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Analysis of the Impacts of Nett Warrior on Lethality, Survivability, Collateral Damage, and Detection Range

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Abstract: Nett Warrior is a mission command system that supports the mission of dismounted combat leaders. It graphically displays a map detailing the location of leaders, friendly vehicles, and enemy activity on an Android Smartphone while allowing Soldiers to communicate using voice, data, and Position Location Information messages. Although Nett Warrior provides new capabilities, they may not have a large enough impact on lethality, survivability, collateral damage, and detection range to make it worth utilizing. This project simulates two scenarios tied to basic infantry tasks, with and without Nett Warrior capabilities, to compare the impacts to overall lethality, survivability, collateral damage, and detection range. The simulation tool utilized was Infantry Warrior Simulation (IWARS) which is a force on force simulation package that models individual and small unit operations. The study culminates by analyzing the outputs from the simulation to look at the efficacy of Nett Warrior on small unit operations.

Keywords: Nett Warrior, Infantry Warrior Simulation, Lethality, Survivability, Collateral Damage, Detection Range

1. Introduction

The Soldier is the centerpiece of the Army's formations and vision for the future. It is important that the Army finds ways to enhance the capabilities of the Soldier. Increasing Situational Awareness (SA) is important for many reasons but is specifically important to this project because an increase in SA enables a Soldier to more successfully conduct missions using intelligence data collected prior to and throughout an operation (Sisto, 2015). The Nett Warrior system is a system currently being fielded with the goal of enhancing SA for the dismounted infantry leader (Rosen and Walsh, 2011). Although Nett Warrior is a fielded system, its usage has been limited due to technical issues; as such, its full impact on survivability and lethality has not been quantified. Combat simulation offers a way to explore the effectiveness of the system by allowing for an in-depth exploration of scenarios without needing the resources to conduct an experiment that is not virtual. This paper looks at the overall effectiveness of Nett Warrior capabilities by analyzing the impacts to overall lethality, survivability, collateral damage, and detection range of a target in offensive and defensive combat scenarios with and without the device.

1.1 Nett Warrior

The Nett Warrior device has evolved over the years. It has taken on the name of Land Warrior, Ground Soldier System, and Ground Soldier Ensemble SA (Rosen and Walsh, 2011). Nett Warrior is a Soldier-worn mission command system that graphically displays a map detailing the location of leaders, friendly vehicles, and enemy activity on an Android Smartphone. It allows Soldiers to communicate using voice, data, and Position Location Information messages. It is connected through a secure digital radio waveform using the Soldier Radio Waveform (SRW) network. Nett Warrior can send and receive digital messages containing position reports, free text, observation reports, medical evacuation requests, mayday messages, overlays, route planning, Nuclear Biological Chemical reports, survivability messages, and situation reports. (Gilmore, 2015). These capabilities enable Nett Warrior to increase a soldier's SA which is expected to improve his or her survivability and lethality while decreasing the amount of collateral damage and increasing the detection range of a target (Rosen and Walsh, 2011). Despite Nett Warrior's potential benefits, its usage has been somewhat limited by issues with the SRW network and the associated radio. Additionally, the Nett Warrior interface requires Soldiers to look down and take their hands off their weapon (Welsh, 2014). These issues have caused the system to be used primarily in training

environments, with only a small number of units choosing to use it in combat. However, the Army is looking to correct these issues and provide the Nett Warrior capabilities to Soldiers as part of the Integrated Visual Augmentation System program.

Note that this analysis focuses on evaluating the capabilities of Nett Warrior, as opposed to the current system. As such, this study assumes that the network is reliable, and the user interface seamlessly conveys information to the user.

1.2 Combat Simulation

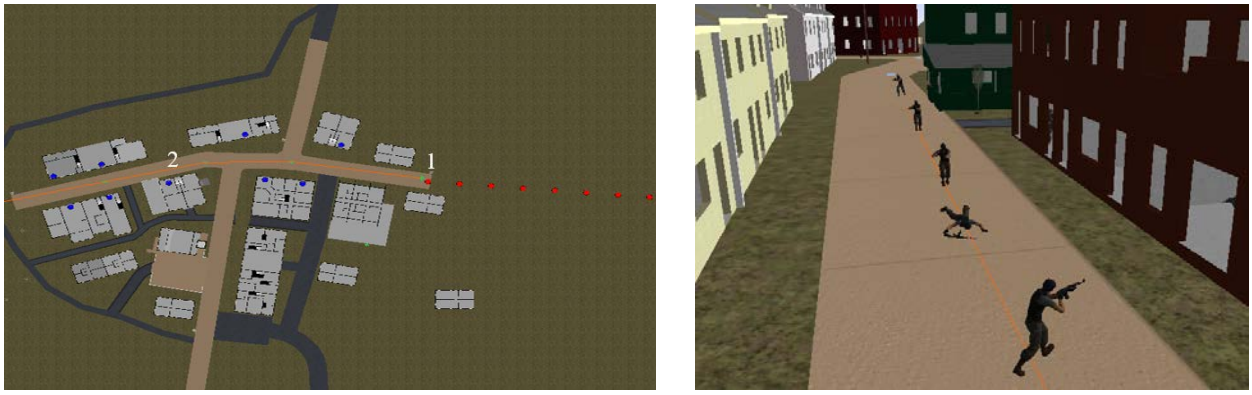
This analysis uses combat simulation to explore the relationships between the presence of Nett Warrior capabilities and its impact on lethality, survivability, collateral damage, and detection range of a target. Combat simulations are a powerful tool for studying causal relationships among different systems and courses of action (Kress, 2012). The combat simulation package used for this analysis is IWARS, which is an agent-based, force-on-force combat simulation program. It represents individual soldiers, teams, and small-unit combat operations in complex environments, including in military operations in urban terrain (IWARS Methodology Guide, 2014). This research used IWARS to simulate a rifle squad completing two infantry warrior tasks with and without the Nett Warrior capabilities.

2. Methodology

The first step in modeling the effectiveness of Nett Warrior capabilities was to create two base scenarios in IWARS. The first scenario models an infantry squad conducting an ambush. In this scenario, a blue force squad ambushes a red force squad as they travel down a road. The second scenario models an infantry squad reacting to contact. In this scenario, while on patrol, a blue force squad encounters a red force squad who is concealed in ambush positions inside of buildings alongside the road. The blue force squad maneuvers to counterattack positions at the other end of the battlespace to set a counter ambush on the red force squad. After the two scenarios were created, they were altered to include the blue forces having the Nett Warrior capabilities. After the four scenarios were created they were analyzed using the Batch Run Analysis and Simulation Studio (BRASS) program within IWARS. The BRASS analysis populated the number of red and blue agents killed in action (KIA), the number of shots fired, the number of times a bullet hit a target, and the range at which targets were initially identified.

2.1 Ambush Scenarios

A model was built in IWARS to replicate an ambush mission with and without Nett Warrior capabilities. According to Army doctrine an ambush is “an assault by fire or other destructive means from concealed positions on a moving or temporarily halted enemy” (ATP3-21.8, 2016). The model uses Fort Benning’s McKenna MOUT site to simulate the town, with the red force moving east to west. The two-dimensional map is shown in Figure 1a, with the initial position of the red squad labeled with a number one. At the start of the mission the red squad travels down the orange path into the blue squad’s kill zone, labeled with a number two. A kill zone is “the part of an ambush site where fire is concentrated to isolate or destroy the enemy” (ATP3-21.8, 2016). The blue force members are concealed in positions inside the buildings running alongside the



(a) (b)

Figure 1. (a) Map of ambush scenario showing red and blue squads in initial positions. (b) View from blue force member engaging red force squad at position 2.

road. Figure 1b is a three-dimensional map that depicts what the kill zone looks like from the perspective of the blue force as the red force is walking down the path in Figure 1.

Nett Warrior capabilities were replicated through combining several different features in IWARS. The squad leader is given access to the Common Operating Picture (COP). The COP is a network-connected data store of all known information (IWARS User Guide, 2014). This information provides data to a User Defined Operating Picture (UDOP), a handheld device used to send, receive, and display data for a specific area of operations (IWARS User Guide, 2014). Although the UDOP is similar to Nett Warrior, it does not possess all of the same capabilities. Therefore, additional capabilities were necessary to better represent Nett Warrior's capabilities. This was done by allowing the agents to share other known agent locations continuously as well as send and process SALUTE reports. SALUTE reports contain important information about the enemy's size, activity, location, unit identification, time, and equipment.

2.2 React to Contact Scenarios

A second model was built in IWARS to replicate a react to contact mission with and without Nett Warrior capabilities. According to Army Doctrine a react to contact is when "a squad or platoon employs suppressive direct and indirect fires; maneuvers to a position of relative advantage; and assaults to defeat, destroy, or capture and enemy" (ATP3-21.8, 2016). The model uses Fort Benning's McKenna MOUT site to simulate the town, with the blue force moving left to right as seen in Figure 2a. The two-dimensional scenario map is shown in Figure 2a. In Figure 2a, the red force members are concealed in positions inside the buildings running alongside the main road that is oriented east to west. The location of blue squad's starting position is labeled with a number one. The first fire team, consisting of the first four members of the blue squad, proceed through the red force's kill zone labeled number two. Once the red forces initiate the ambush, they take the first right turn available and proceed to counterattack positions inside the buildings around location 3. The second fire team, consisting of the last five blue squad members, waits five seconds and then immediately turns right to get to their counter attack positions while avoiding the red kill zone. The five second delay is intended to model the time it would take to make the decision to move to the counterattack positions without the aid of Nett Warrior. Once the blue force squad leader is set in his counterattack position, a second red squad, staged at location number four, is triggered to move. This second red squad walks down the road from north to south along the road where the blue force has set up counterattack positions. The three-dimensional map in Figure 2b depicts what the battlespace looks like as the blue force is utilizing the path network labeled number three in Figure 2a to set up their counter attack positions.

Just as in the ambush scenarios, in the modified mission the squad leader is given COP access allowing him to receive updates from the UDOP. All the agents share other known agent locations continuously as well as send and process SALUTE reports. Additionally, with Nett Warrior capabilities, the second blue fire team does not wait five seconds before proceeding to the counter attack positions. Instead they immediately turn right. This is meant to model the assumption that Nett Warrior capabilities will minimize the decision-making time of the blue squad by deciding to immediately turn right.

(a) (b)

Figure 2. (a) Map of react to contact scenario showing red and blue squads in initial positions. (b) View from blue force moving into counter ambush positions at Location 3.

2.3 BRASS

Once the scenarios were created they were analyzed using BRASS. BRASS is an organizational tool that is used to perform design of experiments and explore statistical significance for different factors. Additionally, it allows a user to run batch runs of IWARS to account for the stochastic nature of combat (IWARS User Guide, 2014). BRASS includes an Output Analysis tool, which was used to create three analysis files. The first data file determined how many blue and red agents were killed in action (KIA) for each run. The second data file was a count of the number of times a weapon was fired, and how many times an agent was hit in each run. The third data file recorded the range at which each red agent was initially detected by each blue agent.

Since IWARS is a stochastic simulation package, it is necessary to run it multiple times to account for variability. Equation 1 can be used to determine how many times each model should be run. This equation determines how many times the simulation needs to be run in order to be within a certain percent of the mean. In the equation, *s* is the standard deviation, *t* is the t-table value corresponding to the desired confidence level and sample size, *DRP* is the desired relative precision, and $\bar{X}$ is the mean. For this analysis, *DRP* was set at 10 percent. From this equation it was determined that each simulation needed to be run 110 times to achieve the DRP, based on a confidence interval of 95 percent.

$$n = \left(\frac{s \times t}{DRP \times \bar{X}}\right)^2 \quad (1)$$

3. Results and Analysis

Each model was run 110 times with certain metrics calculated to evaluate the effectiveness of Nett Warrior. The lethality metric was measured by the number of red agents that were KIA. The survivability metric was measured by the number of blue agents that were KIA. The amount of collateral damage possible was measured by examining the number of times a weapon was fired and did not hit another agent, compared to the number of times a weapon was fired and hit another agent. The detection range was measured by recording how far away a red agent was from a blue agent when initially detected. The results from the simulations suggest that the effects of Nett Warrior capabilities were fairly dependent upon the type of mission.

3.1 Ambush Scenarios

Nett Warrior capabilities increased lethality of the blue squad in the ambush mission as indicated by a significant increase in the number of red KIA ($p=0.007$). Figure 3 shows the average number of red deaths over the 110 runs with and without Nett Warrior. In the scenario without Nett Warrior capabilities the average number of red deaths was three, while the average number of red deaths in the scenario with Nett Warrior capabilities was four. On average the blue force was able to inflict one more KIA with Nett Warrior capabilities than without. This increase in lethality is likely due to the increase in communication between members of the blue force with Nett Warrior. As one blue agent identified a red agent, they had the ability to broadcast that information to the whole squad. This allowed blue force members further down the ambush position to be prepared for incoming enemy forces.

Nett Warrior capabilities did not significantly decrease the number of blue KIA in the ambush missions ($p=0.833$). A smaller amount of blue KIA would have indicated an increase in survivability; however, in this situation the blue force experienced a similar amount of KIA with and without Nett Warrior. Figure 3 shows the average number of blue deaths over the 110 runs. In the scenario without Nett Warrior, as well as in the scenario with Nett Warrior the average number of blue deaths was five. Nett Warrior capabilities should have allowed the leaders of the squad to report the location of known agents and should have allowed the blue force to actively send detailed reports to the other soldiers about the red forces size, activity, location, unit identification, time, and equipment. It was assumed that this should have increased their SA enabling them to identify enemy agents' faster and with more accuracy. It is possible that this did not happen because the blue force already had the tactical advantage in terms of protection. The blue force was protected by their concealment in the buildings alongside the road

IWARS showed that the average detection range of the blue force increased by an average of 73 meters *(SD=34.447)* with the Nett Warrior system. This meant that the blue force was detecting the red force at a further distance in the scenario with Nett Warrior capabilities than without. It is possible that this happened because the blue force was already set in their positions and had the time they needed to wait for the Nett Warrior messages. In these scenarios waiting for Nett Warrior messages did not significantly slow down the blue force's decision-making process. The time they had to wait for Nett Warrior messages did not impact their ability to detect red forces at a further distance.

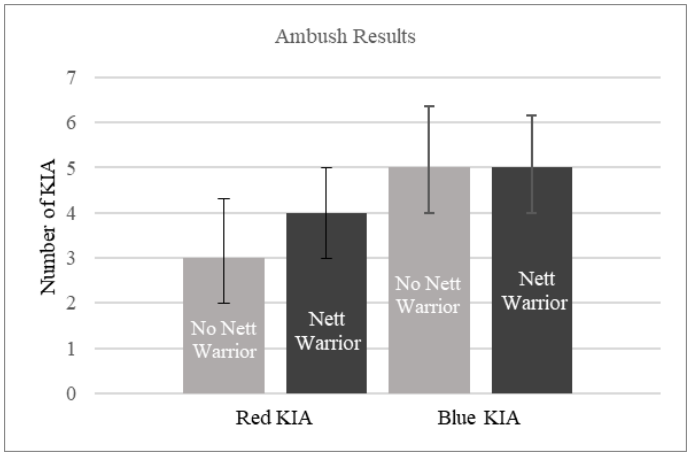


Figure 3. Survivability and lethality for the ambush scenario with and without Nett Warrior

Nett Warrior capabilities did decrease the amount of collateral damage. Collateral damage can be mitigated when the agent hits the target more often. Hitting the target more often means that there are fewer stray bullets flying into unknown and unintended locations. Figure 4 shows the accuracy of the blue agent's shots. In the scenario without Nett Warrior the percentage of hits was 25% compared to 75% misses. In the scenario with Nett Warrior capabilities the percentage of hits was 26% compared to 74% misses. Although there was a change in the percent hits and the percent missies, it was not found to be significant ($p=0.941$). However, the number of shots fired significantly increased from 65 without Nett Warrior to 80 with Nett Warrior ($p=8.23x10^{-9}$). It is possible that even though the blue force was not significantly mitigating collateral damage, the increased communication allowed them to concentrate their fires. This concentration of fires is likely why the blue force was more lethal in the scenario with Nett Warrior capabilities.

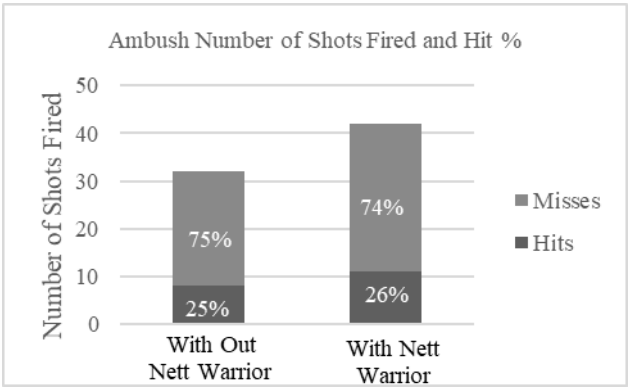


Figure 4. Number of Shots Fired and Hit % for the ambush scenario with and without Nett Warrior

3.2 React to Contact Scenarios

Nett Warrior capabilities significantly increased the number of red KIA in the react to contact mission, indicating that the blue force was more lethal ($p=0.003$). Figure 5 shows the average number of red deaths over 110 runs. In the scenario without Nett Warrior, the average number of red deaths amounted to six, while the average number of red deaths in the scenario with Nett Warrior amounted to seven. On average the blue force killed one more red force soldier when they had Nett Warrior capabilities. Though this change might seem small, the effects would be multiplied when looking at larger unit operations. Nett Warrior capabilities allowed the blue force agents to send and receive important location data about the enemy. As one blue agent would see an enemy they could report important information about the target to their own forces

further down the road. It is likely that Nett Warrior allowed the blue force to prioritize targets and work more efficiently in their sectors of fire. If two agents were engaging with one red force, they could have easily recognized the situation and allocated one of their resources to another target. The blue force was also more lethal because Nett Warrior capabilities reduced the time it took the second fire team to make the decision to maneuver to counterattack positions. It is assumed that they were able to get into their positions with more time to prepare to engage with the enemy.

Although Nett Warrior capabilities did decrease the number of blue KIA, indicating an increase in survivability, it was not found to be significant (*p=0.750*). Figure 5 shows the average number of blue deaths over the 110 runs. In the scenario without Nett Warrior there were a total of four blue KIA. In the scenario with Nett Warrior there were a total of three KIA. Nett Warrior capabilities should have allowed the leaders of the squad to report the location of known agents and actively send detailed reports to the other soldiers about the red forces size, activity, location, unit identification, time, and equipment. This should have decreased the amount of time it took them to make decisions and engage with the enemy before they could be killed or wounded themselves. It is possible that there was not a significant difference in blue KIA because the blue forces were spending time communicating with the Nett Warrior device and not detecting or engaging with enemy. This trend can be further explored by looking at the average detection range.

IWARS showed that the average detection range of the blue force actually decreased by an average of 5 meters (*SD=8.390*) with the Nett Warrior system. This meant that the blue force was detecting the red force at a slightly closer distance in the scenario with Nett Warrior capabilities than without. It was expected that Nett Warrior capabilities would have enabled the blue force to detect the red force from a further distance, similar to the ambush scenario. However, the fast pace and dynamic aspects of the react to contact scenario did not allow them to realize the benefits of the system. An analysis of the mission sequences found that the blue forces were spending time using their UDOP devices and sending SALUTE reports, which caused them to miss seeing the enemy that was readily detectable.

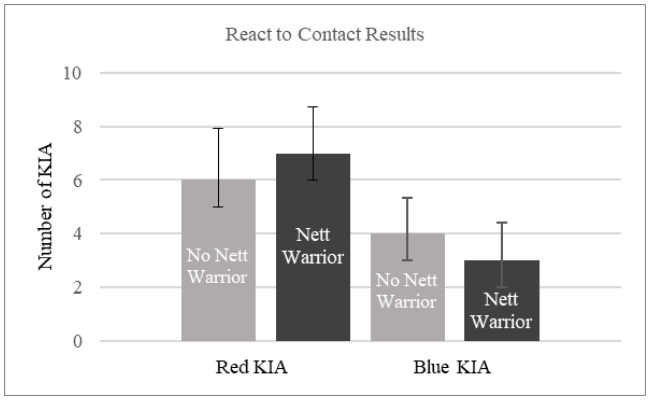


Figure 5. Survivability and lethality for the react to contact scenario with and without Nett Warrior

Nett Warrior capabilities did decrease the potential for collateral damage for the react to contact scenario. Figure 6 shows the percentage of times the weapon was fired and hit a red agent, and the percentage of times the weapon was fired and did not hit a red agent. In the scenario without Nett Warrior the percentage of hits was 26% compared to 74% misses. In the scenario with Nett Warrior capabilities the percentage of hits was 28% compared to 72% misses. The change in the percent hits and the percent missies was found to be significant (*p=0.016*). Nett Warrior capabilities painted a more holistic picture of the battlefield. Knowing the location of agents as well as detailed descriptions of the enemy increased their SA. In this scenario it was extremely important to know the location of the enemy because the fire teams were operating in different battle spaces for a period of time. Furthermore, the number of times the blue force fired their weapon significantly increased from 65 without Nett Warrior to 80 with Nett Warrior ($p=2.441x10^{-6}$). This is likely due to increased communication allowing for concentration of fires. Just as in the ambush scenarios, it is possible that the increased communication allowed the blue force to concentrate their fires, which may be why the blue force was more lethal in the scenario with Nett Warrior capabilities.

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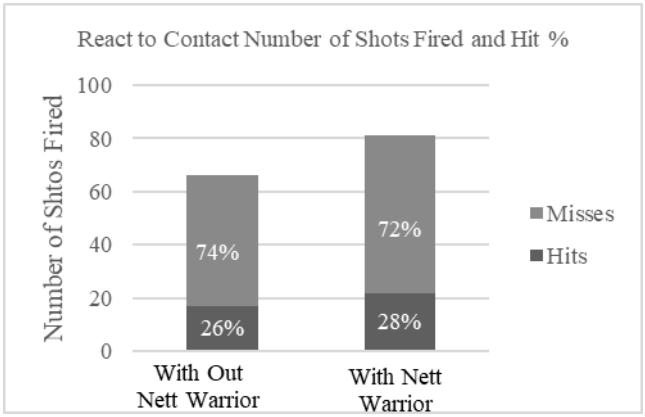

Figure 6. Number of Shots Fired and Hit % for the react to contact scenario with and without Nett Warrior

4. Discussion and Future Work

It is important to note the differences between the two missions. In the ambush scenario, the blue force was on the offensive, while in the react to contact scenario, the blue force was on the defense. Therefore, in the ambush scenarios the blue force already had the advantage, allowing them the time to adequately use Nett Warrior to enhance their ambush. Meanwhile, in the react to contact scenario, the blue force was in a compromising position and had to act quickly. Nett Warrior still provided them the ability to concentrate their fires and kill more enemy agents. However, in both scenarios there was not a significant change in survivability. In the ambush scenario this is because the blue force already had a good advantage in terms of protection, so the benefits of Nett Warrior were only marginal for survivability. In the react to contact scenario, the blue forces were busy using the system, causing them to detect the enemies later, resulting in them offsetting the benefits that they were receiving from the system.

This analysis was somewhat limited, in that it only looked at two scripted missions in a single environment. Depicting only two of the four warrior tasks is somewhat limiting because it is not getting a holistic view of the type of tasks that Nett Warrior will be a part of. Further research into the remaining Infantry tasks would strengthen the results of this research by confirming or refuting the findings presented in this paper. Further research could point out whether Nett Warrior capabilities have an effect on survivability, mitigation of collateral damage, and detection range given there was not a consistent finding in this research. A more thorough study including the full scope of infantry tasks could also identify the missions that Nett Warrior provides benefits, allowing leaders on the ground to appropriately equip their Soldiers.

It is also important to note that combat simulations are inherently limited by unreliable data, rapid changes in the environment and military campaigns, and the uncertainty of human behavior (Kress, 2012). As such, coupling live experimentation with the constructive simulation would provide additional insight, as well as validate the results of this study. The live experimentation would outfit one squad with Nett Warrior and a second squad without Nett Warrior; the two squads would perform missions similar to the ones presented in this study. The results of the study would also allow for the Nett Warrior device to be accurately modeled in IWARS.

5. Conclusion

The emerging importance of SA enhancing capabilities for Soldiers has significantly impacted technology in the military. It pushed the Army to create a Soldier-worn mission command system that supports the mission of the dismounted Soldier. This paper presented research conducted through modeling and simulating on the ability of Net Warrior capabilities to improve lethality, survivability, and detection range and decrease the amount of collateral damage possible. Two base models were created that were then altered to incorporate Nett Warrior capabilities. BRASS analysis was conducted on the scenarios and found that in the ambush scenarios the blue force's lethality was improved, the survivability did not change, collateral damage did not significantly decrease, and the detection range increased. In the react to contact scenarios the blue forces lethality improved, the survivability did not significantly increase, the collateral damage decreased, and the detection range decreased. The difference in results can be explained by the fact that in one mission the blue force was on the offensive, and in the other mission the blue force was on the defensive. It can also be explained by the pace of the missions.

The ambush mission was less dynamic and fast paced compared to the react to contact mission. This research suggests that Nett Warrior capabilities effectively increase lethality, do not impact survivability, decrease collateral damage in more complex scenarios, and increase the detection range in less dynamic and slower paced missions. Further analysis, coupled with live experimentation, is recommended to fully understand the impact of the Nett Warrior capability.

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