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14. ABSTRACT

On 3 October 1993, the US military conducted what was supposed to be a quick raid in downtown Mogadishu, Somalia, which came to be known as the Battle of Mogadishu. While the raid was a tactical and operational success for US forces, the asymmetric advantage that the Somalis had in the urban environment of Mogadishu ultimately led to a strategic failure for the United States. To further explore the asymmetric advantage and potential technological offset strategies, the author developed an Operational Decision Game (ODG) exploring similar threats that US forces witnessed in 1993, but set the ODG in the future imagining new technology available to US forces. Based on the analysis of the historical case study and ODG responses, the author and three colleagues developed a future technological concept called Technology for Urban Terrain. Technology for Urban Terrain comprises four individual systems that US forces can employ separately or together for synergistic effects. Together, these systems close current gaps across five warfighting functions.

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LOOKING BACK TO UNDERSTAND THE FUTURE: HUMAN MACHINE COLLABORATION IN THE NEXT BATTLE OF MOGADISHU

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
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Executive Summary

Title: Looking Back to Understand the Future: Human Machine Collaboration in the Next Battle of Mogadishu

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Thesis: To offset the danger and complexity of urban warfare, US forces can leverage human machine collaboration across multiple warfighting functions to gain and maintain the advantage in urban terrain.

Discussion: As the world's population continues to migrate into urban areas, particularly in the developing world, the probability that US forces will fight in these areas in the future increases. While the US military strategizes how to approach the future urban environment, it is instructive to look to historical cases of urban warfare to understand the successes and failures that determined the outcomes of conflict in the urban environment. The 1993 Battle of Mogadishu provides a case that is rich in the ways that the enemy exploited an asymmetric advantage over US forces leading to failures in the joint warfighting functions of protection, maneuver, fires, and intelligence. More than two decades later, advances in technology allow US forces to interact with machines in new ways to gain and maintain the advantage. The author proposes a future technology concept for the urban environment called Technology for the Urban Terrain.

Conclusion: Technology for Urban Terrain is a four-system solution taking advantage of advances in human machine collaboration to close gaps across five warfighting functions. The four systems that comprise the Technology for Urban Terrain will contribute to the successes of US forces by allowing them to rely on machines to reduce cognitive load, protect friendly forces, prevent civilian casualties, and minimize collateral damage. Each system can be utilized individually or these systems can work together to achieve synergistic effects. The Needle Finder uses big data analytics to combine open source and classified data to provide better situational awareness from all available methods in an area of operations. The Drone Squad contributes to the WFF of maneuver, fires, force protection, logistics, and intelligence, and is a scalable and modular solution that adapts to the unique needs of a squad-level unit. The OMALV is a manned, autonomous, and tele-operated tactical-level motor transport system enhancing logistics, protection, fires, and maneuver in both urban and open terrain. Finally, the ADS is a non-lethal fires solution that provides protection to friendly forces by creating a standoff range between threats and the ADS system. Together, these four systems seek to reduce the asymmetric advantage the enemy has operating in the dangerous and complex urban environment.

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Introduction

As the world's population continues to migrate into urban areas, particularly in the developing world, the probability that US forces will fight in these areas in the future increases. Joint Operating Environment 2035 predicts that security challenges in these environments will be numerous; "Alienation, poverty, and disorientation of formerly rural residents interacting with more cosmopolitan urban citizens may increase the potential for criminal and gang-related activities as well as the development of urban insurgent groups."[1] While the US military strategizes how to approach the future urban environment, it is instructive to look to historical cases of urban warfare to understand the successes and failures that determined the outcomes of conflict in the urban environment. The 1993 Battle of Mogadishu provides a case that is rich in the ways that the enemy exploited an asymmetric advantage over US forces leading to failures in the joint warfighting functions of protection, movement and maneuver, fires, and intelligence. More than two decades later, advances in technology allow US forces to interact with machines in new ways. Historical case studies allow US forces to imagine how human machine collaboration could have allowed them to succeed in the same warfighting functions where they previously failed. Therefore, looking back helps US forces understand the future by reimagining the battle with new technology that could rebalance the outcome in more favorable terms for the United States and its allies.

This paper will develop a future technological concept for the urban environment. It will do this by first explaining what human machine collaboration is and how it might work on an urban battlefield. Then, this paper will analyze the 1993 Battle of Mogadishu to understand the major shortcomings that US forces experienced. Next, this paper will imagine a notional situation in 2030 that has similar characteristics to the Battle of Mogadishu by providing a

description of an Operation Decision Game (ODG) that takes place in the urban environment of Warri, Nigeria and makes new technology available to the player. Fifteen participants played this ODG providing patterns and creative responses about how to apply future technology to achieve each player's theory of victory. Finally, based on feedback from the ODG and collaboration with other students who created urban-centric ODGs, this paper will present a four-system future concept that provides US forces an advantage across multiple warfighting functions in the urban environment.

Human Machine Collaboration

Human machine collaboration uses machines to enhance the ability of the human to be more efficient, make faster decisions, stay better protected, or achieve another type of advantage. In his book review of *Chess Metaphors: Artificial Intelligence and the Human Mind*, Garry Kasparov, chess grandmaster, discusses the ultimate strategy to win chess matches consistently. To prove his hunch, he developed an experiment to enhance his chess game after he lost to IBM's supercomputer, Deep Blue, in 1997. Instead of playing chess against a computer, his new philosophy was to play with the computer; "The idea was to create the highest level of chess ever played, a synthesis of the best of man and machine."[2] Kasparov discovered that with a computer as his partner, he could focus on "strategic planning instead of spending so much time on calculations."[3] The experiment was so revolutionary it continued and many competitions later he found that teams comprised of humans and machines consistently outperformed even the best supercomputers.[4] Kasparov concluded that pairing a human with one or more computers provided the "best of both worlds;"[5] it allowed the human to employ creativity while the computer helped the player make the best decisions and reduce his cognitive load.

Nearly 20 years after Kasparov's experiment, former Deputy Secretary of Defense began leading the Department of Defense in a similar experimentation campaign to discover the potential of human machine collaboration in warfare. In a speech to the Atlantic Council in May 2016, Secretary Work said that human machine collaboration could produce a United States military advantage compared to our competitors because of how machines have the potential to enhance human performance and decisions.[6] Work stated that "Advances in artificial intelligence and autonomy – autonomous systems – is going to lead to a new era of human-machine collaboration […] Collaboration is using the tactical acuity of a computer to help a human make better decisions […] using manned and unmanned platforms."[7] While humans and machines have worked together in warfare throughout history, the machines of future will be different because of the degree of artificial intelligence (AI) and autonomy that they will employ. This will enhance the ability of both the human and the machine to be more efficient and more accurate. Specifically, the Department of Defense is investigating five different approaches to incorporating AI and autonomy into future systems. These five approaches are:

> Learning systems for handling big data and determining patterns, human-machine collaboration for more timely relevant decision making, assisted human operations through technology assistance like exoskeletons or wearable electronics, […] advanced human-machine combat teaming such as with manned and unmanned systems working together, and network-enabled autonomous weapons and high-speed weapons like directed energy.[8]

As the volume and types of technology, information, and data increases, it is imperative that the US military investigate ways to use these to its advantage to outmaneuver its adversaries. Exploiting promising technological possibilities will allow US forces to incorporate AI and autonomy to transform the way forces fight in the joint environment. Imagine, for example, US forces using human machine collaboration in urban combat in the future. In this scenario, US

forces exploit all available networks and sensors organic to the urban environment to fuse with traditional intelligence sources to provide enhanced battlespace awareness. US forces could add unmanned ground vehicles (UGV) into convoys for logistics resupply to protect US lives. While the UGV transits the city for resupply, it is equipped with sensors, sending information back to a robust mesh communication network incorporating more information into the US battlespace picture. Overhead, US forces operate small drones with modular pods to perform whatever task they require for that mission, from multispectral imaging, to full motion video, to cueing other weapons. One of those weapons could be a non-lethal directed energy system providing counter-personnel, changing the paradigm of using lethal weapons that can be difficult to employ in an urban environment. These are just a few examples of how human machine collaboration could enhance warfighter performance in the future by making them faster, protecting them, helping them make better decisions, and allowing them to employ non-lethal and lethal weapons at the correct times. Secretary Work describes it best: "I think more in terms of Ironman; the ability of a machine to assist a human where the human is still in control of all matters…but the machine makes the human much more powerful and much more capable."[9]

Historical Review of the Battle of Mogadishu

On 3 October 1993, the US military conducted what was supposed to be a quick raid in downtown Mogadishu, Somalia, which came to be known as the Battle of Mogadishu. The raid was a tactical success, capturing two of clan leader Mohammed Farrah Hassan Aideed's top lieutenants and other important leaders, but turned into a costly rescue operation resulting in eighteen Americans killed, seventy five wounded, and two downed helicopters.[10] The battle challenged President George H.W. Bush's concept of the United States as the "New World Order;" the United States entered Somalia to help prevent further humanitarian devastation in

Somalia, but ended up facing a humiliating tragedy of its own.[11] From a national security perspective, the Battle of Mogadishu left a profound aversion on policy makers to intervene in other humanitarian and peacekeeping missions around the globe, particularly throughout the 1990s. The coordinated violence brought about by Aideed's clan and the dynamics of operations in Mogadishu exceeded what US forces had anticipated as they began their raid on 3 October 1993. Among many of the complexities US forces met on 3 October 1993, they were caught off guard by the Somali's fighting ability and the challenges of battle in Mogadishu's urban environment. These complexities contributed to US military challenges in accomplishing the joint warfighting functions of protection, movement and maneuver, fires, and intelligence during the Battle of Mogadishu.

This historical case study will examine how the human dimension of the Somali enemy and the physical terrain of Mogadishu challenged the US forces' ability to accomplish four joint warfighting functions during the US raid on 3 October 1993. First, for context, this historical case study will provide a general overview of some of the factors that shaped the environment going into the Battle of Mogadishu and provide a brief summary of the major elements of the battle itself. Next, this case study will discuss the unique aspects of the human dimension. Specifically, it will describe a complex enemy who its culture and environment to achieve an asymmetric advantage over US forces. The asymmetric advantages allowed a technologically inferior force to rally support from the local population to collect intelligence, inhibit friendly movement, and hide in plain sight. Additionally, this case study will discuss the demands that US forces faced in the battlespace of Mogadishu's urban environment. Finally, this case study will analyze four of the joint warfighting functions, including protection, movement and maneuver, fires, and intelligence to explain how challenges present in the human and physical

terrain caused problems in accomplishing these functions and how those challenges impacted the outcome of the battle.

Background

The background leading to the Battle of Mogadishu created an environment that was ripe for the Somali forces to trap US forces in the city, killing eighteen Americans and causing President Clinton to redeploy the military to prevent further loss of American lives. After former Somali President Siad Barre fled Mogadishu in 1991 and the clans occupying Mogadishu defeated his remaining forces in May 1992, the void left an opportunity for various factions that formerly opposed Barre to seek power in a new government.[12] The clan controlling the area in and around Mogadishu divided into new factions and pitted two strong groups against each other, one led by Ali Mahdi and the other by Mohammed Farah Hassan Aideed, resulting in even greater violence and lawlessness throughout the capital.[13] Additionally, Somalia had been in a harsh drought for over three years and the warlords who had food had power, leading to added violence in the struggle for food.[14] By August 1992, Americans were widely aware of the sick, starving, and suffering Somalis. The American media cast vivid images into American's living rooms, and President Bush was ready to respond by providing food and supplies in an effort known as Operation *Provide Relief*.[15]

Initial humanitarian efforts helped restore order in the war-torn nation and feed thousands of people, but shifted the balance of power and agitated Somali clans. Operation *Provide Relief* ended in December 1992, and Operation *Restore Hope* began to stabilize the situation until a permanent United Nations peacekeeping force could take over.[16] The goals of Operation *Restore Hope* were to provide a secure environment in order to provide humanitarian assistance to

Somalis, and to restore order to southern Somalia.[17] US forces successfully promoted and enhanced the security environment so relief supplies could flow throughout the country, and eventually paved the way for UN peacekeeping forces to take over in May 1993 in United Nations Operations in Somalia II (UNOSOM II). During UNOSOM II, US forces were in support of the multinational UN coalition. The UN conceived that the US would provide logistical support and a Quick Reaction Force (QRF) in support of the UN mandate.[18] Continued presence of UNISOM II forces and their success in disarming Somalis risked Aideed's power to the extent that he ordered the ambush and killing of twenty four Pakistani soldiers on 5 June 1993.[19] The following day, the UN passed United Nations Security Council Resolution 837 calling for "the immediate apprehension of those responsible," and the mission of US forces transformed into a manhunt for Aideed.[20]

In August, Task Force Ranger (TFR) arrived in Somalia to capture Aideed and degrade the power of the leadership supporting his efforts.[21] On 3 October 1993, TFR identified a lucrative target and quickly prepared a raid deep in Aideed's highly populated area, which would have to take place in the daylight, to take advantage of the time sensitive intelligence.[22] Despite the complexities of the enemy and operating environment, TFR's strategy was to use speed and surprise to its advantage. Since TFR planned the raid as a quick grab of Aideed's leadership, TFR traveled light, leaving behind night vision and extra supplies like water, rations, and ammunition.[23] The plan involved "160 men, 19 aircraft, and 12 vehicles"[24] to fast rope in on the target, seize, and clear the objective while others secured the approach, then return using a prepositioned ground convoy.[25] When the mission was supposed to be nearly complete for the Rangers Aideed's political alliance, known as the Somali National Alliance (SNA), successfully used an RPG to shoot down a Black Hawk, known as Super 61, which was providing cover for

the mission on Aideed's turf. There were three contingency plans that the TFR commander set into motion: land a CSAR helicopter, activate the QRF, and divert available Rangers and Delta forces to the crash.[26] The TFR ground convoy that was a part of the original raid picked up the captured Somali prisoners, casualties, and other forces that needed to return to the US compound at the airport. At the same time, armed Somalis were flooding the crash site and US forces were fighting to secure a perimeter. The ground convoy contended with swarms of Somalis, obstacles, and ambushes, which resulted in more casualties.

By now, the situation had degraded even further, with heavily armed and hostile crowds, smoke, road blocks, and other obstacles inhibiting the rescue of the Super 61 crew, and Rangers who were now securing the crash site. The QRF headed to reinforce the crash site, but met too much resistance from the Somalis, and its commander ordered it return to the US compound. During this time, the SNA shot down a second Black Hawk, Super 64, about a mile south of Super 61. US ground convoys were not able to make it to the crash sites in multiple attempts throughout the day causing US forces to request help from Pakistani and Malaysian forces that had tanks and armored personnel carriers, despite language, doctrine, and training barriers.[27] Ultimately, the Pakistani and Malaysian vehicles containing those nations' forces, QRF personnel, and Rangers made it to the site of the first crash and were able to bring the casualties from Super 61 and Rangers back in the convoy. The convoy had so many people that some soldiers were on top of vehicles and others ran alongside, while helicopters provided overhead fire support.[28] Another QRF company arrived at the second crash site to retrieve casualties, and found that the Somalis had already taken the pilot captive. Tactically, the United States met its objectives on 3 October 1993, but strategically the operation failed because of the number of American casualties in what was supposed to be an effort to feed starving Somalis. Following

the death of eighteen Americans at the Battle of Mogadishu, President Clinton made the decision to withdraw US forces in 1994.

A Multi-Dimensional Enemy

The Somalis were complex and dangerous opponents for US forces in spite of their lack of formal military organization, training, and technology. According to William Roseanu's article "Every Room is a New Battle: The Lessons of Modern Urban Warfare," "Regrettably, Aideed did not fight the war the Americans were prepared to wage. The 'fugitive warlord' proved to be a master of asymmetrical technique. Lacking vast firepower, sophisticated communications, and a highly trained and disciplined force, he instead utilized the advantages of the classic irregular force."[29] The organization of Somali society into clans provided Aideed with loyal men, women, and children fighters in the form of his political alliance, the SNA. In addition to clan loyalties, Aideed's propaganda and US miscalculations leading to death of noncombatants and destruction of property further turned the population against the United States and motivated them to become actively hostile. Further, Aideed was adept at exploiting US weaknesses and collecting valuable intelligence about US military techniques, tactics, and procedures. Finally, Aideed and the SNA's use of a simplistic, low-technology approach to warfare was difficult for the United States to detect and counter.

With the lack of formal governmental structure, Somalis are organized into their own durable form of government, a clan system. Somalis' identification with clan affiliations goes back hundreds of years and these affiliations define strong, loyal relationships.[30] The country's water scarcity, lack of arable land, and poor economy has reinforced competition and clan loyalty.[31] Additionally, clan affiliations define the country's power structure; upsetting an

internal balance of power between clans generally leads to violence. This was evident in some of the most benign activities the United States took in Somalia, fueling the warring clans. For example, the United States provided food to Somalis to prevent starvation, yet according to Andrew Natsios in *Humanitarian Relief Intervention in Somalia,* "Pouring food into this unnatural and corrupted system […] would reinforce the power of the warlords by giving them more wealth with which to keep their followers loyal, purchase more weapons, and capture the loyalty of other unallied clans."[32] Moreover, after 5 June 1993, the United States, in its effort to capture Aideed, took sides against Aideed's clan in the tenuous situation in Mogadishu by disproportionately disarming his clan and disabling Radio Mogadishu, which Aideed considered a declaration of war.[33] In a hearing before the Committee on Armed Services, House of Representatives on *US Military Participation in UN Operations in Somalia* held 21 October 1993, Ambassador Mohamed Shanoun testified: "A decision to disarm one clan and not all clans at the same time is a recipe for war in Somalia. A move to take over and shut one radio station and not the other belonging to the other clans at the same time is totally unwise."[34] Furthermore, when clans face a common external enemy, clan members generally work together effectively to defeat it. While Somalis generally felt positively towards US forces when their mission was to provide food, supplies, and relief efforts, Ambassador Shanoun believed that when the US tried to capture Aideed, the US actually made him more powerful and energized Somalis to rally against the US intrusion.[35]

Somalis were also energized to rally behind Aideed because of his effective propaganda, which stood in contrast to UNISOM II's agitation of Mogadishu citizens causing intense animosity towards the United States by October 1993. Aideed used regular rallies and Radio Mogadishu to spread false messages. One of the most common messages was that the United

States was in Somalia to convert the Somalis to Christianity.[36] Aideed also claimed that the UN had come to colonize Somalia.[37] The propaganda called on Somalis to resist US forces by any means available. Additionally, the United States damaged its reputation by killing noncombatants and damaging the city of Mogadishu. On 12 July 1993, US forces struck a location where members of the United Somali Congress and Somali National Alliance were meeting. Many of the United Somali Congress members were open to working with the United States to participate in peace settlements. US intelligence reported that the site was a place where Aideed planned operations, so the US forces launched a coordinated air and ground strike reportedly claiming the lives of seventy-four, including an imam. The raid, killing local leaders who were once willing to work with the United States, ended the possibility of a peaceful settlement.[38] Finally, the citizens of Mogadishu witnessed the death and destruction caused by US firepower, which was not well suited for the precision required in the urban environment of Mogadishu. Rosenau indicated that "Despite strict rules of engagement that severely limited the use of mortars and artillery, the U.S. forces inflicted significant collateral damage in Mogadishu. During a 17 June attack, for example, helicopter gunships pounded an Aideed stronghold with 105 mm rounds, killing at least sixty Somali noncombatants. Although the gunships were removed in August, the lavish use of firepower during the first few months of UNOSOM II significantly alienated the civilian population."[39] By October 1993, the dislike of US forces was so fervent that hundreds of armed Somalis were ready to expel US forces. Rosenau emphasizes that "Aideed's forces […] were civilians who could be called upon to pick up arms on short notice and carry out raids, ambushes, and other operations."[40]

Not only were Aideed's forces committed to violence and disruption, but they were also adept at understanding and exploiting the United States' capabilities, which was ultimately a

decisive factor in the Battle of Mogadishu. According to Clayton Chun of the US Army War College, "The SNA could count on numbers to overwhelm any UN or Task Force Ranger actions. […] They too could concentrate firepower by mass of numbers, yet their fighters could melt away swiftly into the streets of Mogadishu."[41] Aideed and the SNA leadership knew how to exploit US weaknesses by imposing casualties on US forces. In fact, the SNA realized that US forces used helicopters for speed and firepower, and by September 1993, the SNA was trying to use Rocket Propelled Grenades (RPGs) to bring a helicopter down. Aideed tried to lure helicopters to a particular area by harassing Americans and then engaging the helicopters with RPGs.[42] The SNA's first successful shoot down of a Black Hawk was 25 September 1993, a week before the Battle of Mogadishu, in which the SNA would use the same technique.[43] Aideed's supporters were everywhere, and he used them to observe US forces, gaining valuable intelligence about how and when they would act. For example, TFR was stationed at the airport and Somali contractors who worked at the airport would observe its activity and report it to clan leadership.[44] Somalis could also observe TFR activity from the hills surrounding the airport. The observers came to recognize important patterns; if helicopters departed the airport with TFR personnel, they were likely on a mission. Furthermore, TFR observers recognized that TFR followed "templated" activities, which TFR was using to reduce training and exercise requirements, but allowed the Somalis to prepare to react based on the template they observed.[45] In an after action report, Colonel Casper, the QRF Commander regretted "The complexity of the mission, the congestion and diversity of urban terrain, and the heavy reliance on near-real-time intelligence drove TF Ranger to a templated approach for the accomplishment of its task. […] repetition and consistency had unintentionally telegraphed their mode of operation to those who

were interested."[46] The SNA's solid understanding of TFR tactics gave them a major advantage to prepare to counter US forces.

The Somali's passionate support for Aideed, deep understanding of American tactics, and easy access to weapons made for a deadly combination. The abundance of military assistance during Barre's regime provided the clans with weapons and ammunition. According to Robert Baumann and Lawrence Yates in *My Clan against the World: US and Coalition Forces in Somalia 1992-1994* "The United States supplied $403 million to Somalia during this period, it merely headed a long list of suppliers that included the USSR, China, Italy, Germany, South Africa, and Libya."[47] It was not unusual to see men, women, and children on the streets of Mogadishu openly carrying weapons. Further, in Aideed stronghold neighborhoods such as the Bakara Market, close to the site of the first downed helicopter in the Battle of Mogadishu, an RPG sold for about $10 USD.[48] In addition to the abundance of weapons, Somalis were motivated to use them; by July, the SNA announced a bounty for killing UN or US personnel.[49]

Finally, the SNA's low-tech warfare tactics provided effective command and control (C2) and citizen mobilization in the Battle of Mogadishu. Aideed had divided Mogadishu into eighteen sectors, each with its own duty officer who either used a low power radio or word-of-mouth communication and runners.[50] Spotters in each sector would notify the duty officer of relevant intelligence, and the duty officer would alert Aideed. The SNA's intimate knowledge of the city allowed masses to mobilize to any point in the city in under thirty minutes.[51] The mobilization plan involved using the duty officers in each sector to mobilize their sector and simplistic signaling techniques like burning tires to draw people to a specific location. On the afternoon of 3 October 1993, the SNA utilized these techniques to C2 and mobilize its forces when a spotter first alerted SNA leadership of TFR departure from the airport. The SNA

mobilized and ordered sector commanders to isolate Americans by setting up road blocks and targeting helicopters. These efforts were successful in bringing down two helicopters and making the rescue attempt a deadly endeavor for the Americans.[52]

Complex Urban Terrain

The capital city of Somalia, Mogadishu was a difficult battlespace for US forces because of the SNA's ability to quickly alter the terrain, the challenge of combatant discrimination, and the poor physical condition of the city. Mogadishu's normal population was about 500,000 people, but had tripled in size due to the flow of refugees into the city.[53] Mogadishu had strategic importance to Somalia because it contained one of the country's two major sea ports, an airport, and the little remaining financial service and commerce left in the country. The city had experienced significant problems since the overthrow of the Barre regime in 1991 sparking a violent struggle between Mahdi and Aideed for control of the national government. According to Terrence Lyons and Ahmed Samatar's *Somalia: State Collapse, Multilateral Intervention, and Strategies for Political Reconstruction*, "In the course of their fighting, looting became all encompassing – not only were homes looted of the furnishings but also their door frames, wiring, pipes, and structural steel. Nearly all public infrastructure, from bridges to power and water lines, was blown up or dug out."[54] Functioning public services like running water, electricity, and sanitation were rare as were functioning public institutions like police or courts.[55]

The SNA was intimately familiar with Mogadishu's neighborhoods. The SNA's division of the city into sectors developed terrain experts in each of the city's eighteen sectors.[56] Additionally, the SNA, as the defender of Mogadishu enjoyed certain advantages. According to Rosenau, "As in any mode of warfare, defenders in urban battles enjoy distinct advantages.

Intimate knowledge of the buildings, alleyways, tunnels, and rooftops that are a feature of most cities—perhaps gained over the course of a lifetime—is one obvious advantage."[57] Rosenau also points out that this advantage is the norm and not the exception in urban warfare; he indicates similar trends were present in Beirut in 1982 and in Grozny in 1994 – 1995.[58] Moreover, most of the maps that US forces had of Mogadishu were out of date. City blocks were small and congested, which made it difficult to discern overhead imagery. Additionally, the city was constantly changing because it was at war; debris, non-functioning vehicles, and other road barriers made new routes impassable routinely.[59] Finally, the SNA was skilled at quickly changing the flow of the city for ground traffic by using its armed populace to rally in a particular area, or by setting up blockades and barriers, which the SNA employed throughout the Battle of Mogadishu.

Another major challenge for US forces operating in the urban environment of Mogadishu was discriminating between combatants and noncombatants, and protected sites. Combatants did not wear any special insignias to designate themselves and the SNA commonly used civilians as a means of protection. The SNA accomplished this by countering US forces' precision fires by turning the Law of Armed Conflict against the US. In fact, according to Baumann and Yates, "The bitter reality of fighting in Mogadishu was that combatants seldom operated as discrete elements. Indeed, on the contrary, they typically welcomed the presence of noncombatants, seeking protection in the knowledge that American ROE emphasized avoiding casualties."[60] The SNA's use of women and children as human shields was another common tactic.[61] Furthermore, the SNA commonly used otherwise protected sites under international law for their military advantage. Baumann and Yates confirm "The complete willingness of the Somali militias to seek cover behind noncombatants or in a humanitarian facility such as a hospital typified the

difficulties of operating in Mogadishu."[62] The SNA's tactics to melt into and out of the population allowed them to hide in plain sight and deceive US forces of their status.[63]

Finally, US forces faced challenges in Mogadishu because the use of the available precision weapons caused significant collateral damage given the close proximity of structures and deteriorating condition of the city. Many of the buildings in Mogadishu were already damaged due to significant combat between Somali forces since the ousting of the Barre regime in 1991, which had weakened their structures. Also, the structures were of poor quality to begin with and were not properly reinforced. Therefore, the use of many US weapons caused more damage than intended. Rosenau provides one such example: "Compounds were surrounded by concrete walls of variable quality. Ceramic floors in buildings caused ricochet problems. Retaliation on a university building from which a mortar attack was launched caused the building's collapse."[64] The close proximity of structures also mitigated the United States' advantage in using long range, precision weapons because the collateral damage caused was counterproductive to US goals and contrary to US ROEs.

Joint Warfare Functions

Protection

US forces struggled in the protection of friendly forces, weapon systems, and facilities leading up to and during the Battle of Mogadishu, while the enemy masterful used protection from its ability to blend into the urban environment and the civilian population. According to Joint Publication 3-0, Joint Operations, protection "focuses on preserving the joint force's fighting potential."[65] One of four ways that the joint force employs protection is by using "passive defense measures that make friendly forces, systems, and facilities difficult to locate,

strike, and destroy."[66] Since the arrival of TFR in August 1993, the SNA was able to locate and observe them at their compound, gaining valuable intelligence and diminishing the element of surprise in their operations. Additionally, the SNA used tactics that allowed it to strike friendly systems and forces in the air and on the ground during the Battle of Mogadishu. The US forces had observed this behavior before but did not adequately protect its systems and forces from being struck by the enemy. The lack of protection of US forces reinforced enemy tactics; observing US forces was a successful technique that provided SNA with advanced indications and warning, while using RPGs against helicopters and isolating Americans with ambushes and obstacles caused more casualties during the Battle of Mogadishu than Americans were willing to accept.

The SNA was collecting intelligence on activities taking place at US forward operating bases by employing plain clothed civilians to observe US forces. The Rangers operated from the airport, which provided adequate infrastructure for TFR personnel and equipment when they arrived in August 1993. The airport, however, did not provide the appropriate protection from the Somalis who were viewing their actions in plain sight. Further, it was clear to the SNA that the United States was using TFR for the specific purpose of bringing down Aideed and his organization, which ruined the element of strategic surprise for US forces and made the intelligence that SNA collected on TFR more valuable.[67] The SNA used airport contractors to report on TFR activities at their compound in the airport, observed TFR activities from low hills surrounding the airport, and tracked templated missions that TFR was conducting. To its credit, TFR realized that it was being observed and tried to mask its activities by making them seem routine. For example, at varied times during the day, TFR helicopters would travel around Mogadishu using different routes, and sometimes even landed.[68] To try to deceive SNA of the

templated activities, TFR personnel would leave the objective sites by helicopter and at other times by ground convoy.[69] Yet, to the SNA the fact was inescapable that TFR was ultimately after Aideed and his leadership, which was worth the SNA's continued patient observation. According to Baumann and Yates, "Aideed did not have to conduct exhaustive analysis to deduce that any Ranger mission could turn out to be an attempt to seize him. In addition, the airfield from which TF Ranger helicopters departed was itself visible to observers on rooftops outside the perimeter not more than 1 kilometer away."[70] As a result of intense observation, the SNA understood that TFR preferred using rapid aerial insertion as a means to achieve its objective because it provided speed, which gave TFR the best opportunity to accomplish a mission before the SNA could react.[71] However, with SNA intelligence, the TFR's element of surprise was weakened and allowed SNA to develop strategies to react.

Another element of US protection that was lacking was the physical protection of TFR's helicopters flying at altitudes that made them vulnerable to the SNA, who were protected by the urban terrain. Just one week earlier on 25 September 1993, the SNA shot down a US helicopter belonging to conventional forces following Aideed's guidance to exploit American weaknesses. The Somalis brought down the helicopter with an RPG while it was flying at an altitude of about 100 feet and a speed of 150 knots killing three US soldiers, and represented an important confidence boost to the SNA.[72] The Army's leadership in charge of the aviation brigade made the difficult decision to suspend flights over central Mogadishu recognizing vulnerabilities and the extreme difficulties associated with a rescue attempt should another helicopter be shot down.[73] Also, it became increasingly clear that from the summer and into the fall, the SNA had large stockpiles of RPGs and was gaining proficiency at firing them. However, there was a distinct divide between US conventional forces experience on 25 September 1993 and the failure

of their Special Forces brethren, TFR, to apply those lessons to protect their aircraft and personnel. Granted, Rangers are elite forces and high risk missions are their specialty; however, they made no adjustments to their helicopter tactics based on what was happening with SNA use of RPGs against US helicopters. The Commander of US Forces Somalia (who did not command Special Forces), Major General Montgomery, stated his concern about their practice: "They routinely fly in low circles above the ground force at about 500 feet – well below the burnout elevation of an RPG…It was almost as if they thought they could not be hit." Unfortunately, TFR met the bitter reality of the SNA's competence with RPGs when they downed Super 61 and Super 64, and severely damaged Super 68 on the night of 3 October 1993.[74]

US forces also lacked protection on ground convoys to survive deadly Somali tactics that were becoming regular and more difficult to counter by late summer 1993. As the SNA ratcheted up violence towards the US using mines, ambushes, RPGs, and small arms fire, the vehicles that US ground forces had were not adequate for the mission, mostly consisting of High Mobility Multipurpose Wheeled Vehicles (HMMWVs) and five-ton trucks. Moreover, the Americans did not have any armored vehicles. During the summer, Major General Montgomery requested armored reinforcements to help protect his forces for a dreaded scenario like the one that played out on 3 October 1993. He explained "It was increasing concern over my inability to get to US or UN forces in extremis that led to my request for armor/mech reinforcements earlier in July and August. The Pakistanis had the only armor in the city and it was old and inadequate."[75] The danger to US forces played out vividly in the streets of Mogadishu on 3 October 1993. One particularly clear example of this was the ground convoy that took prisoners and Rangers back to the US compound immediately following the downing of Super 61. While loading the vehicles a Somali gunman shot and killed a HMMWV Mk 19 gunner, and another

Somali destroyed a five-ton truck using an RPG.[76] While making its way back to the US compound, trying to avoid obstacles and ambushes, another vehicle became disabled due to enemy fire, killing and wounding more Rangers.[77] Masses of Somalis poured out to the street and hit the vehicles in the convoy from all sides. By the time they made it to their destination, half of the seventy-five men in the convoy had been killed or wounded.[78] No other US led convoys would be able to make it back to the crash sites that day, and the US had to ask multiple coalition partners to use their armored vehicles before getting permission from the Pakistanis and Malaysians who went into Mogadishu to rescue US forces. Though use of the partner vehicles was absolutely critical to the rescue effort, the time critical emergency did not allow the coalition partners to overcome problems from the differences in the nations' language, training, experiences, and doctrine.

Movement and Maneuver

US forces were not able to exploit movement or maneuver to their advantage in the Battle of Mogadishu. Joint Publication 3-0 defines the function of movement and maneuver as the ability of joint forces to secure "positional advantages before or during combat operations and by exploiting tactical success to achieve operational and strategic objectives. This function includes moving or deploying forces into an operational area and maneuvering them to operational depths for offensive and defensive purposes. It also includes assuring the mobility of friendly forces."[79] The SNA's ability to mass people, set up obstacles to isolate Americans, and dictate their pace and direction of travel severely restricted movement and maneuver for US forces. Further, US forces were unable to exploit the tactical success of capturing twenty-four SNA officials into an operational or strategic success. Instead, the death of eighteen Americans overshadowed the tactical victory, eventually forcing the United States withdrawal from Somalia.

A key task for movement and maneuver that SNA made very difficult for US forces was the ability to "Provide mobility for joint forces […] without delays caused by terrain or obstacles."[80] The SNA's superior knowledge of the urban terrain of Mogadishu, and its organization to rally crowds, gave it the ability to move about the city with impunity while denying the same to US forces. At the first site of TFR beginning the raid on 3 October 1993, Giumale, an SNA commander, directed his forces to isolate Americans.[81] Giumale's goal of isolating Americans would force them to fight in small, disconnected groups from each other unable to mass firepower or get reinforcement. Chun recounts the SNA strategy to restrict US forces' movement when the Somalis first spotted TFR: "Giumale notified sector commanders to move SNA militia to meet Americans. Militiamen organized ambushes along routes most likely to be taken from Mogadishu airport. […] Militia from all points of the compass drove with a variety of vehicles or advanced on foot."[82] Giumale's actions gave his forces significant territorial advantages. These advantages include significantly restricting TFR movement, blocking the city's most expedient routes for TFR use, and preventing TFR from using speed to conduct raids while relying on ground convoys.

The SNA also used its ability to harass, ambush, and block US forces, which manipulated the US contingency force's ground movement to and from the crash sites of Super 61 and Super 64. Due to the desperate situation at the crash sites, the TFR commander ordered the ground convoy that was in route to the airport carrying prisoners to divert back to the site of the Super 61 crash to provide reinforcement. SSGT Matt Eversmann was a Ranger in charge of a team initially responsible for a blocking position, but was later on the convoy trying to make it to the crash site. He says, "The crash site was due north of our location, so I figured that we could drive a block north, make the first right, drive a few blocks, take another right, and we would

wind up at the crash site."[83] What was supposed to be a short trip soon turned into a long one; Eversmann recalled "The convoy was halted on the street that was obviously not the crash site. We all dismounted and quickly moved to the front of the vehicle and found cover. […] The problem with these intersections was that it gave the enemy three directions from which to fire at us. Plus, adding in the houses and multiple-story buildings, there was an awful lot of ground to cover and not nearly enough men to do it."[84] Ultimately, the convoy would never make it to the crash site because of the SNA's skill in disrupting ground movement with armed crowds and obstacles.[85]

In addition to the danger that SNA forces imposed on US forces' movement, they were also successful at disorienting US forces in their urban terrain. During the operation, the violence and confusion that the SNA created on the ground made it necessary for helicopters to guide the ground convoys using large, bright orange panels on top of the vehicles. The smoke from the burning road blocks and firefights made these panels very difficult and at times impossible to see from the air.[86] In fact, the ground convoy that was originally part of the TFR raid trying to make its way back to the crash site of Super 61 became disoriented due to road blocks and enemy fire. The disorientation resulted in the convoy making a wrong turn missing the crash site and later having to make a U-turn before being ordered to return to the airport because of casualties the convoy was taking.[87] On its way back to the airport, the convoy was disoriented again when confusion separated the lead vehicle from the rest of the convoy.[88]

Finally, US forces were not able to use the Battle of Mogadishu to gain a position of advantage over the enemy to achieve operational and strategic objectives. Tactically, the US forces accomplished their mission to take top SNA leadership prisoners, and inflicted significantly more casualties on the SNA than US forces had. Somali casualty estimates vary

widely and do not separate noncombatants; most sources believe there were 300 – 500 Somalis killed, and 700 – 1000 wounded during the fourteen-hour Battle of Mogadishu.[89] The loss of American lives, and the fact that the Somali took the pilot of Super 64 captive, outraged Americans and caused President Clinton to announce the withdrawal of US forces from Somalia.[90] The US political environment gave the strategic victory to Aideed, who got what he most wanted, the Americans to leave, followed by the UN.

Fires

The US forces' application of fires during the Battle of Mogadishu were not best suited for an urban environment due to the collateral damage they caused. Per Joint Publication 3-0, "To employ fires is to use available weapons and other systems to create a specific lethal or nonlethal effect on a target. […] Fires typically produce destructive effects, but various nonlethal ways and means […] can be employed with little or no associated physical destruction."[91] Limiting collateral damage is a key consideration in the application of fires, and falls under the principle of proportionality in the law of war.[92] Additionally, the Commander of US Forces Somalia translated the purpose of the US mission under UNOSOM II "to capture Aideed alive with minimal friendly casualties and collateral damage."[93]

From a fires technology perspective, US forces were largely using the same type of lethal fires in Desert Storm that they used in the Battle of Mogadishu. Historical evidence implies that modern forces like those of the United States often find it difficult to use a technological advantage over a resolute and low-tech opponent in an urban environment. Weapons that US forces used two years earlier in Desert Storm were much better suited to that enemy and environment. Rosenau affirms, "By the time Americans resorted to the use of anti-tank guided

missiles to root out snipers, it had become apparent that the firepower which had demolished the Iraqi Republican Guards was ill-suited to the streets of Mogadishu. […] [T]he Gulf War's promise of a style of fighting minimizing noncombatant casualties was a long way from fulfillment."[94] US forces were challenged balancing the protection of US forces' lives and minimizing collateral damage in Mogadishu.[95] The weapons systems that were most effective at reducing friendly casualties, like the AC-130 gunship, were not allowed by the Rules of Engagement on 3 October 1993 because of the collateral damage they caused.[96] As it happens, July 1993 was the last time that US forces used AC-130s in Mogadishu when a raid reportedly killed seventy three Somalis, including local leaders who once supported United States' efforts.[97] On the other hand, the suppressive fire in the Battle of Mogadishu provided by close air support helicopters like AH-1F Cobras was more precise, but according to some accounts "did not completely destroy enemy positions or buildings. Many buildings that were struck were reoccupied by Somali guerrillas within minutes."[98] Additionally, the helicopters that supplied the suppressive fire in the Battle of Mogadishu were vulnerable of being hit by an RPG. Finally, the proximity of buildings, and conditions of structures in Mogadishu caused bullets to ricochet and weapons to rip through structures. These factors of operating in an urban environment lead to significantly more collateral damage than the plans of US forces intended.

In addition to the challenges that US forces experienced with their application of lethal fire, their application of non-lethal fires was not successful because of the Somalis' low reliance on technology, and their inability to overcome Aideed's persuasive propaganda. Non-lethal fire techniques like electronic or network attacks require that the enemy use networks or the electromagnetic (EM) spectrum to be effective, which was typically not the case with the SNA. The SNA had used the EM spectrum to talk over radios, but they were not dependent on the

radios and had become accustomed to communicating using word-of-mouth and runners after Aideed was tipped off that US forces were eavesdropping. The United States was equally unsuccessful at using information operations because it was not as persuasive as Aideed's own propaganda distributed through massive rallies and over his radio station. According to Baumann and Yates, "While conducting psychological operations of his own to fan the flames of public animosity toward UNOSOM II, Aideed skillfully maintained the public posture of a reasonable and willing peacemaker."[99] US forces disabled the low power radio transmitter running Radio Mogadishu by mid-July, but the messages that Aideed spread were well set into the minds of his supporters and the US forces were unable to reverse this mindset using information operations of their own.

Intelligence

The US forces' lack of overall understanding of Somali culture as they exploited and fused intelligence hindered US decision making. Joint Publication 3-0 describes one purpose of intelligence as the understanding of "what the enemy is doing, is capable of doing, and may do in the future."[100] US forces had many modes of intelligence collection including imagery collection from manned platforms, unmanned platforms, and satellites, but they failed to correctly interpret the intelligence because most US forces did not have a good understanding of Somali culture. Additionally, the situation in Mogadishu required a robust human intelligence (HUMINT) capability, which challenged US forces because the United States had signaled its goal to capture Aideed, thereby making it both difficult and dangerous to get close to him and his allies.

US forces needed a strong intelligence capability to operate in Mogadishu requiring close ties to the local community; unfortunately, those ties had been severed by the end of

summer. When the United States deployed TFR to Somalia in late summer 1993 with the purpose of capturing Aideed, the US telegraphed their motive and drove Aideed underground.[101] The CENTCOM J3 at the time, Brigadier General Zinni, USMC, believed "this shift made the Somali operational environment far more hostile and cost the coalition staff critical sources of information. […] a poor grasp of the local culture and politics maybe led to things like not understanding where a particular individual was, or who he was, or what his relationship was, and maybe caused mistargeting in some cases […]."[102] Increasing hostility of Aideed's clan towards the US forces made some of what would have been the most lucrative collection locations deep in Aideed's territory in Mogadishu too dangerous to enter and collect as Aideed's clan became more emboldened in their support.[103] Finally, during Operation *Restore Hope* and Operation *Provide Comfort*, the I Marine Expeditionary Force Commanding General, Lieutenant General Johnston, and the Ambassador, Robert Oakley, had reoccurring engagements and nurtured personal relationships with Aideed, which was useful in understanding his perspective and intentions.[104] These engagements were no longer possible once the United States' goal became the capture of Aideed and his SNA leadership.

The US forces lacked a robust HUMINT capability required to capture Aideed and his SNA leadership.[105] However, the US forces' lack of Somali cultural awareness made it difficult for them to adequately interpret intelligence. For example, US forces had imagery that showed large weapons stocks, but there was a gap in the intelligence in understanding how the Somalis would employ them, and the threat they posed.[106] Additionally, according to Baumann and Yates another barrier to understanding Somali culture was that "Capable, unbiased, or politically neutral translators were in short supply. UNOSOM II personnel stood out in Somalia and had no hope of infiltrating the streets even if they had been disposed to do so."[107] Due to the US forces'

lack of understanding of Somali culture, they had a hard time sensing day-to-day changes.[108] Likewise, Baumann and Yates highlight that US forces had difficulty distinguishing "friend from foe, a fact that immeasurably increased the danger of operating in a complex urban environment."[109] Distinguishing friend from foe became even more complex with SNA's practice of routinely using noncombatants as human shields and operating in protected sites.

Conclusion

US forces did not adequately understand their opponent or the urban terrain in the Battle of Mogadishu, which contributed to challenges in fulfilling the joint functions of protection, movement and maneuver, fires, and intelligence. The United States entered Somalia to avert a humanitarian disaster, but as the situation deteriorated, and the mission changed to capturing Aideed, the ways in which the SNA organized and fought gave them certain asymmetric advantages against US forces. The Somalis' unyielding loyalty to the clan, their ability to mobilize men, women, and children, their easy access to weapons, and their non-reliance on high tech solutions made them a difficult opponent for US forces. Moreover, the SNA's battlespace of Mogadishu was terrain that the local populace understood and used to their advantage to hide, ambush, and disorient US forces. The Somalis' deep understanding of the battlespace allowed them to move quickly and strategically while denying US forces the same advantage. Finally, SNA's skill at exploiting US forces, whose political system did not accept significant casualties, turned the United States' harrowing tactical victory at the Battle of Mogadishu into a strategic triumph for Aideed. In the end, Aideed watched the departure of US forces from Somalia, followed by the UN, and regained his power and authority in Mogadishu, declaring himself the country's President in 1995.

Operational Decision Game Background

Boko Haram's (BH) Advance towards the Islamic State of Nigeria is an Operational Decision Game (ODG) created by Majors Alexandra Plunkett and Joseph Montagna that seeks to speculate about a potential 2030 scenario in Warri, Nigeria (available at Appendix A). This notional future threat presents a situation that could lead to similar experiences for US forces as they had in the Battle of Mogadishu. Similar to the Battle of Mogadishu, the ODG takes place in a densely-populated city on the littorals where insurgents are able to seamlessly blend into the population and in some areas, have won the favor of the populace. This favor is important in BH's ability to use the populace as a weapon against US forces, allowing them to mobilize people as obstacles to the movement and maneuver of US forces. Additional locals are expected to turn in favor of BH as US forces cause civilian casualties or damage to the city, as they did in Somalia. Finally, the historical and future scenario both have enemies that employ cost imposing strategies against a larger, technologically-superior conventional force in ways that are challenging for US forces to detect and counter.

The ODG contains two games, one in which participants play from the US force perspective and the other in which participants play from the BH perspective. While the US perspective was critical to understanding possible US theories of victory and developing a US future concept, the BH perspective provided insight into how the enemy of the future may adapt as US forces incorporate new tactics and technology. Each perspective provided three future concepts that participants could employ to achieve their theory of victory. The US future concepts provided potential future uses of human machine collaboration for technology that is at least at a technology readiness level that would allow for real-world operations by 2030. The BH future concepts incorporated commercial-off-the shelf technology that insurgent groups are

either beginning to use or are likely to use in the future. Participants provided information on their approach to the scenario and gave insights on how they might employ future technological concepts, if at all. Each participant's feedback provided multiple perspectives on the player's theory of victory, how they perceived the problem, and how they elected to employ (or not employ) the future concepts (see Operational Decision Game Results, Appendix B).

The ODG presented a situation in which twelve years of destabilization in the coastal city of Warri, Nigeria, resulted in an opportunity for BH to establish itself in the oil hub of the Delta State. The scenario for the ODG reads as follows:

> The optimism of Nigeria as a democratic anchor state in Africa has been in decline since 2018 when violence from Boko Haram (BH) reached its peak in the northeast of the country. The dramatic spike in violence drastically increased security costs for Nigeria's Army, diverted government resources from other services, and discouraged foreign investment. In conjunction with the violence, after reaching its peak in 2018, Nigeria's GDP has contracted at least one percent annually furthering the grinding poverty throughout the country. Moreover, Nigeria is currently experiencing an extreme food shortage caused by increased desertification and pastoral grazing pushing farther south into the country. Finally, Nigeria's inability to implement family planning has resulted in high birth rates leading to its current youth bulge in which the economic support to dependency ratio is 1:10.
>
> BH's aggression in northeast Nigeria between 2018 and 2030 has led to mass migration to the south of the country, as families fled in search of greater stability and opportunity. Many families were drawn into the city of Warri in the Delta State because of its status as an oil hub. The migration from the north swelled the population of Warri, a largely Christian city, with Sunni Muslims who settled in the southeast of the city. The new Muslim inhabitants have had a difficult time assimilating and fulfilling their dreams for a better life. BH hungry for resources to create their Islamic State of Nigeria see the oil hub of Warri as necessary territory and is able to exploit its new Sunni inhabitants.
>
> After BH was able to gain a stronghold in southeast Warri, it was able to establish enough forces and momentum to take over the city's key infrastructure, including the airport, river port, and refinery. Furthermore, BH waged an offensive against the Amphibious Infantry Battalion, killing 120+ infantry and causing the remainder to

> abandon their equipment, which was then seized by BH and repositioned at various defensive positions throughout the city. BH has limited supplies and food from entering the city, starving the citizens and killing hundreds of Christians in offices, schools, police stations, and churches, raising the death count to over 10,000 in Warri.
>
> The atrocities against Christians in Warri led to United Nations Security Council Resolution 2030 authorizing a forceful response against BH leadership. The US-led task force responded quickly, with II MEF as the main effort, retaking eighty percent of the city's major infrastructure and, before redeploying, and turning the mission over to the UN-led stability force called UN Operations in Nigeria (UNON). UNON is a Combined Joint Task Force (CJTF) made up of the Nigerian Army, African nations fighting BH including Cameroon, Niger, and Chad, and 24 MEU (REIN). BH still maintains authoritarian presence in the neighborhood in the southeast making its population unreachable to the UN force. The 24 MEU (REIN) will support Internal Defense and Development and stability operations as part of a CJTF to include counterinsurgency, Foreign Internal Defense, and support the Joint Special Operations Task Force (SOJTF) conducting High Value Individual (HVI) raids. Nigeria, Cameroon, Niger, and Chad forces will provide security operations to maintain conditions for nongovernmental organizations to provide humanitarian relief.

The ODG provided Boko Haram's most likely course of action (MLCOA) for participants to understand the enemy's behavior in their development of a concept of operations. BH will likely divide the city into small sectors, controlled by sector lieutenants. Within a sector, BH communicates by shouting, employing runners, using walkie-talkies, and posting on social media. The sector lieutenants are responsible for communication between sectors using cell phones. BH is expected to make extensive use of human intelligence (HUMINT) to provide intelligence, surveillance, and reconnaissance and recruit near real-time mass mobs using text alerts and megaphones to increase chaos and population/weapons density in southeast. Finally, with respect to US forces, BH is expected to allow both air and ground forces into the city to become canalized. Their intent it to trap US forces inside a city sector by using impromptu roadblocks made of trash, tires, or fires, moving groups of fighters to bridges and roads once US

forces have crossed, and quickly mobilizing masses of civilians to protest in streets and collapse on US ground forces.

The ODG participants who played from the US perspective received four objectives from USAFRICOM. These objectives included: 1) Deny BH the ability to move outside southeastern section of Warri; 2) Capture key BH leadership from Warri and transport to the airport in northeast Warri for immediate airlift to detainment; 3) Set conditions to enable follow-on humanitarian aid; and 4) Minimize civilian casualties and damage to infrastructure within Warri. These objectives required participants to isolate the enemy, ensure freedom of maneuver in the air and ground, perform stability operations, employ non-lethal fires, and conduct a robust intelligence operation. The intent of these objectives was to provide a similar mission that US forces experienced in Somalia and to understand how participants thought about each of the warfighting functions.

Participant playing the first game from the perspective of US forces had three future concepts at their disposal, in addition to traditional forces and materiel. The first future US concept, called the Non-Lethal Active Denial System, is a counter-personnel device that directs millimeter wave energy to penetrate the top layer of human skin at distances up to 500 meters, causing humans to move out of the beam of energy in fewer than five seconds. The ODG asked participants whether they would use the concept and how they would employ it in the scenario. Specifically, the ODG tried to understand whether the participants would mount the system on ground vehicles, helicopters, fixed wing aircraft, or unmanned aerial vehicles. Additionally, the ODG tried to determine how the participants would cue the system or whether it would be autonomous. The second future US concept called “Post and Seek” uses a software application to scrape social media posts and pass images of interest to a small drone or swarm of drones.

Then the drone flies into the environment to seek out the image in a pre-programmed area where it anticipates that the human or object from the image resides. The ODG asked participants how they would employ the concept, what they think is the optimal size of the drone, and whether they would recover the system after use. Finally, the third future US concept provided an information warfare capability to US forces, which incorporates a traditional information operations (IO) capability with enhanced IO capabilities to influence and understand the enemy population. One enhanced IO capability allowed participants to use social media scraping to identify themes, messages, key influencers, and enemy networks. Another enhanced capability denied enemy social media accounts that produced propaganda. The ODG asked participants to describe which IO capabilities they would employ and how they would employ them.

Participants playing the second game from the perspective of BH had three future BH concepts to apply to their theory of victory. Understanding how the enemy might employ technology against US forces in the future is critical to framing the future problem for US forces and developing future US concepts. The first BH future concept is a low-cost commercially available antenna and cell phone application that allows users to quickly set up a network of more than ten users at a range of several miles. This concept does not rely on towers, routers, or satellites. The ODG asks participants under what conditions they would use this concept. The second future BH concept is using commercial drones. The ODG asks the participant to elect how they would employ the drone providing several options to include gathering ISR, spotting for fires, delivering logistics, and employing an airborne improvised explosive device. Finally, the third future BH concept is an IO concept that allows social media bots to spread mass volumes of propaganda. The ODG asks participants under what conditions they would use the bots.

Operational Decision Game Results and Analysis

This section will provide an analysis of the results of the ODG *Boko Haram's (BH) Advance towards the Islamic State of Nigeria* (available at Appendix B). Fourteen participants played the ODG, with nine participants playing game one from the perspective of US forces and five participants playing game two from the perspective of Boko Haram. The participants provided narrative responses, making each participant's response unique from other respondents. In addition to providing unique responses, participants commonly interpreted how to respond to the same questions in different ways. For example, some participants used the "Necessary Capabilities" section to list specific technology, while others listed categories of technology, tactics, or warfighting functions. While comments were useful in understanding a problem statement, theory of victory, and utility of future concepts, little commonality existed between responses overall. This analysis will highlight the areas of response commonality, differences, and exceptionally unique or creative responses for game one and two.

Game 1

The key elements of the problem statement that the nine participants identified for game one included restricting BH movement, capturing BH leadership, minimizing civilian casualties and damage to civilian areas, ensuring freedom of maneuver for US forces, and creating a safe and secure environment for follow-on aid. As few as two participants and as many as five participants identified these elements in their identification of the problem. There was some agreement of the threats in the scenario, with the following threats appearing at least twice in the participants' responses: removal of BH leadership could lead to a worse outcome, difficulty of identifying and listening to the enemy in an urban environment, and redundancy of BH networks

and defense. There was no common agreement among respondents of opportunities for US forces in the scenario.

As a result of some agreement in the participant's problem statements and threats, several commonalities exist in participants' theories of victory. First, multiple participants acknowledged that victory requires a heavy intelligence effort. The nature of the intelligence differed among participants but some disciplines included social media scraping and fusion using big data analytics, signals intelligence, imagery intelligence, and human intelligence. Second, two participants emphasized the importance of using an interagency approach to ensure successful stability operations. Third, four participants agreed that isolating the outer perimeter of Warri and conducting rapid raids for high value individuals is important. Finally, three participants agreed that it is important to understand the key network nodes.

Of the nine participants, six elected to use the first future US concept, a counter-personnel non-lethal active denial system. Overall, respondents found it to be useful to disperse and disrupt crowds to allow other methods to complete a raid. How participants elected to use the active denial system was varied. Three respondents believed that it would be useful on ground vehicles and two respondents thought that it would be useful to integrate the system onto AC-130s, helicopters, and larger UAVs. One respondent did indicate a concern about the power that is required to use the active denial system and limitations of power available on current UAVs. Another respondent voiced concern over the potential psychological effects of civilians who had been countered using the active denial system. One participant provided feedback about how to cue the system. The participant recommended that a camera mounted on the vehicle would be more useful to cueing the system than using another system like a drone.

Finally, another participant recommended that the active denial be equipped with a counter-fire capability from RPGs and guided munitions.

Three of nine participants elected to use the post and seek drone system that autonomously looks for a particular person or image in an area determined by the operator. One participant would use it to geolocate humans and objects of interest as soon as someone posts an item of interest on social media. One participant posited that while this capability is performing other missions it could be used to cue another weapon system, like the active denial system. Another participant recommended that the capability incorporate lethal fires. Also, a participant who did not employ this concept indicated that the capability did not justify a great enough advancement over current capability to justify adding it to the inventory. However, if US forces did have this capability he would elect to employ it as a swarm to cover more ground and increase probability that some systems survive a mission.

Five of the nine participants used the third future US concept incorporating a traditional and enhanced IO capability to achieve their theory of victory for their concept of operations. Of these five, three of the participants elected to use both traditional and the enhanced IO capabilities. One participant noted that denying BH activity and accounts was important during deliberate operations but not on a routine basis. Another participant indicated that he would like the capability to have social media bots not only build and monitor a social media campaign but also to autonomously respond based on what users view and how users respond. Finally, yet another participant recommended that the enemy listen for enemy messaging and autonomously develop alternative messaging positive to the cause of US forces. He also indicated that bots could be used to create confusion to enhance the success of raids and slow the enemy's tempo.

Game 2

The key elements of the problem statements that the five participants identified for game two included increasing BH influence, mitigating US interference, increasing local destabilization, and retaining BH access to high valued infrastructure. Participant's definition of the problem tended to drive their theory of victory. For example, participant two identified increasing BH influence and mitigating US interference as key elements of his problem statement and described his theory of victory as a fight at the strategic level that requires a large IO campaign against the US to increase BH legitimacy. Making the war too costly for the US was also key to participant two's theory of victory. Likewise, participant five assesses the key elements of his problem statement as BH retaining control of infrastructure, mitigating US interference, and increasing BH influence. To rectify these problems, his theory of victory included the killing, capture, or execution of US forces and propagandizing the acts. Additionally, participant five recommends baiting US forces to enter southeast Warri where BH controls the engagement zone and attack to cause the greatest casualties. Participant five also recommended causing problems in northern Warri to cause US forces to overreact, causing damage to the city, killing civilians, and delegitimizing their presence. Finally, of the two responses for Temporal and Spatial Dimensions, the respondents tended to agree that BH needed to react quickly to US forces, but also indicated that time is on the side of BH and they should be prepared for a protracted conflict.

Participants had a very high rate of using the future BH concepts, with all five participants using at least two of the future concepts to achieve their theory of victory. All participants elected to employ the first future BH concept, a commercial antenna and cell phone application that allows BH to rapidly establish a network. Some of the benefits that participants

annotated were that it allows communication off of normally observed platforms, it is removed and reestablished quickly to prevent signals exploitation, and it makes it more difficult for US forces to exploit BH communications. Likewise, all five participants used the second future BH concept, employing commercial drones. Participants used future BH concept two in multiple different ways including for ISR, fires (lethal and non-lethal), command and control, protection. Several notable uses included combining the commercial drone with the antenna in future BH concept one to increase the range. Another participant used the drone to taunt US forces in any way possible, from dropping IEDs to trying to disable rotary aircraft by flying into its blades. Three participants elected to use the drones to film footage that would be unfavorable to US forces and publish it as propaganda. Finally, four of the five participants elected to use future BH concept three, social media bots. Participants thought that this concept would be useful to publish inflammatory comment towards Warri's Muslims population attributable to US forces as well as publish negative press about the US. Another participant elected to use the bots as a primary means of overt and covert communication with other BH fighters. The participants also employed the bots to spread malware and deny essential services to the population, like emergency services, and attribute disruption to US forces.

Future Concept - Technology for Urban Terrain

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From the siege of Carthage in the Third Punic War to the current battle for Raqqa, wars have been fought in cities throughout history. Cities present militaries a multitude of challenges that are not present in open terrain, yet urbanization is expected to increase to the point that sixty percent of the world's population will live in cities by 2035.[110] As William Roseanau highlights

in his article "Every Room is a New Battle: The Lessons of Modern Urban Warfare," open terrain, in contrast to urban terrain allows "maneuver and the virtually unrestricted use of firepower […] where tall buildings, narrow streets, noncombatants, and other obstacles are few or non-existent."[111] The characteristics that make the urban environment challenging for US forces, provide the enemy excellent terrain where they can exercise an asymmetric advantage. As a result, the Marine Corps Operating Concept (MOC) emphasizes that "operations in urban areas are the most likely to occur and the most dangerous."[112] Further, the MOC emphasizes the Marine Corps must "Exploit man-machine interface and manned-unmanned teaming (MUM-T) to overcome challenges in urban terrain."[113] To this end, the Technology for Urban Terrain is a four system solution taking advantage of advances in the man-machine interface and MUM-T to close gaps across multiple warfighting functions and increase US military success in the urban environment.

The systems that comprise the Technology for Urban Terrain together contribute to the warfighting functions (WFF) of intelligence, fires, logistics, force protection, and maneuver. First, the big data, machine learning/artificial intelligence (AI) analysis tool, called Needle Finder, contributes to the intelligence WFF by providing added support to the intelligence analyst already on the ground. This big data tool enhances any analyst's ability to better and more quickly "facilitate understanding the enemy, terrain, and civil considerations."[114] It also enables enhanced support to the targeting process by providing more in-depth, holistic analysis of situations, places, and people during the find and fix portion of the targeting process. Big data machine learning/AI assisted analysis will provide analysts the ability to sift through massive amounts of data ranging from full motion video, to social media, to smart home data quickly to help develop and provide better situational awareness as well as develop pattern of life within a

given geographical location. Enhanced analysis capabilities will lead to more accurate, precise targeting, increasing both our kinetic and non-kinetic effectiveness while decreasing collateral damage and overburdening units and assets.

The second system is a drone system that contributes to maneuver, fires, force protection, logistics, and intelligence WFF. The Drone Squad (DS) is a scalable system composed of a single system at the squad level that can be integrated into a drone swarm option to provide support to multiple echelons of command. The DS can also be customized by mission because of the different payloads the DS can carry. Payloads can vary from a direct fire capability, target acquisition capability, intelligence support capability, and a chemical, biological, radiological, and nuclear detection capability. The DS provides a multitude of mission support functions to the squad level and higher echelons. In support of maneuver, the DS can gain an advantageous reconnaissance position that enables US and coalition forces to quickly maneuver on the enemy. The DS can engage the enemy via the support packages and force enemy movement, and support US and coalition forces control of an area by increasing the distance a force can control by reducing the limitation of blocked line of sight due to terrain. In support of the fires WFF the DS can maneuver through or over terrain ahead of any US or coalition force to provide a position to request indirect fires that prevents US or coalition forces from exposing their position to enemy direct or indirect fire. The DS small signature will allow the DS to remain in place to observe the effects of indirect fire missions. In support of the force protection WFF the DS can enhance the defensive measures US or coalition forces are using in support of operations, and assist in the identification and location of friendly forces across the battlefield. The DS can also support logistical or combat operations by being able to move ahead of forces around dead space to identify obstacles or threats. Lastly, in support of the intelligence WFF the DS is a fast method

for lower echelons of command to collect data in the operating environment and then provide threat assessments or targeting identification to US or coalition forces on the ground.

The third system is the optionally manned and armed logistics vehicle (OMALV) and primarily supports the logistics WFF. However, the system contributes directly to both maneuver and force protection in sustaining combat power. This system is an unmanned ground vehicle (UGV) platform that provides manned, autonomous, and tele-operated tactical-level motor transport operations. Moreover, OMALV offers the ability to scale the composition of convoys with up to five unmanned vehicles to every manned vehicle. This manned and unmanned scalability allows convoys the ability to task-organize to the threat environment. Additionally, the OMALV is armed with a stabilized weapon system capable of autonomous and tele-operated fire controls. A day and night optic provide for precision fires during all hours. Each OMALV is able to act as a wingman in a leader-follower manner to provide mutually supporting fires while convoys make their way along a route. Finally, the Drone Squad is able to integrate with the OMALV for ISR support and application of indirect and direct fire systems.

The fourth system is the Active Denial System (ADS), which is a non-lethal counter-personnel system that contributes to the fires and force protection warfighting functions. In terms of fires, the ADS produces non-lethal precision effects from a variable standoff range. The ADS affects human targets by causing the human targets to move out of a specific area. This system reduces collateral damage that might otherwise occur from lethal fires in an urban environment. The ADS fires will mostly support close operations and can be used in fires in support of decisive operations, shaping operations, or sustaining operations depending on the commander's purpose. Likewise, the ADS will provide protection to US and coalition forces by enhancing survivability and effectiveness of friendly forces. Since the ADS repels people at a

certain radius, it will minimize mobs in the vicinity of US forces and create a standoff distance that makes threats from enemy weapons less effective.

The Technology for Urban Terrain future concept incorporates four new systems that will benefit US and coalition forces in the urban environment. This concept will describe the following four systems: Needle Finder, Drone Squad, OMALV, and the ADS. For each system in the Technology for Urban Terrain future concept, this section will provide a problem statement and a hypothesis for how the system proposes to solve the problem. Next, this section will present a capability description, concept of employment, and measures of success for each future system that the concept proposes. Finally, this section will provide system tradeoffs and recommend areas for future research.

Needle Finder- Big Data Machine Learning/Artificial Intelligence (AI) Analysis

Problem Statement: The world has gone digital and the amount of big data that each person and organization produces daily continues to increase leaving an even bigger digital thumbprint. Billions of hours and terabytes of information is left unanalyzed and unexploited, with even more millions being generated in near-real to real time. The United States military must figure out how to harness and analyze big data quickly, and increasingly, with less people.

Hypothesis: If the government uses an operational research approach to existing artificial intelligence (AI), analytical software, and programs then the capability required by the military will be available for employment in less time than it would take to procure new programs.

Capability Description:

Needle Finder is a program that sifts through available historical and current data, and has the AI to analyze the data within the means of a unit mission set. The Defense Advanced Research Projects Agency (DARPA) is currently researching six programs that focus on the development and use of AI for analysis and prediction as well as programs to provide analysis and recommendation for action against critical influencers through social media. The Department of Defense (DoD) will purchase access to large repositories of data such as Closed Circuit Television (CCTV) of urban areas, personal fitness devices, smart home devices, and all social media platforms. Needle Finder will use the data the DoD purchases and its repository of full motion video, imagery, and measures and signatures data to sift through for analysis when an analyst prompts it to assist in finding and fixing targets. Analysts will be able to run multiple queries based on mission sets simultaneously. The program will then sift through all of the data available, historic and real-near real time and provide predicative analysis to the analyst as recommendations to possible human and material targets, pattern of life tracks, locations for attacks, protests, or gatherings, etc. The analyst will either accept, decline, or flag to continue monitoring. Through the analysis and approval process the artificial intelligence learns patterns and links between physical and human networks and continues to provide recommendations.

Concept of Employment:

The DoD will purchase access to large repositories of data such as personal fitness devices, smart home devices, social media platforms, and CCTV footage in the area where forces are deployed. Needle Finder will access all of these repositories as well as all full motion video and raw data in the DoD repository, and will process data using a cloud interface on any

computer. This capability will be resident at the Army Brigade or equivalent and higher Intelligence Section (S/G2), specifically to the analysts who are responsible for fusion of information and intelligence.

Intelligence analysts will input the unit mission set and nest it with the higher headquarters mission to enable boundary analysis, which will enhance the find and fix portion of the targeting process and force protection. The analyst sets the mission geographical boundaries to narrow the initial data sift and analysis. Once the program identifies a person, place, or thing of interest it will then automatically widen its aperture to find links and connections both in and outside of boundary or prescribed data sets. Artificial Intelligence will then provide basic analysis of the targets identified, i.e. analysis of imagery highlighting change detection on the roof of a possible combatant. It will also then identify the individual who owns the building providing social network handles and an initial social media scrape of the individual's accounts. All of this information and analysis will be flagged for the intelligence analyst to confirm or deny the target for further analysis and monitoring or not.

Measures of Success:

The most important measure of success for this concept is the amount of time it takes to cycle through the targeting process: find, fix, and finish. Upon entrance into a theater it may take months for a unit to fully develop and understand the operating environment, and only then can targets be engaged. Success would enable this understanding of the operating environment and key players within it in a matter of weeks instead of months. Success depends on the US forces' ability to more rapidly and holistically understand the problem and commit fewer assets, but with greater fidelity of the situation, resulting in more effective results quicker.

Tradeoffs:

US forces must make tradeoffs in its development of big data analysis tool. First and foremost is the initial access to the data. DoD will have to purchase access to many data services that would provide information such as personal fitness devices and smart home devices etc. While DoD could utilize a small portion of its budget to purchase such data, the overall Defense budget is fluid from year-to-year and dedication to such a program may require shifting focus and funds. Second, the organization recording and archiving CCTV footage may only archive data for a limited amount of time. Additionally, as individuals and organizations move to recording and storing data on cloud networks, the DoD's reliance on networks will become essential. The DoD's preparation prior to entering a new theater will become and remain essential to gaining and maintaining the digital initiative. Understanding the network infrastructure and digital footprint of the countries the DoD is focused on as well as requesting and purchasing the proper data feeds will be crucial.

Areas for Future Research:

Once the Needle Finder is fielded and providing support to the intelligence analyst additional research and development could further develop support possibilities of the technology. First, further development of AI and machine learning could lead to future "less man-in-the-loop" target discretion and analysis, providing and executing recommendations for target engagement. Flagging targets as important non-kinetic (think Information Operations or capture targets), kinetic targets (think kill/destroy), or engagement areas would enable faster planning cycles, greater fidelity and discretion of asset engagement, and limit collateral damage. Second, future research and development might focus on AI's ability to calculate more accurate

second and third order effects outcomes based on method of target engagement. This would provide the man-in-the-loop greater fidelity of effects on the ground allowing for more accurate follow-on planning and actions. While this development would further AI, it will never fully replace the manned-unmanned team of machine, analyst, and operator.

Drone Squad

Problem Statement: Dense urban terrain (DUT) provides the enemy multiple opportunities for forces to maneuver undetected and gain an advantageous firing position due to limited ISR assets.

Hypothesis: The Drone Squad provides, beginning at the squad level, an intelligence, surveillance, and reconnaissance (ISR) capability with mission swappable pods that enhances the forces ability to conduct missions.

Capability Description:

The DS is a small drone system at the squad level that provides local ISR to the squad and has swappable mission modules that leaders can choose to employ based on mission requirement. As mission requirements change the individual drone can be linked to other drones to form the DS. In the DS set up, the drones can be linked together to move and maneuver as a separate force with different mission pods as required to accomplish any assigned mission.

Concept of Employment:

A squad could use an individual drone for local ISR to provide time and distance of nearby enemy so leaders can determine threats and risk to force. The drone will allow the operator to look ahead, see around dead spots, or lead into confined areas to determine risk. For

example, an infantry squad leader could send a drone into a house first to identify if there are any hostile forces inside or a vehicle commander could use a drone ahead of his vehicle or convoy, around a blind spot, or into an intersection to determine if the route is visually clear of threats. Depending on the mission pod the drone is carrying, if the drone discovers a threat, the operator could engage the threat with the drone directly, call for indirect fire, maintain observation, or track the threat.

If the commander requires multiple drones to cover an area, he could employ them using the DS concept. A platoon leader would be able to employ four drones in a DS and Company Commander could employ as many as 12 drones in a Company level DS. A Battalion commander and higher would be able capitalize on the number of operational drones to design mission specific DS. Operating using the DS concept allows the commander a quick response to a critical situation, such as target development, support to troops in contact, or personnel recovery. If the commander requires target development he could task the DS to fly a reconnaissance mission to identify routes, to determine target location based on biometric scanning, or to fly a repetitive pattern to determine pattern of life. The commander could respond to a troops-in-contact situation by employing the DS to provide a faster ISR asset response, indirect fires capability, or to maneuver on the enemy force. Due to the DS scalable size, the DS could support personnel recovery efforts by providing a wide search area, using biometric scanning mission pods to identify personnel involved, tracking the missing personnel, or providing fire support until recovery. The DS concept provides leaders a low cost and responsive ISR asset for quickly evolving battlefields.

Measures of Success:

The two measures of success for the DS are reduced collateral damage and increased situational awareness at the squad level. A squad would need to assess the reduction in collateral damage during actual combat situations due to the difficulty of fires clearance, operator training, and target identification. It would also be useful for evaluators to assess collateral damage at military training centers before the DS is used in combat. A squad can assess its increase in situational awareness during home station training and during training at a military training center. The unit's willingness to train with the DS from the individual level and higher is the most significant factor in whether the squad will see an increase in situational awareness.

Tradeoffs:

The drone or the DS would still require an operator, reduced flight time, and payload size. The operator can set the drone or DS to operate semi-autonomously, but the DS will still require an operator to verify targets for engagement, load mission plans, pilot the drone if wanted, and provide maintenance. The operator still requires training to operate the drone, however, since the drones are based off of current market systems, units could leverage the knowledge base of personnel who already know how to pilot drones and create a unit training plan. Additionally, the DS utilizes commercial-off-the-shelf drones, whose flight time is limited to battery life. Current drone systems have approximately thirty to forty minutes of flight time. Therefore, the leader would need to take battery constraints into consideration for ISR planning, or ground units would need to carry additional batteries to keep the drone operational.[115] Finally, the drones have a limited payload capacity. Considering recent evidence, criminal organizations

that use drones to deliver drugs into prisons have been limited to the weight of a hand gun, which is approximately three pounds.[116]

Areas for Future Research:

Although current commercial drones can avoid obstacles and track targets, there are still areas to improve the DS capability. First, the mission pods are based on multiple commercial-off-the-shelf drone systems, such as facial recognition, land survey, and CBRNE detection drones.[117] Mission pods need to be designed to fit the size, weight, and power constraints of the drones. Second, to use the DS concept, each drone needs an easy-to-use swarm software program that would allow fast linking and processing power distribution to allow for data management. Third, the DS would require integration with or access to a database to pull information. This information could range from biometric, vehicle, or weapon identification information. Fourth, while current drone systems do have onboard maneuvering capability, the DS requires additional research and development on artificial intelligence to maneuver against a target so that the drone can utilize additional drones, cover, and concealment. Fifth, to be as functional as possible, the drone requires longer battery life and additional payload capacity, while retaining a small deployable design. Lastly, to assist in mechanized or motorized operations, the DS could benefit from a vehicle mounted launching and charging station.

Optionally Manned and Armed Logistics Vehicles (OMALV)

Problem Statement: In both the open and urban environment, traditional ground transportation vehicles in the logistics community are not currently configured or equipped to meet the force protection demands and distributed environment described within the Marine Corps Operating Concept.

Hypothesis: The employment of optionally manned armed logistics vehicles will minimize friendly casualties by keeping personnel out of harm's way, increase convoy force protection, extend sustainment requirements for distributed maneuver forces, and re-allocate manpower to other high demand force structure requirements.

Capability Description:

The optionally manned and armed logistics vehicle (OMALV) is an unmanned ground vehicle (UGV) able to provide tactical-level ground transportation lift and internal convoy security. The OMALV is either operated as a traditional ground logistics vehicle with a human driver and internal crew or operated autonomously in a leader-follower fashion linked with a manned command vehicle. When an OMALV is not manned, the unmanned vehicle is able to navigate autonomously or by inputs from the associated command vehicle. The ratio of manned versus unmanned vehicles in planning convoy operations is one to five. The OMALV weapon system is tele-operated or autonomous and outfitted with a stabilized crew-served weapon ranging from a M240G, Mk-19, .50-cal machine gun or up to a 30mm chain gun. Additionally, the turret system would put the gunner inside the vehicle and out of harm's way by configuring the stabilized weapon system with day and night optics and engagement controller. The manned command vehicle is able to monitor up to five unmanned vehicles and network their associated weapon systems into the convoy's force protection and fires plan. Unmanned OMALVs act as wingmen during convoy operations and provide mutually supporting fires along the convoy's route either by autonomous or tele-operated operation.

Concept of Employment:

The OMALV is an armed logistics vehicle primarily employed to conduct resupply convoys and long-haul movements of supplies, bulk liquids, and military containers via motorized transportation. The OMALV system offers the capability to operate convoys at an increased rate in any given twenty-four hour cycle with a reduced footprint of personnel. Employing OMALVs is scalable from motor transportation platoon sized missions to a Transportation Support Battalion during Marine Expeditionary Force sized missions. The lethality of a stabilized gun system able to operate day or night provides the type of precision fires that make convoy operations "hard targets" in all environments. When engaging enemy threats, the weapon system is able to provide accurate rounds on target at the maximum effective range of the respective weapon system. Additionally, the Drone Squad could integrate with the OMALV to provide an ISR platform for convoy operations. Drone Squads would provide convoy commanders route reconnaissance information, guardian angel over-watch during road marches, and the ability to call for indirect fire or air support when the DS detects enemy threats.

Other areas the OMALV system has potential supporting are offensive and defensive operations. During offensive operations, unmanned OMALVs could provide the firepower required to conduct a reconnaissance mission or act as a vanguard when able to minimize human risk factors. The OMALVs ability to network internal fires and stream video from the vehicle's day and night optics provide valuable intel from the ground level. Unmanned OMALVs offer new means to reduce friendly casualties such as executing bounding over-watch in complex urban terrain for manned units following in trace, executing route clearance missions along main supply routes (MSR), and all the way up to conducting movement-to-contact operations in locating and relaying enemy locations. For defensive operations, OMALVs could be employed

in a defensive picket-line to over watch difficult terrain with reduced line of sight using an economy of force or set into security post duties much like a sentry in a guard post within a Forward Operating Base.

Measures of Success:

There are four areas for measuring the success of this system: increase the lethality of convoys operations in a twenty-four hour period, increase throughput of convoy operations in a twenty-four hour period, decrease manpower requirements for conducting convoys, and reduce the requirement for maneuver forces to protect logistics units. Providing precision fires to convoys turns previously perceived "soft targets" into "hard targets" to attack. The increased lethality of convoy's force protection and internal security should reduce the demand for maneuver elements embedding in resupply convoy missions or patrolling MSRs. Reducing the need to man every vehicle provides the ability to generate more convoys per day and allows force structure to move to other high demand manpower fields. Success in these four areas may reduce friendly causalities by not exposing unnecessary personnel into harm's way.

Tradeoffs:

Several tradeoffs exist with reducing manned requirements in convoy operations. First, motor transportation (MT) personnel do more than just drive vehicles from location to location. Often, MT personnel maintain and prepare every vehicle for convoys, then load and offload supplies to their customer. There may be a tradeoff to continue to do similar activities with fewer MT personnel which may impact the current MT organization. Secondly, the cognitive load of an individual will greatly vary when monitoring unmanned OMALVs in a garrison versus combat environment. Studies will need to research the correct balance of manned versus

unmanned vehicles in convoy operations. Third, enemy threats will look for ways to deny the use of unmanned technologies by means of jamming, spoofing, or creating complex environments difficult for machines to comprehend. As OMALVs are presented with new situations and environments, the OMALV will be required to have an ability to upload shared information along the system enterprise. Fourth, as new technologies for the OMALV emerge, the new force structure will be required to maintain and operate the new system. It may be necessary to reduce MT operators at the cost of creating new requirements for more mechanics, armory and optics personnel, communicators, or other military occupational specialties. Finally, the tolerance for losing gear is not well received within military ranks, even if it is due to a combat loss. How will this approach to gear accountability change as units become less risk averse with employing unmanned vehicles in high risk situations?

Areas for Future Research:

Proven technologies for driving unmanned vehicles in extreme environments exists but the pairing of employing UGVs and autonomous weapon systems does not exist. First, in decreasing the man-in-the-loop and human cognitive load, research and development will need to address the combination of both autonomous UGVs and weapons systems. Operators of this system in a combat environment will quickly reach a tipping point of being over saturated with situational information and internal convoy task management. Research should focus on reducing tele-operated functions to the maximum extent possible to decrease the manpower requirement for conducting convoy operations. Second, vehicles breaking down or getting stuck is a common occurrence. Research will need to address unmanned recovery vehicles to remove the requirement of recovery operations currently being a manned mission. Finally, research should investigate new efficiencies in loading and unloading vehicles to address the manpower

gap created by fewer MT personnel. The task to load and unload a convoy is time consuming and research will need to focus on more efficient container and storage systems and the best way to reduce friction in the delivery of supplies.

Active Denial System (ADS)

Problem Statement: In the urban environment, traditional fires cause significant collateral damage; accomplishing the mission while minimizing friendly casualties and collateral damage requires new fires technology.

Hypothesis: The non-lethal active denial system (ADS) provides a counter-personnel capability that will reduce damage to the environment, decrease civilian and friendly casualties, and allow forces to clear areas faster to enable freedom of maneuver.

Capability Description:

The ADS is a non-lethal weapon that provides a counter-personnel capability by using directed millimeter wave energy. The millimeter wave energy thermally stimulates nerves on the surface of the skin instinctively causing a person to move. [118] In the development of the system, researchers tested the system on over 13,000 volunteers and found that within seconds, reflexes caused the volunteers to move out of the beam to avoid the sensation on their skin.[119] This effect is the "repel effect" and causes humans to close their eyes, turn their heads or bodies, and move out of the beam.[120] The system has multiple built in safeguards including short shot duration, a scope for the operator to see the entire beam path, and hardware and software to adjust the beam path to adapt for environmental conditions.[121] Together rigorous testing, demonstrations, studies, independent reviews, and legal reviews proved the ADS technology effective in a relevant environment.

The DoD could integrate the ADS into multiple weapon systems depending on the intent for use. Currently, the maximum range of the ADS is 1,000 meters; however, shorter standoff ranges are possible. Due to the variation in standoff ranges, the ADS could be integrated into fixed-winged platforms, helicopters, larger UAVs, ground vehicles, and maritime vessels. The power that the system requires varies with the standoff range and depends on the generation of ADS technology. A solid-state ADS technology, currently in development, will allow for a smaller form-factor with a lighter power supply that will be man-transportable and could be useful for dismounted infantry.

Concept of Employment:

The ADS is a counter-personnel weapon to use as a tool in the escalation of force. Specifically, the ADS should be a standard part of operations for crowd control, convoy and patrol protection, and checkpoint security. The ADS fills the gap between "shout and shoot" by providing a non-lethal weapon that gives a standoff range, but that the target cannot ignore or overlook. To incorporate the ADS into the rules of escalation of force, the military member would give the threat a verbal warning, then a visual warning using a device like a flag or light, and then employ the ADS prior to the use of lethal force. In this situation, the weapon would likely be mounted on a ground vehicle, including the OMALV, or be man-transportable by the individual. The DoD may also decide to integrate the ADS on fixed and rotary wing platforms that are providing fire support for ground forces, or use the ADS as an alternative to lethal force in close coordination with ground forces. Crew on-board a ground vehicle or aircraft could fire the system, or an operator in the rear could fire it using a low latency camera. Either way, the operator in the ground vehicle, aircraft, or rear will receive the same image through the boresight of the weapon.

Incorporating this non-lethal weapon into the inventory provides the Joint Force Commander (JFC) additional options and provide benefits for US forces in the urban environment. According to Joint Publication 3-06, *Joint Urban Operations*, "When civilians and hostile forces are intermingled, non-lethal weapons will provide the JFC a broader range of capabilities intended to significantly reduce undesired injuries to civilians and damage to infrastructure." In addition to providing positive effects for the population of urban environments, there are benefits of using the ADS to US forces. For example, an ADS can provide friendly forces an alternative to clear angry mobs to a distance that reduces the threat of weapons against friendly forces and provides room for maneuver. There may also be a psychological benefit for US forces. Journalist David Brooks as quoted in *ARMY Magazine*, describes a scenario where insurgents use women and children in attacks against US forces causing US forces to engage, "soldiers and Marines feel a totalistic black stain on themselves because of an innocent child's face, killed in a firefight. The self-condemnation can be crippling."[122] In this same situation, the ADS would allow US forces to use non-lethal force.

Measures of Success:

The three most important measures of success for this system are reducing civilian casualties, friendly casualties, and collateral damage. An optimal decrease in these parameters is difficult to forecast since it is largely dependent on the character of the war. For example, if US forces are largely conducting air support, one might observe different results from an ADS than if ground and air forces were both heavily involved in an urban conflict. That said, a possible place to start measuring whether the ADS is successful is to look for a greater than twenty percent reduction of civilian casualties and collateral damage, and a greater than ten percent

reduction in friendly casualties. Success in these measures may also increase support and trust of the local and US populace.

Tradeoffs:

There are several potential tradeoffs inherent with the ADS technology. First, the weapon could be affected by weather and atmospherics. An ADS integrated into an aircraft or ground vehicle may not be useful in inclement weather, including sand and dust storms. Similarly, the maritime boundary layer could reduce the intensity of the beam. In these cases, the user may not have the weapon available to him or the weapon may require additional power to achieve the same intensity on the target. Additionally, integrating the ADS into systems with limited size, weight, and power (SWAP) tolerances may cause operators to choose using the ADS technology instead of another sensor. For example, the MQ-9 currently does not have the SWAP to integrate an ADS, but it might be possible to integrate if the operator chose to temporarily remove and replace another sensor for missions when the ADS would be more useful. To prepare for these situations, it would be useful for the ADS to employ open system architecture and interface so it can be "plug-and-play" into existing combat systems. Finally, as with all non-lethal weapons, the ADS may not be useful in accomplishing the specific goals of the operator and the situation may escalate to a lethal engagement.

Areas for Future Research:

While multiple technology demonstrations proved ADS technology works, additional research could increase its capability even further, particularly as the ADS integrates into other systems and platforms. First, the research and development community must continue to invest in batteries that provide sufficient power in the smallest form factor possible. Second, while

initial deployment of this weapon will have a man-in-the-loop, future research should be dedicated to more autonomous employment to take the load off of task saturated operators. Third, because of vibration and atmosphere that the directed energy beam will encounter when on an aircraft or ground vehicle in motion, research should improve beam stabilization. This will ensure the beam has sufficient intensity when it hits the target and reduce jitter of the beam on the target. Finally, a spiral development program could incorporate a counter-fire capability to protect ground vehicles and aircraft against rocket-propelled grenades and guided munitions.

Conclusion

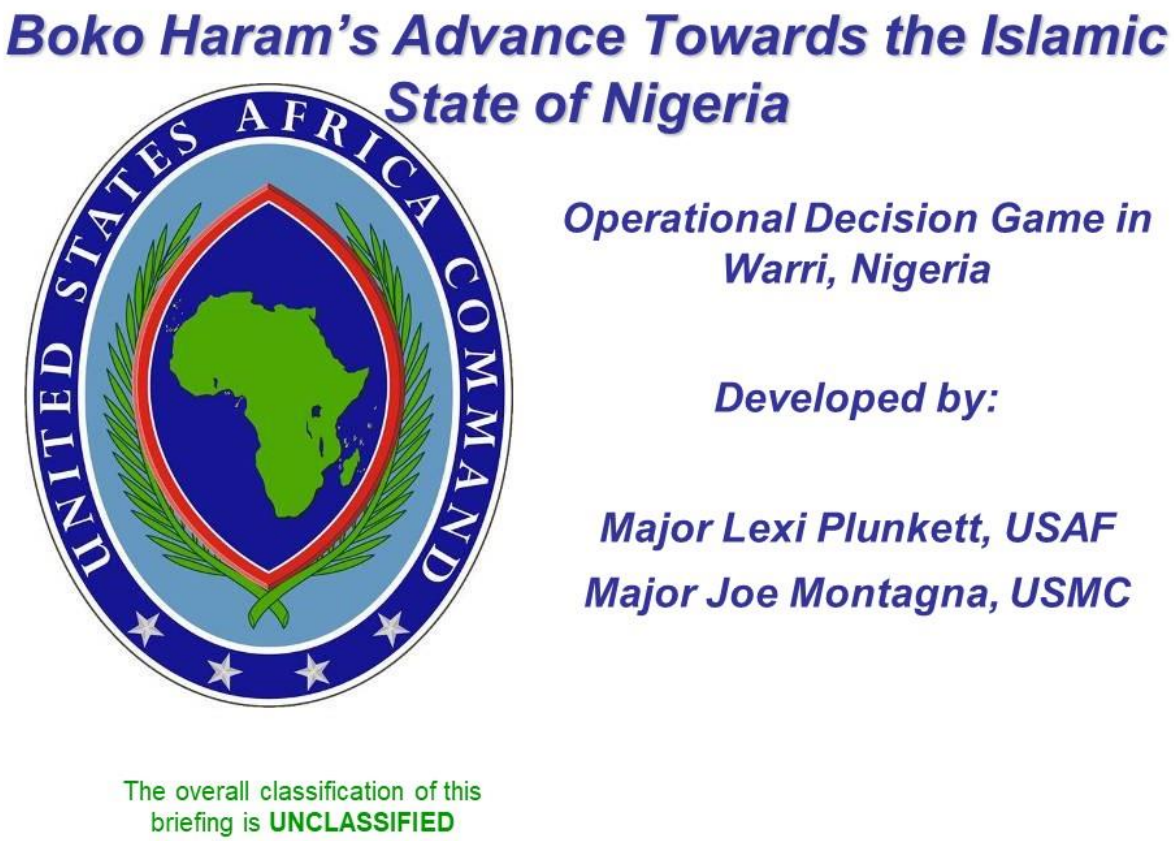
The four systems that comprise the Technology for Urban Terrain close current gaps across five warfighting functions in urban environments. These systems will contribute to the successes of US forces by allowing them to rely on machines to reduce cognitive load, protect friendly forces, prevent civilian casualties, and minimize collateral damage. Each system can be utilized individually or work together to achieve synergistic effects. The Needle Finder uses big data analytics to combine open source and classified data to provide better situational awareness from all available methods in an area of operations. The Drone Squad contributes to the WFF of maneuver, fires, force protection, logistics, and intelligence, and is a scalable and modular solution that adapts to the unique needs of a squad-level unit. The OMALV is a manned, autonomous, and tele-operated tactical-level motor transport system enhancing logistics, protection, fires, and maneuver in both urban and open terrain. Finally, the ADS is a non-lethal fires solution that provides protection to friendly forces by creating a standoff range between threats and the ADS system. Together, these four systems seek to reduce the asymmetric advantage the enemy has operating in the dangerous and complex urban environment.

Conclusion

Combining the lessons from the Battle of Mogadishu with the advent of new human machine collaboration technology allows the US military to imagine a next-generation technological concept that will shift the advantage in future urban warfare. The Battle of Mogadishu demonstrated the challenges that US forces had against a technologically inferior opponent who could blend into and influence the population with ease. Incorporating human machine collaboration into the next urban campaign has the potential to enhance intelligence collection and fusion, protect lives, deliver accurate and discriminant fires, and move through previously unpassable streets. The Technology for Urban Terrain does just this; it combines four systems that can be deployed together or individually to limit the enemy's asymmetric advantage that US forces may experience in cities. With the rapid growth of urban spaces around the globe, US forces require systems that leverage greater human machine collaboration to protect and enhance their ability to be successful in future urban warfare.

Appendix A – Boko Haram's (BH) Advance towards the Islamic State of Nigeria

Boko Haram's Advance towards the Islamic State of Nigeria Operational Decision Game created by Majors Alexandra Plunkett and Joseph Montagna



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Guidance and Context

This operational decision game (ODG) is an unclassified fictitious scenario developed as part of the requirements for completion of the Advanced Studies Program at the USMC Command and Staff College.

The purpose of this ODG is to test a future operational concept(s) as part of a notional future threat. Your participation is extremely important to understand how different players approach the challenge and employ technology. The more information that you are able to provide on your thought processes, concept of employment, and warfighting functions, the better we can refine our future concepts.

Thank you for your participation!

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SITUATION 2030 – Violent Destabilization in Warri

The optimism of Nigeria as a democratic anchor state in Africa has been in decline since 2018, when violence from Boko Haram (BH) reached its peak in the northeast of the country. The dramatic spike in violence drastically increased security costs for Nigeria's Army, diverted government resources from other services, and discouraged foreign investment. In conjunction with the violence, after reaching its peak in 2018, Nigeria's GDP has contracted at least 1% annually furthering the grinding poverty throughout the country. Moreover, Nigeria is currently experiencing an extreme food shortage caused by increased desertification and pastoral grazing pushing farther south into the country. Finally, Nigeria's inability to implement family planning has resulted in high birth rates leading to its current youth bulge in which the economic support to dependency ratio is 1:10.

BH's aggression in northeast Nigeria between 2018 and 2030 has led to mass migration to the south of the country, as families fled in search of greater stability and opportunity. Many families were drawn into the city of Warri in the Delta State because of its status as an oil hub. The migration from the north swelled the population of Warri, a largely Christian city, with Sunni Muslims who settled in the southeast of the city. The new Muslim inhabitants have had a difficult time assimilating and fulfilling their dreams for a better life. BH hungry for resources to create their Islamic State of Nigeria see the oil hub of Warri as necessary territory and is able to exploit its new Sunni inhabitants.

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SITUATION 2030 – Violent Destabilization in Warri (Continued)

After BH was able to gain a stronghold in southeast Warri, it was able to establish enough forces and momentum to take over the city's key infrastructure, including the airport, river port, and refinery. Furthermore, BH waged an offensive against the Amphibious Infantry Battalion, killing 120+ infantry and causing the remainder to abandon their equipment, which was then seized by BH and repositioned at various defensive positions throughout the city. BH has limited supplies and food from entering the city, starving the citizens and killing hundreds of Christians in offices, schools, police stations, and churches, raising the death count to over 10,000 in Warri.

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UNSCR 2030 and UNON

The atrocities against Christians in Warri led to UN Security Council Resolution 2030 authorizing a forceful response against BH leadership. The US-led task force responded quickly, with II MEF as the main effort, retaking 80% of the city's major infrastructure and, before redeploying, and turning the mission over to the UN-led stability force called UN Operations in Nigeria (UNON). UNON is a CJTF made up of the Nigerian Army, African nations fighting BH including Cameroon, Niger, and Chad, and 24 MEU (REIN). BH still maintains authoritarian presence in the neighborhood in the southeast (outlined in red on slides 9 - 10) making its population unreachable to the UN force. The 24 MEU (REIN) will support IDAD and stability operations as part of a CJTF to include counterinsurgency, FID, and support JSOTF conducting HVI raids. Nigeria, Cameroon, Niger, and Chad forces will provide security operations to maintain conditions for NGOs to provide humanitarian relief.

Security Council
United Nations

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AFRICOM Guidance

- Deny BH the ability to move outside southeastern section of Warri
- Capture key BH leadership from Warri and transport to airport (northeast Warri) for immediate airlift to detainment
- Set conditions to enable follow-on humanitarian aid
- Minimize civilian casualties and damage to infrastructure

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BH Fighters and Equipment

- No less than 1,500 BH fighters living amongst civilian population.
  - Large death counts of initial BH fighters resulted from fighting Nigerian Army. Most that are in Warri now moved to Warri from NE Nigeria in groups of 20-40 after BH began assault on Warri and when fighting II MEF.
  - Leader is A'been Pupeen who is in his late 40s, has been fighting for BH in NE Nigeria for two decades. He only communicates face-to-face, and lets his network of Lts use cell phones/radios/twitter, etc.
  - Lts are well trained in warfighting functions and messaging operations. Many have trained abroad with elements of ISIS and Al-Shabab. Majority of fighters are not trained or literate, but are motivated by drug addictions and ideology.
- Can quickly mobilize no less than 5,000 civilians in the southeast to support efforts if UNON threatens BH.
  - High unemployment rate leaves all ages/sexes without anything to do during the day.
  - Mosques can by used to shelter fighters, and conduct messaging.
  - Women and children will be used to conduct reconnaissance, conduct mass protests around UN forces, and act as human shields for armed fighters.
  - Average civilian has one cell-phone with data per household and has internet access via internet cafes (most operate 24/7) at least once per week.
- BH will capitalize use of Warri's 4G/LTE cellular and internet infrastructure.
- Equipment:
  - 55 "Technicals"
  - ~5-10 Anti-aircraft guns (ZU-23-2, Strela 2)
  - ≥1,500 Small arms (AK-47, Heckler & Koch G3, BM-59)
  - ~500 Mortars
  - ≥1,000 RPG-7
  - Suspected to have small cache (~1-5) SA-7s or 14s.
  - ~50 IEDs – more built as required (location of factory in SE of Warri unknown)
    - Includes IED, Vehicle-Borne IED, House-Borne IED, Air-Borne IED
  - ≥100 smart phones
  - Computers

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CTF Composition (Friendly Forces)

- Air Force
  - 24/7 RQ-4 Global Hawk coverage
  - 2 CAPS MQ-9 Reaper coverage
  - 4 EC-130 Compass Call
  - 4 x AWACs
  - 4 x JSTARs
  - 4 x C-130 (lift)
  - 4 x KC-46
  - 1 F-35 squadron (18 aircraft)
  - 3 x RJ-135
  - AF DCGS PED stateside
  - Maintenance available in theatre
- Marine Corps
  - 1 x ARG/MEU
    - 1x HQ Element
    - 1x Infantry Battalion (REIN)
    - 1x Combat Logistics Battalion
    - 1x VMM (REIN)
- Coalition Forces
  - 1 x INF Battalion (Nigeria)*
  - 1 x INF Company, each (Cameroon, Niger, Chad)
- Special Operations Forces
  - MARSOC: 1 x Marine Raider Co
  - AFSOC: 1 x DET (6) T-6 Super Tucano
  - USASOC: 1 x DET (6) 160th SOAR MH-47
- Other
  - Role 3 Medical Facilities aboard amphibious shipping
  - CRC in theatre (ground C2 node)

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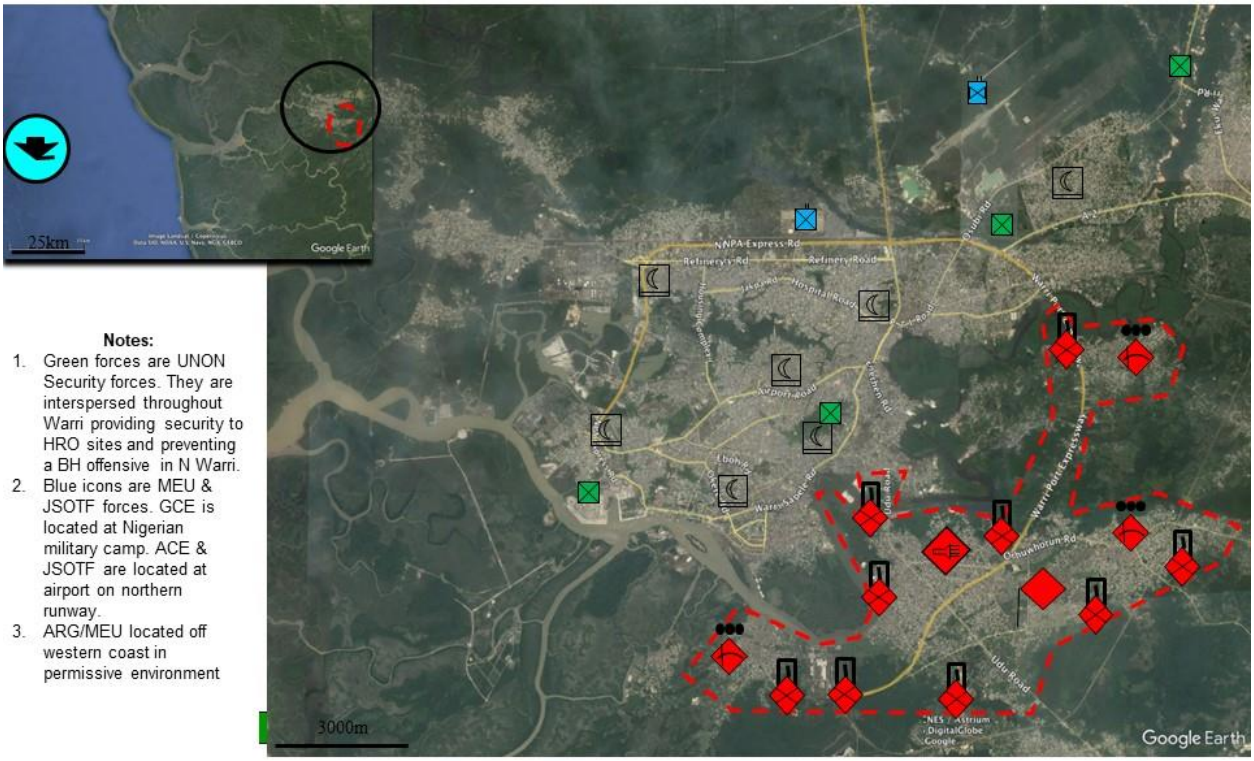
Warri Laydown At A Glance



Notes:

1. Green forces are UNON Security forces. They are interspersed throughout Warri providing security to HRO sites and preventing a BH offensive in N Warri.
2. Blue icons are MEU & JSOTF forces. GCE is located at Nigerian military camp. ACE & JSOTF are located at airport on northern runway.
3. ARG/MEU located off western coast in permissive environment

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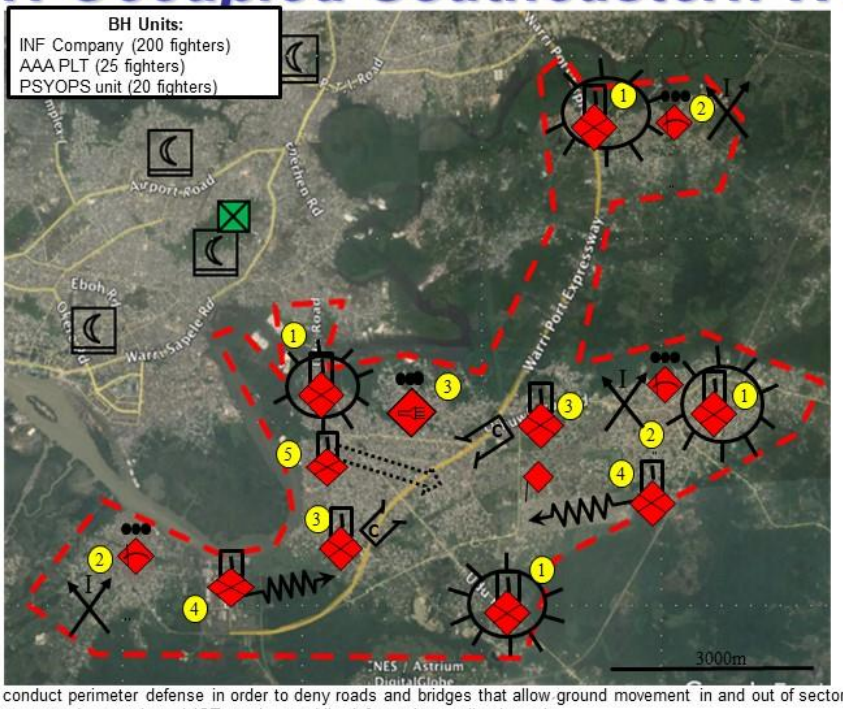
BH Occupied Southeastern Warri



1. 4x INF Company teams conduct perimeter defense in order to deny roads and bridges that allow ground movement in and out of sector. They will most likely allow superior sized force to pass by unmolested IOT conduct mobile defense in canalized terrain.
2. AAA PLT interdict approaching enemy aircraft into southeast
3. INF Company canalize forces into central portion of southeast Warri; PSYOP Platoon will exploit US forces using images and video of urban combat
4. 2x INF Company teams fix attacking forces to channel enemy forces in the center of the sector to ambush US forces
5. INF Company conducts a counterattack to kill as many US forces and possible

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Additional Information on BH MLCOA

1. BH has SE Warri divided into no less than 7 sectors. Each sector is probably divided further. Sectors likely have 24/7 sentinels that report to a "duty officer" who reports to the sector's Lieutenant. Communications are conducted in a variety of ways from shouting, sending runners, walkie-talkies, and occasionally social media messages.
2. Lieutenants are all connected via cell phones.
3. BH conducts perimeter surveillance but keeps majority of permanent fighters clustered inside population centers.
4. BH allows US forces (air and/or ground) to penetrate well inside city and become canalized. Intent is to trap US forces inside a sector by using impromptu roadblocks (trash, tires, fires, etc.), moving groups of fighters to bridges and roads once US forces have crossed, and quickly mobilizing masses of civilians to protest in streets and collapse on US ground forces. Expect other civilians to be attracted by gunfire to see what is going on.
5. BH is using HUMINT to serve as ISR around Warri, especially at the airport and northern military camp. Expect BH to recruit near real-time mass mobs using text alerts, megaphones, and mosques to increase chaos and population/weapons density in southeast.

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Additional Information on UNON MLCOA

1. CJTF will have 24/7 video surveillance over SE Warri and will be able to monitor and/or jam radio frequencies at will.
2. CJTF forces will have the capability to destroy communications infrastructure but will likely refrain from doing so.
3. JSOTF will likely conduct all HVI missions at night. MEU will likely conduct 24/7 counterinsurgency and FID missions.
4. CJTF will likely maintain a forward presence around the perimeter of SE Warri using combined arms and various air and ground mobility assets. HQ and various reserve elements will likely be kept in garrison on north side of Warri. CJTF will maintain logistics link via USAF and ARG.
5. CJTF will attempt to minimize repetitive tactical missions.
6. CJTF will minimize civilian deaths. CJTF will allow civilians to migrate out of and into SE Warri in order to ensure civilians have equal access to aid and markets.

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GAME 1

- Game 1: Future US concepts against BH current capabilities.

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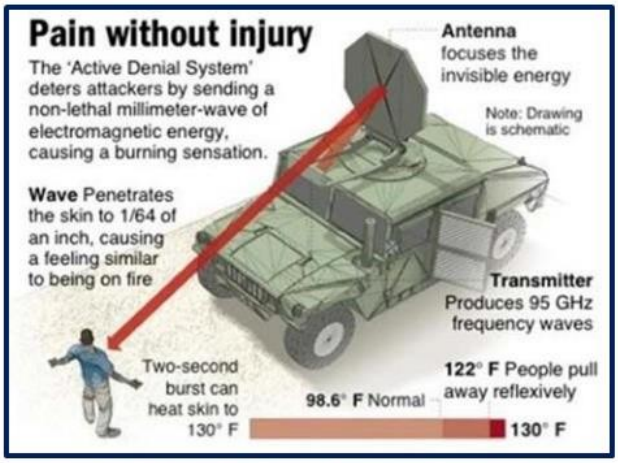
Future US Concept 1
Non-Lethal Active Denial

- **Crowd control: Non-lethal active denial system (ADS)**
  - **Directs millimeter wave energy to penetrate top layer of human skin**
  - **Most humans cannot withstand > 3 sec, no humans have withstood > 5 sec**
- **Under what conditions would choose to employ this capability?**
- **How would you employ it?**
  - **Would you integrate it into ground vehicles, helos, UAVs?**
  - **How would you queue it?**
  - **MUM-T: Would swarms of drones be useful to queue ADS?**



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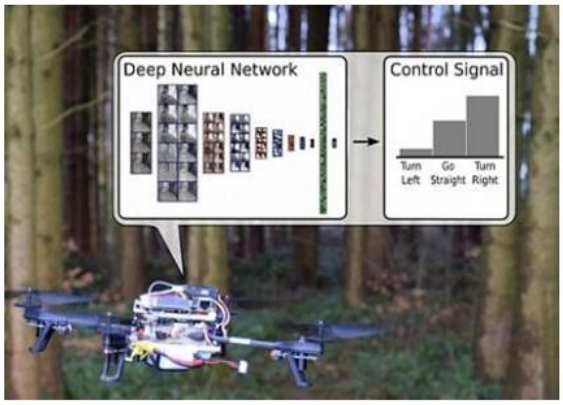
Future US Concept 2
"Post and Seek"

- "Post and Seek" capability
  - Software scrapes social media and passes images of interest to drone (or drone swarms)
  - Drone(s) will use learned behavior to look in a preprogrammed area to identify location of image and pass location back to US forces in a small data format
  - Drone can perch on rooftop or window sill to wait for object to pass while conserving power
- Flies autonomously in urban terrain
- Learns and solves complex problems
- Would this be useful?
- How would you employ it? Would it require a swarm?
- Would you recover it?
- What size drone is best for this application? Like a hummingbird? Like a hawk?



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Future US Concept 3 Information Warfare

- CJTF Information Warfare Capability
  - Social media scraping to identify themes, messages, key influencers, and enemy networks
  - Deny enemy propaganda accounts and activity
  - Traditional IO using strategic information designed to influence enemy population
- How would you employ it?
  - Would you use all three functions listed above?
  - How would you prioritize efforts?
  - What types of messages and platforms would you target as a part of your IO campaign?

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Fill in the problem framing, COA Graphic/narrative, and theory of victory slides

References on key terms are provided

SOLUTION SET

UNCLASSIFIED

Problem Framing

Problem Statement (incl. list of key facts and assumptions):
Tensions Between Current Conditions and Desired Conditions:
Elements that Must Change to Achieve the Desired Conditions:
Opportunities and Threats to Achieving the Desired Conditions:
Limitations:

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COA Graphic and Narrative

COA GRAPHIC OR TYPED DESCRIPTION	MISSION:
	INTENT: (purpose, method, desired condition)
	CONCEPT: (incl. key tasks by phase)

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Theory of Victory

Synopsis of your Central Idea

Necessary Capabilities

Application & Integration of Military Functions

Spatial & Temporal Dimensions

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GAME 2

- Game 2: Future BH concepts against US current capabilities.

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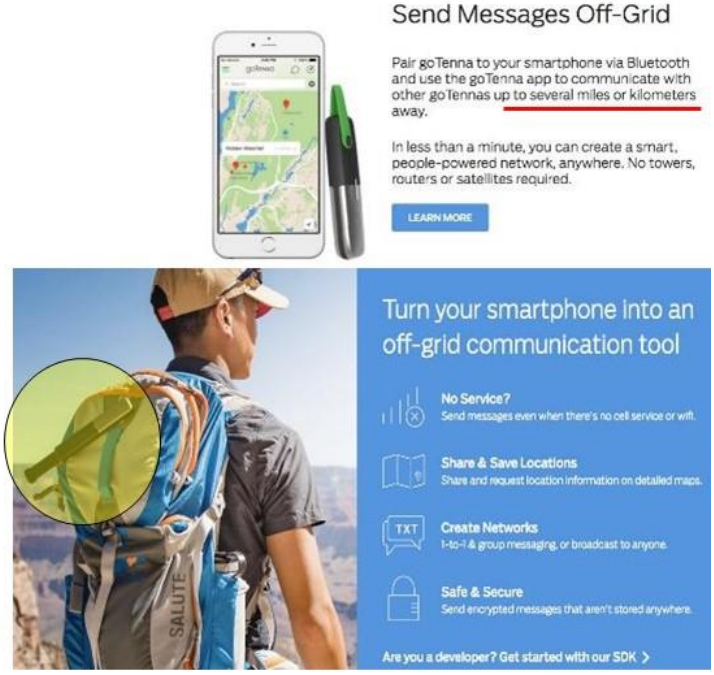
Future Non-State Concept 1

- **Linked communication infrastructure using smartphones.**
  - **Low-cost antenna and app creates a smartphone-to-smartphone network.**
  - **Does not require towers, routers, or satellites.**
  - **Networks groups of ≥10 users in a range of several miles.**
  - **Network can be established in < 1 min**
- **Under what conditions would you employ this capability?**
- **How would you employ it?**
  - **Would you integrate it into fighting against US forces?**
  - **MUM-T: How would an otherwise technologically outmatched force use this technology?**



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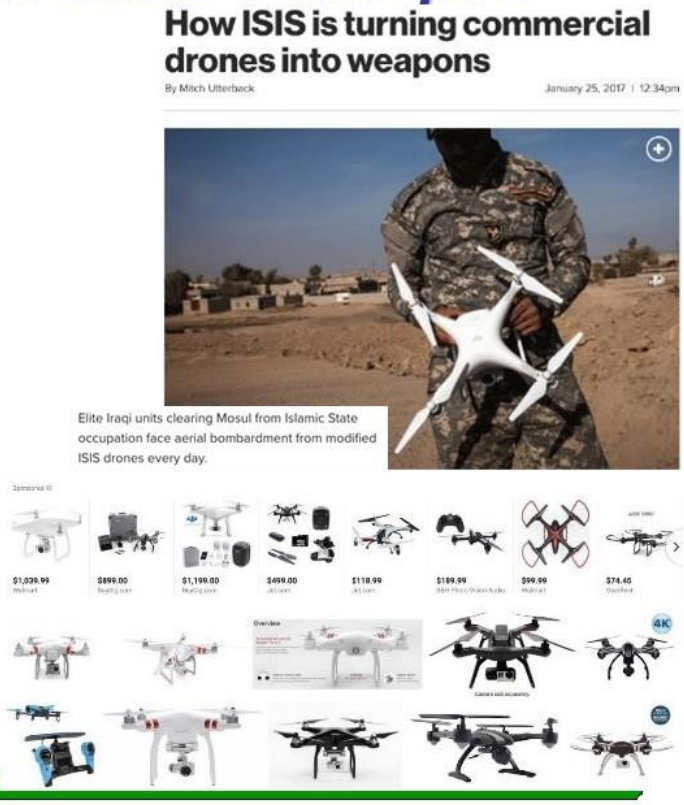
Future Non-State Concept 2

- **Using low-cost commercial drones for ISR, Air-Borne IED (ABIED), and communication relays**
- **How would you integrate multi-class drones into any of the following warfighting functions?**
  - **Intelligence**
  - **Fires**
  - **Maneuver**
  - **C2**
  - **Protection**



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Future Non-State Concept 3

- **Social media BOTs to spread mass volumes of propaganda**
  - **Propaganda widely distributed on networks likely to be accessed by US and Coalition populations**
  - **Propagates to popular platforms like Facebook, Twitter, and Instagram.**
  - **Includes images, video, text, and fake news.**
  - **America's intervention largely requires public support.**
- **How would you employ it?**
  - **Under what conditions would you choose to employ a media campaign as BH fights US in Warri?**

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Fill in the problem framing, COA Graphic/narrative, and theory of victory slides

References on key terms are provided

SOLUTION SET

UNCLASSIFIED

Problem Framing

Problem Statement (incl. list of key facts and assumptions):
Tensions Between Current Conditions and Desired Conditions:
Elements that Must Change to Achieve the Desired Conditions:
Opportunities and Threats to Achieving the Desired Conditions:
Limitations:

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COA Graphic and Narrative

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Theory of Victory

Synopsis of your Central Idea

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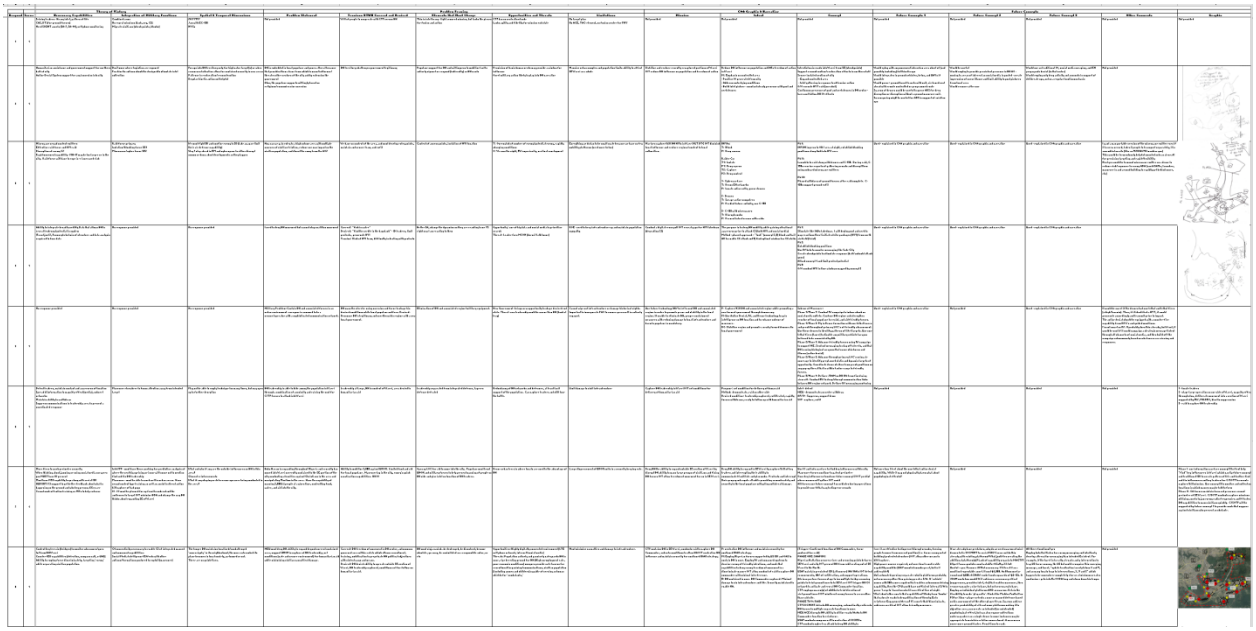
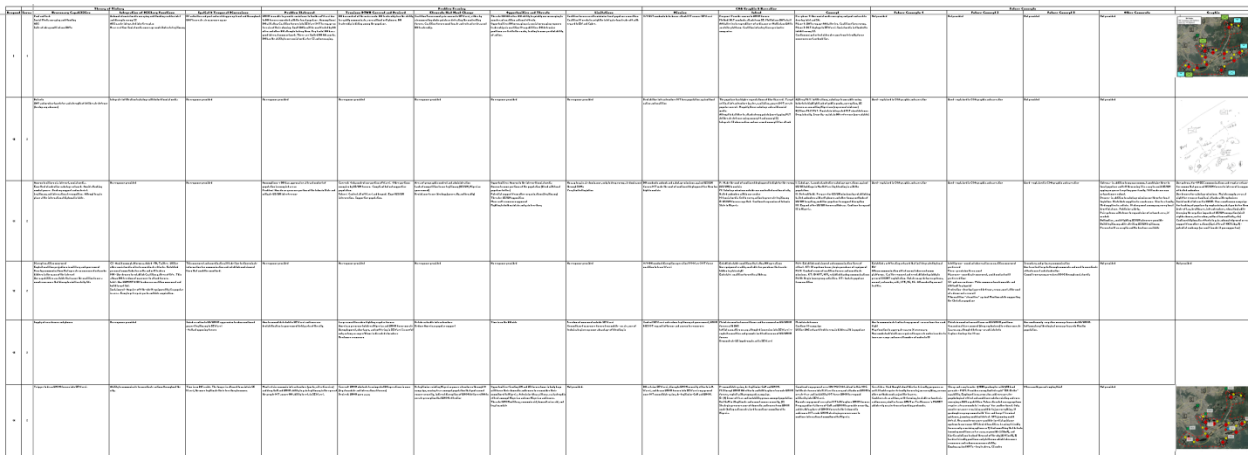
Appendix B - Table of Respondent Solutions to BH Advance towards the IS of Nigeria

Boko Haram's Advance towards the Islamic State of Nigeria Operational Decision Game Results





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[5] *Ibid*.
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