages that logistical commanders will have on the battlefield with these new types of applications? What are the immediate dangers with substituting logistical soldiers with technology on the front lines? What are the risks versus rewards with switching soldiers out with technology?

Conclusion: The Army's logistical success on any future battlefield cannot solely rest on the shoulders of technological innovations alone. Instead the Army must continue to develop and improve the tactical logistic soldiers themselves. The Army can do this by meshing technology with soldier capability, while incorporating innovation and enhancing tactical training for logistical soldiers while matching the Army's growing modernization priorities. It is the soldier who will flexibly apply such technology advancements in the future in order to maintain the freedom of maneuver for the military force.

Preface

Today, the United States' Army is the most dominant and feared land force this world has ever seen. We have been executing the War on Terror for the past 18 years on a continuous rotation of military force throughout multiple locations. From a the nation's standpoint we must remain committed to the fight on terror but more importantly we must be vigilant of our growing adversaries throughout the world who seek to do us and our allies harm. As the Army continues to deploy soldiers to support our Combatant Commanders requests, our opponents have been taking notes. Our adversaries have watched us closely over the past 18 years and have drawn lessons learned from our fights. They have modernized their force, applied new applications of technology and reorganized their internal tactics and techniques for war fighting. It is imperative we do the same with our force to maintain competitive advantage over our adversaries and preserve our Army's readiness. Let me be very clear, I support and agree with the U.S. Army Modernization Strategy put forth by the Secretary of the Army Dr. Mark T. Esper and Chief of Staff of the Army General Mark A. Milley. The U.S. Army Modernization Strategy is perfectly coincided with the 2018 National Defense Strategy and 2017 National Security Strategy and lays out how the U.S. Army will meet the future security challenges of our nation.

Although I agree with the U.S. Army Modernization Strategy, it doesn't mean that I don't have concerns. When modernizing our force, specifically the logistical aspects on the battlefield there are certain concerns of dependency on new emerging technology that I believe have shifted our focus away from being tactical logisticians. I fear that this type of dependency on technology will limit our commanders on the battlefield with the support they need to maintain the freedom on maneuver. As leaders, we should always be able to give our commanders in the field multiple support structures to help complete the objective. When we start removing

supporting capabilities or capacity from the battlefield and start depending solely on technology driven applications we limit our commanders in the field options on how to conduct their mission sets.

As the conduct of war is changing, we see the realization of near peer threats emerging in the global world. The next fight that the U.S. Army faces will be in multiple domains and the capabilities of our adversaries will be at a level that our Army is not used to confronting. In the Army's direction of modernizing the force, we see the possibility of removing logistical soldiers from the front lines and replacing them with technology driven applications that have the ability for automated decision making. I am skeptical of this technology, such as autonomous vehicles replacing logistical soldiers that conduct tactical convoy operations (TCOs). The next war will be fought in multiple domains and the idea of facing near peer threats whose abilities to degrade our communications or networking system will be a constant concern. Is the idea of relying of technology driven applications for logistical support on the front lines a reasonable possibility on supporting the next war? I have a concern that placing such emphasis on these new applications so close to the front lines while our enemies having the ability to degrade or damage such technology will leave our maneuver elements with a void in logistical support. There is no greater failure in the logistical community, if a maneuver element is in drastic need of supplies in order to maintain the fight and as logisticians we fail to provide such support. Are relying on machines or new innovations to get requested supplies to the front lines the answer while keeping in mind the abilities of our enemies? We must build the capability of our logistical soldiers who will be on the front lines because we can't rely on technology to be the answer when bullets start flying. The next war will be won by the service members who fight in it, not by the technology.

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Introduction

There is no debate that the complexity of warfare is growing at a rapid pace due to the improvements in technology. Countries around the world are pouring large amount of resources into research and development in order to maintain the competitive advantage in warfare. From the turn of the 21st Century, the arms race in warfare technology has risen at a faster rate than anyone expected. There has been a significant push in the technology arms race to find the next modernization creation that will provide battlefield superiority. The United States Army is no different and after almost two decades of continuous combat operations from Afghanistan and Iraq, the need to modernize the force couldn't be greater.

With the creation of the 2018 Army Modernization Strategy by Secretary of the Army, Dr. Mark T. Esper and Army Chief of Staff (CSA) General Mark A. Milley, they established the Army's priorities to remain competitive in the future fight. Within the Army Modernization Strategy, it lays out the six focus areas for modernization consisting of Long Range Precisions Fires (LRPF), Next Generation Combat Vehicles (NGCV), Future Vertical Lift (FVL), Army Network, Air and Missile Defense (AMD) and Soldier Lethality.[1] From the NGCV modernization standpoint there is a desired production outcome of an autonomous system application that would have the ability for automated decision making in the NGVC. This innovation aspiration of autonomous vehicles has linked itself to the U.S. Army Logistics Corps and ignited the idea of the possibility of autonomous resupply or sustainment. According to the Army Chief of Staff G-4, Lieutenant General Aundre Piggee, "autonomous resupply is one of the most promising areas of innovations that will transform Army Logistics for the future fight. In the future, sustainment soldiers will not be required to man vehicles if we can instead deliver materials by autonomous or semi-autonomous ground vehicles, aerial vehicles and watercraft.

These vehicles could take soldiers out of harm's way and provide responsive sustainment to widely dispersed units when conditions pose unsuitable risk.[2]

By removing logistical soldiers from the forward line of troops (FLOT) on the battlefield and replacing them with autonomous vehicles to conduct resupply or sustainment operations, introduces a serious risk to any operation. As we move into the future fight where militaries conduct war across multiple domains including electronic warfare (EW) or cyber, the idea of putting autonomous vehicles on the front lines of the battlefield as part of the main effort for resupply or sustainment may raise some concerns to the units that are requesting logistical support. The adversary's ability in a near peer fight will have significant impacts on the US military network that could result in degraded communications or jammed signals on the front lines. This drives the idea of the last priority of Army Modernization Strategy that Soldier Lethality needs to be considered over the autonomous approach. This debate falls under the main question that during a near peer conflict on the front lines, would a maneuver commander in drastic need for ammunition rather put their trust in an autonomous system that relies on network capability or a logistical soldier who is trained to sustain in a contested environment to deliver immediate resupply?

What is not up for debate is that the U.S. Army needs to be ready to fight and win in ground combat utilizing its full arsenal of options. These vehicle systems that provide autonomy and automated decision making are capabilities for the commanders on the ground, but they should not be the main course of action for executing sustainment operations on the front lines in a near peer fight. As the Chairman of the Joint Chiefs, General Joe Dunford, USMC, stated, the primary difference between success and failure on and off the battlefield has been historically about the humans not about the hardware.[3] The Army's Soldier Lethality modernization priority

and the improvement in the individual soldier is the answer to the future fight. By improving the training of the logistical soldier to operate in a contested environment will be imperative to conducting sustainment operations on FLOT. The sustainment soldier's ability on the front lines to accept risk, prioritize requirements and balance resources to complete the mission is the art of tactical logistics, but relying on the new logistics technology capabilities as the answer puts the dependency on the science approach to logistics.[4] The Army's success in future battles on the front lines will be based on the logistical foundation upon which it is supported. The continued improvement in the tactical logistical soldier rather than the sole dependency on emerging technology will be the determination of a successful outcome versus a catastrophic failure in supporting the fight in a great power conflict.

The Crucible of Ground Combat

General Milley stated in his initial message to the U.S. Army as the CSA that the Army's fundamental task is like no other and it is to win in the unforgiving crucible of ground combat.[5] As logisticians, the U.S. Army logistics branch must sustain the freedom of maneuver on the front lines in order to complete that fundamental task given by General Milley. The logistical soldiers must be agile, adaptable, flexible and overall a master of their craft. With the introduction of automated decision making with artificial intelligence and the NGCV, will these systems have the same attributes as a logistical soldier? The likelihood that systems can be programmed to every scenario that ground combat can produce is highly unlikely. Soldiers can adapt to situations, think outside the box and act when needed. Systems must be programmed and given parameters to execute its mission.

As the Army logistician supports the maneuver force on the front lines in a near peer fight, the conditions on the ground will be unforgiving. According to the U.S. Army Doctrine Publication (ADP) 1, it defines land combat against an armed adversary as an intense, lethal human activity. Its conditions include complexity, chaos, fear, violence, fatigue and uncertainty. The battlefield often teems with noncombatants and is crowded with infrastructure.[6]

The problem with autonomy systems and automated decision making is whether the system can be trusted to act in accordance with rational decision making under extreme conditions. Land battle has always produced ambiguous situations, and this is no different from what logistical soldiers face during ground resupply missions. Ground convoys throughout conflicts have always been contested and challenged by the enemy. The logistical solider who provides sustainment to the maneuver forces must always contemplate and react to the mission, enemy, terrain, troops, time and civilian considerations (METT-TC). Sometimes these considerations happen within a split second based off the soldier's experiences and operating environment. For automated decision making in autonomous resupply vehicles, the decision will be based off programming parameters and scripted scenarios. The complexity of ground combat will require human decision making and not computed decision making. According to ADP 1, due to the land environment being so complex, the potential for unintended consequences remains quite high. In the end, it is not the quality of weapons, but the quality of soldiers employing them that determines mission success.[7]

The opportunity payoff for engaging and destroying logistical convoys are larger than going head to head with a maneuver force. The ability to degrade the supplies of the adversary and fight against a less lethal force makes logistical convoys a priority target. This is why Soldier Lethality modernization priority is significant, not just for every soldier in the U.S.

Army, but also improving the logistical soldiers to fight in a near peer threat environment. When it comes to near peer threats, they know the U.S. Army depends on its logistical supply train to sustain the force. The enemy will seek out the Army's supply chain and logistics entities and engage them to cut off the support to the main effort.

An enemy attacking a logistics convoy is not new to warfare, and examples of historic logistical soldiers engaging the enemy on resupply missions is ample. With the introduction of autonomous vehicles during ground resupply missions, the defensive posture of such convoys will be degraded because it lacks the situational awareness and the understanding of the operational environment that is brought by the individual soldier in the convoy. Logistical soldiers are briefed prior to any resupply operations and are informed of the current situation on the ground before execution. This gives the logistical soldiers the ability to assess the situations on the ground and make calculated decisions if needed. These decisions could be from either breaking contact with the enemy or staying in place and engaging with the enemy due to the circumstances.

According to U.S. Army Transportation Corps Historian Richard Killblane, the U.S. Marine Corps maintained the policy even into Operation Iraqi Freedom that all Marines were riflemen first and therefore drivers would dismount and attack through the enemy in the event of a convoy ambush. This happened to be the same policy for the U.S. Army truck units that arrived in Vietnam.[8] As an Army, one of the most important things to defend is the supply chain. All commanders should put significant effort in protecting and safeguarding their logistical trains. By having logistical soldiers in the resupply trucks, it provides an extra line of defensive measures in case of an attack on the convoy. By removing the logistical soldier from

the resupply convoy and relying on autonomous applications will make the Army's supply chain an even softer target for the enemy to attack.

Tactical Risks of Autonomous Sustainment on the Battlefield

As the Army begins to shift its focus on how the battlefield will shape out in the future fight, they must understand the risks when implementing autonomy and automated decision making in sustainment operations on the front lines. With the progress of modernizing the force, the sustainment vehicle platforms are one of the key areas for autonomy that the U.S. Army is working towards. In June 2018, the U.S. Army awarded Oshkosh Defense $49 million to integrate autonomous technology with the Palletized Load System (PLS) vehicles in order to put robotics in the driver's seat.[9] This is part of the larger overall program for the U.S. Army, the Expedient Leader Follower (ExLF) program. According to Robotic Research, the ExLF program extends the scope of the Autonomous Ground Resupply (AGR) program by developing and installing sophisticated autonomy kits in resupply vehicles, thereby enabling effective autonomous resupply convoy operations. In such convoys, a series of optionally manned vehicles autonomously follow the path of the first (manned) vehicle.[10] These autonomy kits will consist of significant software capability and robotic technology that could be prone to enemy attacks.

In any battlefield, the enemy always gets a vote in what happens. In a near peer fight such as Russia or China, the United States will be evenly matched on multiple domains. For instance, the U.S. Army already anticipates that Russia would target the Army's logistical systems to degrade its sustainment capabilities. Russia's offensive electronic warfare (EW), counter space, and offensive cyber capabilities will jam, spoof, exploit, or destroy friendly

networks and communications systems to prevent friendly mission command.[11] The U.S. Army in Europe recently experienced hacking of their new Infantry Carrier Vehicle-Dragon (ICV-D) that was fielded to the 2nd Cavalry Regiment in 2017. The ICV-D incorporates significant amount of software and according to the Pentagon's Office of the Director of Operational Test and Evaluation, or DOT&E, the ICV-D has shown significant cyber vulnerabilities. The DOT&E report states adversaries demonstrated the ability to degrade select capabilities of the ICV-D when operating in a contested cyber environment.[12] It does not define who "adversaries" are within the report but it can be assumed it was either Russia or executed during a peer on peer exercise. The report continues by stating recommendations to correct or mitigate cyber vulnerabilities for the platform and government furnished equipment.[13] The DOT&E report on the ICV-D only reinforces the proven vulnerabilities of active software systems inside military vehicles. By placing large resupply convoys on the road that are controlled by software rather than the soldiers provides the possibilities for the enemy to make significant impacts on sustainment operations just like what happened to the ICV-D. To think that the Army's software data sets that are implemented into the NGCV or future autonomous resupply platforms couldn't be hacked or manipulated would be naive.

The near peer threats of the U.S. Army could easily target and disrupt large resupply convoys or TCOs that are emitting significant electronic signatures near the front lines. Rather than having resupply vehicles turn at the coordinated intersection or follow scripted computer scenarios, the enemy could alter the automated decision making through offensive cyber-attacks on the network to change the resupply vehicles direction or instructions. The threat of data manipulation by the enemy is only one aspect that represents severe risk when utilizing software sets in vehicle platforms to make decisions on the battlefield. According to Army COL (Ret)

Brian Hall, an Autonomy Program Analyst for the Force Application Division for the Join Staff, states the varying options to vulnerability for autonomous systems is ever present. Autonomy in military applications are vulnerable to spoofing, hacking, intrusive deception measures in ways that humans are not because artificial mechanical systems lack self-awareness, common sense and a general frame of reference against which to measure faulty data. Safeguards and fail-safes are needed to minimize the probability and impact of compromise or failures that could lead to unintended consequences resulting in damage to persons or things that were not deliberately targeted.[14] The U.S. Army must think worst case scenario when fighting a near peer threat and the measures that the adversaries will use to gain the competitive advantage on the battlefield.

A military planner must look at this type of measure from an operational cost for the enemy and think of the most likely course of action. What is the easiest option for the enemy to execute with having the greatest effects? Conducting precision strikes through air or artillery and risking those assets from counter measures of the US military while depleting the on hand quantity of munitions or sitting behind a computer on the front lines targeting large TCOs or resupply convoys through offensive cyber or EW options. The second option provides the enemy the greatest effects for the littlest cost. By replacing the logistical solider on the front lines with autonomous vehicles for resupply operations will result in giving the enemy the ability to mass effects on the U.S. Army sustainment capabilities. If they degrade the ability for the U.S. Army to sustain itself on the front lines, then the enemy will achieve the competitive advantage. This is no different from what the U.S. Army saw during World War II and the ability for the German forces to sustain themselves in a near peer fight. The U.S. Army must take a careful look at the risk it will endure towards their sustainment capabilities and ensure they don't make the same mistakes as previous adversaries. It is noted in MCDP-4, the remarks

of General Dwight D. Eisenhower from the British Army Doctrine Publication on the importance of uninterrupted logistics stating:

> Throughout the struggles, it was in his logistic inability to maintain his armies in the field that the enemy's fatal weakness lay. Courage his force had in full measure, but courage was not enough. Reinforcements failed to arrive, weapons, ammunition and food alike ran short and the dearth of fuel caused power for tactical mobility to dwindle to the vanishing point. In the last stages of the campaign they could do little more than wait for the Allied advance to sweep over them."[15]

As the U.S. Army plans to implement these autonomous vehicles into the sustainment formations, the capability and capacity of the US's adversaries continues to grow. For example, Russia's modernization of their EW capabilities and capacity has significantly grown since 2008. The ability for the US military to operate autonomous vehicles with integrated software sets will be extremely challenging. In 2017, the Estonia Ministry of Defense established a report stating some of Russia's major developmental areas include the introduction of means that will imitate false electronic situations while misinforming their enemy's command and control systems along with the creation of powerful electromagnetic radiation on mobile systems to disrupt communications.[16]

Furthermore, Russia has created specific task organizations within their maneuver formations to enable the EW capabilities and capacity to become deeply integrated within their front line units. The Estonia Ministry of Defense finalized their report noting that Russia's EW development will pose a serious challenge to the proper planning and execution of North Atlantic Treaty Organization's (NATO) defense of the Baltic States and NATO's entire Eastern Flank, in event of a Russian assault. Russia's EW advances will allow its forces to jam, disrupt and interfere with NATO communication, radar and sensor systems, thus negating advantages conferred on the Alliance by its technological edge.[17] Therefore, the idea of autonomous

vehicles with integrated software sets being a key advantage in a near peer threat environment could be debated. Russia could easily exploit this new technology and turn it into a critical vulnerability for the U.S. Army if there was a direct conflict. The most recent example of exploitation of technology on a active battlefield came from Russia's land warfare and their movement into Ukraine in 2014. According to former Commander of Combined Arms Support Command (CASCOM), MG (Ret) Paul C. Hurley, Russia devastated Ukrainian's dependence on digital systems and technology to create significant vulnerabilities as Russia moved into Ukraine's territory by utilizing their electronic and cyber abilities to create the advantage. The Russians attacked military forces, crippled infrastructure, disabled communication networks and even hacked Ukrainian unmanned aerial systems using the feeds to target Ukrainian command and control nodes with artillery and rocket fires."[18] The U.S. Army's sustainment leaders must expect the same type of warfare if confronted by a Russia threat. By putting autonomous vehicles on the front lines with large digital signatures will only produce additional targets for the enemy and leave the maneuver units without amply resupply options.

This urgency to replace soldiers from the front lines and trusting that autonomy is the answer might be what the opponents of the US are counting on. The dependency on technology and autonomous applications could end up hindering the U.S. Army as it conducts maneuvers in a contested environment. This concern won't be annotated through the companies that are promoting autonomy as the next answer to land warfare. John Beck, senior chief engineer for unmanned systems at Oshkosh stated that the fully automated PLS vehicle that Oshkosh is producing drives just like a human."[19] Yet, the conditions and environment on how Oshkosh performed the trial runs is not clear. There was no mention of a third party entity that could

replicate our adversary's capabilities trying to hack or exploit the autonomous system. Therefore, leaving the question could it really withstand the crucible of ground combat?

Additionally, Mr. Beck stated that this autonomous system is based on a local communication network using a 256-bit encryption that produces one layer of cyber security that can be managed.[20] If there is only one layer of security on a local system to protect the autonomous resupply vehicles which have not undergone a significant EW threat in a degraded environment during testing, the doubt on its ability to operate in ground combat against a peer threat is put in to question. Furthermore, COL (Ret) Brian Hall notes that there are multiple ways issues can arise while utilizing autonomous systems, such as preplanned program malfunctions and adversary jamming of sub systems intelligence, surveillance and reconnaissance sensors and associated command, control and communication links. The issues becomes whether there will be enough sensor precision and assured data exchange in contested and unstructured environments to allow autonomous systems to sense what they need to either take action on their own or report the information to their human operators.[21] The unresolved question of survivability of these new systems, whether or not they can withstand hostile attacks or the environmental conditions puts too high of a risk to suggest switching out logistical soldiers with autonomy. The way to mitigate the risk of survivability and protection is to have a logistical soldier driving the resupply vehicles to the maneuver force on the front lines to ensure mission completion.

Software Risk for Autonomous Vehicles

In this technology environment that is moving at a rapid pace, the ability to remain abreast of improvements or upgrades to software will extremely difficult. All software systems must be maintained and updated in order to continue to be relevant and secure. This is no different than Microsoft's "Patch Tuesdays", the scheduled release of security fixes and software applications for its Windows operating system on the second Tuesday of each month to ensure their customers can maintain the latest version with the most current security updates.[22] As these autonomous resupply vehicles come on line, the same type of routine updates will be required to ensure software integrity of the Army's NGCV. This type of routine maintenance maybe feasible during garrison environment, but during ground combat operations against a peer threat seems unsustainable. Units will be moving constantly while subjected to EW and cyber threats regularly. The ability to stop operations and receive software updates through the U.S. Army's network system will only identify their location through electromagnetic signature and will put the units at risks for targeting by precision fires or air attack.

From a complexity issue for maintaining software updates and routine maintenance, the large portion of Combat Service Support units are within the Army Reserve and Army National Guard. Their equipment does not get the same type of routine maintenance that regular Army units do unless they are mobilized. As Chief of Staff for Army Material Command (AMC), Major General Allan Elliot stated seventy-eight percent of the Army's sustainment formation is in the Reserve Component adding that Reserve readiness is challenged by out-of-date hardware and software, and equipment that has been kept in storage. Just like the active duty soldier, Reservists need to be operationalized so they are ready to go when called on.[23] With implementing autonomous applications and maintaining such software throughout the Army

Reserve and National Guard would be an additional challenge to maintain and repetitive cost for the Army. The ability to ensure that both the Army National Guard and Army Reserve maintain their software systems in autonomous applications at the speed of the Regular Army could be questionable because it is a significant challenge now.

Manufactures of the NGCV will easily declare that the software systems they provide will need little maintenance update or additionally security. This may be true in a small sample size of products that are operating on a closed in network. Yet, when the Army is applying this technology to autonomous resupply vehicles that are widely dispersed in all three components of the Army inventory then the complexity of maintaining security and maintenance requirements becomes unrealistic. The problem comes down to the complexity of maintaining such a large dispersed software system while conducing combat operations against a near peer threat in a environment which has not been seen since World War II. The likelihood of failure of autonomous resupply vehicles in combat is severe.

This only provides more justification why logistical soldiers should be the one delivering the supplies to the front lines rather than depending on autonomy as the answer. The risk of failure is too great when maneuver forces are relying on resupply operations on the front lines to maintain the fight against a near peer threat. According to COL (Ret) Brian Hall, autonomous systems are vulnerable to an array of potential failures, including situations common to any software dependent system, as well as additional failures due to their scalable complexity. As the complexity of a system increases, so does the inherent operational risk. Currently, it is increasingly difficult to predict with a high degree of probability how a system might actually perform against an adaptive adversary, potentially eroding trust in the system while asserting operational risk.[24] The Army's sustainment community can't work off the idea of "probability"

when delivering necessary supplies to the warfighter. No maneuver commander should be willing to accept that a resupply convoy may or may not arrive when needed due to software system failures. Understanding that nothing is certain in combat, but by having a logistical soldier in the driver seat of a resupply convoy provides that commitment to the maneuver force. A logistical soldier understands the commitment and necessity of completing a resupply mission and knows the ramifications if those supplies don't get to the front lines when needed. That type of drive within a solider can't be replicated by autonomy.

Back in 2007, the Department of Defense (DoD) established the Unmanned System Roadmap for 2007-2032 with the vision of pursing greater autonomy in order improve the ability of unmanned systems to operate independently, either individually or collaborative, to execute complex missions in a dynamic environment by developing and employing increasingly sophisticated unmanned systems over the next 25 years (2007 to 2032).[25] Within that Roadmap, the Army was specifically tasked by Congress through the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001, by 2015, that one third of the Army's Future Combat Systems (FCS) operational ground combat vehicles should be unmanned.[26]As of 2018, the goal to establish one third of ground combat vehicles to be unmanned has not been achieved. This is due to the complexity of the system themselves and ensuring security across the entire vehicle fleet. The DoD is working through the challenges to achieve one of the main goals of the Roadmap when it comes to security of the vehicle software. The DoD, along with the Army are trying to establish a common control within the system network that would establish a common data link amongst the vehicles and improve the capability to prevent interception, interference, jamming and hijacking from an equal adversary.[27] As the DoD and Army continue to work through the challenges of establishing unmanned resupply vehicles as a viable option to

supporting the front lines. They need to ensure they are not rushing to failure. As the complexity grows with this technology, the difficulty to ensuring security and simplicity of the software systems within the autonomous resupply vehicles will increase. As General Omar Bradley stated in his Armistice Day Speech on November 11, 1948, if we continue to develop our technology without wisdom or prudence, our servant may prove to be our executioner.[28] If the Army rushes into battle against a great power competitor without fully understanding and mitigating the risk to their autonomous systems, they will end up providing the enemy a US military vulnerability for exploitation.

The Combination of Soldier Lethality and Autonomy

The need to think outside the box and the ability to give commanders on the ground multiple options on how to logistically support the next fight will be imperative to mission success in this new era of great power competition. As Commander of Army Material Command (AMC), General Gustave Perna stated, Army logisticians must embrace new thinking and methods and be active participants in the process of modernization and innovation.[29] Yet embracing new thinking and methods does not mean forgetting old ways that have worked. There should be a combination of old and new methods that provide the best outcome for the soldiers on the ground. Just because something is new, doesn't always mean it's the best and just because something has always worked doesn't mean it's the best solution.

When looking at the application of autonomous resupply vehicles and the call for the reduction of logistical soldiers on the front lines. There needs to be a discussion and consideration of what both entities bring to the fight before that decision is made. There should

be a goal to provide the ground commanders options and never making them rely on one course of action. By providing autonomous resupply vehicles that have the capability of automated decision making, it gives the commander on the ground an additional option on how to conduct resupply. The autonomous resupply vehicles or NGCVs should offer the option of fully autonomous where the software is working and the ability to be driven by a logistical solider with no software interaction. In a near peer fight the commander may want to have the logistical soldier drive the resupply vehicles up to the front line because of the EW or Cyber threat in the area. By having the logistical soldier in control of each vehicle in the convoy reassures the commander on the ground that EW or cyber is one less threat to the resupply operation. For instance, if the convoy is attacked during the resupply operation and the logistical soldiers are either wounded or killed, it would be the commander's call to activate the autonomous application for the vehicles. This additional option provides the commander the ability to continue the mission if their unit falls below the minimum force to execute the resupply operation. Yet, the risk for being identified through electromagnetic signature from EW or cyber threat becomes significant. By combining autonomy and the logistical soldier capabilities, it provides the commander on the ground with options. According to Field Manual 4-95, Logistic Operations, a successful logistics commander provides freedom of action to the operational commander by increasing the number and quality of available support options in order to complete the mission.[30] If the Army removes the logistical soldier from the front lines then the commander will only be left with one option.

The Improvement of Tactical Logistics

As GEN Perna stated, in order to innovate, Army logisticians must first do the basics well. That foundation is built through training, experiences and continued self-assessment with an honest picture of the current competencies and capabilities.[31] Currently, the logistical community is stuck in the mind set of fighting a war in a Forward Operating Base (FOB) mentality. The foundation of tactical training is based off moving supplies from FOB to FOB on large line hauls and establishing large supply hubs to conduct sustainment. From this mindset, the thought process of utilizing autonomous resupply convoys as a way of sustainment has some validity to it. Utilizing autonomous vehicles on large main supply routes (MSRs) from FOB to FOB with only the threat of improvised explosive devices (IEDs) being the most likely course of action for the enemy, makes sense.

There is no disagreement on that thought process from the Secretary of the Army, Dr. Mark T. Esper when he visited Tank-Automotive Research, Development, & Engineering Command (TARDEC) and stated if you look back at the Iraq war, one of the most dangerous duties was driving, riding in a convoy between Kuwait City and Baghdad. The Army lost many, many soldiers, too many soldiers, to IED attacks, other attacks on convoys. The Army could've reduced that vulnerability, the sacrifice, with unmanned convoys or convoys that were manned by only a couple of soldiers.[32] This argument is based off the Afghanistan and Iraq war where the US military was fighting against an insurgency with little to no technological capability. This type of thinking can't be applied to the idea of fighting in a near peer conflict.

For instance, if Russia invaded the Baltic States (Latvia, Estonia and Lithuania) the conflict in Europe would begin based off Article V of NATO. The threat of IEDs would not be a

significant one. Going up against a near peer advisory, the likely hood of encountering long range precision fires, tank and mechanized formations, air to ground attacks, EW and cyber-attacks would be of significance. If the United States came to the aid of Baltic States it would be warfare of maneuver, not counter insurgency operations. The Baltic States would want American presence and would not be trying to derail that support by planting IEDs along supply routes. This type of maneuver warfare wouldn't be anything like the experiences of Iraq and Afghanistan. If the Army tailors their sustainment capabilities based off the counter insurgency experiences from the past 18 years, then they will be setting themselves up for failure. The idea of replacing logistical soldiers because of a threat that was encountered in a previous war might have lasting consequences. Again, the ability to have autonomous applications in a resupply convoy is a capability that a commander should have at their discretion to use or not. By providing the commander with multiple capabilities to use while conducting their mission only provides the increased chance for mission success.

Rather than depending on autonomy in the sustainment community as the only answer, the increased tactical proficiency of the logistical soldier needs to be the priority. This is extremely imperative for the logistical soldiers who are assigned to tactical logistic units such as Forward Support Companies (FSC) and Brigade Support Battalions (BSB). These are the logistic elements that will be the closest to the FLOT while supporting the maneuver forces as they engage in the crucible of ground combat against a near peer threat. The ability of the sustainment forces near the front lines to remain agile and flexible will be crucial in a great power conflict. Tactical logistics will encompass the ability to avoid detection, the unit's capability to disperse and move fast, establishing short term logistical rally points, and the lowering of the unit's electromagnetic signature while conducting resupply operations. By

having a well-trained logistic soldier on the front lines will make it easier in completing the task of tactical logistics. The most crucial part of the logistical supply chain is the last leg of transport on the battlefield from the field trains command post (FTCP) or combat trains command post (CTCP) to the FLOT. In the logistics community, everything can go well from the strategic and operational level for sustainment, but if logistical soldiers can't perform tactically in a near peer fight and get the supplies to the warfighters on the front lines, then nothing else matters.

With Soldier Lethality being one of the key modernization priorities for the U.S. Army, Soldier Lethality will be essential for the sustainment community to improve the logistical soldier's tactical proficiency. The Soldier Lethality initiative will span the fundamentals of combat with the improvement of shooting, moving, communicating, protecting and sustaining the force.[33] Regardless of military occupation of specialty (MOS), if they are operating on or near the front lines during a near peer conflict the probability of encountering the enemy's capabilities will be extremely high. Logistical soldiers will need to be ready to defend themselves against an experienced enemy with matched abilities. By incorporating new technology in the sustainment community as a capability rather than a dependency, it will give the logistical soldier the competitive advantage in that near peer fight.

This is not a requirement for logistical soldiers to train as Infantry or Armor units, but to have the competence and capability to engage with the enemy when attacked. The ability to defend themselves and counter the enemy offensive actions will be imperative in the future fight. In the future fight with an equal adversary, the front lines will be fluctuating constantly and the likelihood of encountering the enemy's force will be probable. The maneuver force will not always be present during resupply operations so the sustainment community must have the

tactical knowledge to fight and win. Logistical soldiers during TCOs or resupply missions must be able to react to contact, defend against a near or far ambush, establish a hasty defense, coordinate fires and be prepared to execute casualty evacuation operations along with performing their tactical sustainment tasks.

If the logistical solider fails to grasp the basic tactical knowledge to be on the front lines, then the logistical soldier will become a burden for the maneuver force. This will provide the justification for removing the logistical soldiers from the battlefield and replacing them with autonomous applications. According to CASCOM, the challenge is how to develop agile, adaptive, and innovative sustainment leaders with the requisite attributes, skills and knowledge.[34] By having the Soldier Lethality moderation priority for the entire force and incorporating realistic tactical logistics training, the end result will be a developed sustainment soldier or leader who will be benefit the maneuver force rather than hinder them.

Conclusion

In the future fight the ability to provide seamless logistics will be imperative to success of the entire war. The effect of not providing sufficient logistical support could cause forces to slow down or culminate operations causing a loss of momentum and possible defeat of Army forces.[35] The ability to combine autonomous applications and logistical soldier lethality will increase the overall support for the maneuver forces on the front lines. As General Alfred M. Gray Jr, stated, commanders must base all their concepts of operations on what they know they can do logistically.[36] If logistical soldiers are tactically proficient and have an array of capability

options to execute sustainment operations on the front lines then the maneuver commanders will have the flexibility to execute their mission objectives without the worry of lack of support.

As the U.S. Army continues to build upon its sustainment capability for the future fight, it requires honest and critical feedback to ensure there are no logistics gaps where the enemy could use it to their advantage. The enemy if able will seek the Army's sustainment capabilities and utilize every option in order to degrade or disrupt the Army's ability to provide logistical support to their maneuver forces on the front lines. The U.S. Army sustainment leaders must anticipate that this type of action will take place on the front lines and do everything in their power to ensure the enemy does not alter the supply chains. No maneuver commander should ever be halted or impeded by logistical support. If that is the case then the sustainment community is not doing their jobs. This research papers just identifies an area where the enemy could potentially impact the U.S. Army's capability to sustain the maneuver force. The U.S. Army planners must truly dissect the capabilities of the great power competitors and understand what those capabilities will have on the sustainment force. As GEN Mark Milley stated, the soldiers themselves are a part of the Army's evolution and construction of the future force and the Army needs critical feedback.[37] Hopefully, this paper will identify the risks associated with the idea of substituting logistical soldiers on the front lines with autonomous vehicles that utilizes automated decision making software.

The U.S. Army's logistical success on any future battlefield cannot solely rest on the shoulders of technology innovations alone. Instead the Army must to continue develop and improve the tactical logistic soldiers themselves. The Army can do this by meshing technology with soldier capability, while incorporating innovation and enhancing tactical training for logistical soldiers while matching the Army's growing modernization priorities. It is the soldier

who will flexibly apply such technology advancements in the future in order to maintain the freedom of maneuver for the military force.

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