Agincourt with Artillery

Protection and firepower projection on the modern battlefield

by MAJ Daniel Mahoney

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This is the second article in a three-part series intended to explore the concept of offset strategies and how to overcome an opponent's advantage in mass. In the first article, published on the *Marine Corps Gazette* website in January 2021, the author reviewed the historical case of England's victory over France at the Battle of Agincourt in order to determine how England overcame France's advantage in mass. Armed with the lessons learned from this battle, this series now attempts to determine whether or not these advantages reflect an understanding of the *enduring nature* of war, or if they were simply part of the *changing character* of war specific to Europe in the 15th century.

In this article, the author examines the concepts of *protection* and *firepower projection* in order to better understand how to take advantage of them and how they can reinforce one another. Armed with this insight, the author next develops a materiel solution designed to replicate on some future battlefield the *qualities* of protection and firepower projection present within England's army at Agincourt. Finally, this article tests this materiel solution using an operational decision game and reviews the feedback from this game in order to determine whether or not the lessons of Agincourt are useful when considering how to achieve an offset to a future opponent's advantage in mass.

Initial Concept Development

Stated in terms of an offset, Agincourt demonstrates how ranged and protected firepower can offset an advantage in mass. While Henry's leadership and understanding of the battlefield were important, those tactical and leadership aspects of the battle are supplementary efforts in achieving the offset itself. With this in mind, the author researched current doctrine and future operating concepts regarding protection and firepower projection in order to explore ways to achieve a 15th-century-longbow type of offset against a near-future overmatch of mass.

Protection. Broadly defined, protection is the preservation of a military force's means of fighting.[1] Protection can apply to large formations or to individual soldiers. It can focus on physical systems, which contribute directly to combat power or digital systems which support the mission. This article will use the Army's five principles of protection in order to evaluate protection at Agincourt and to develop an initial concept for a future system.

According to the Army, effective protection is integrated, layered, redundant, enduring, and has a full-dimension approach.[2] For the purpose of this article, we consider both the degree of protection of individual longbowmen and also the entire English army as a system of systems. This analysis is relative to the English and French armies at Agincourt. It is objective when possible but requires some subjective judgment based on prevailing tactics and norms of the era.

Regarding individual systems, English longbowmen were equal to French crossbowmen regarding layered and full-dimension protection but were less well protected with respect to integrated, redundant, and enduring protection. Where longbowmen and crossbowmen were equal (layered and full-dimension protection), the case for the longbowmen is highly contextual. In both instances, the English wooden stake provides protection against a different threat source (mounted cavalry), whereas the French shield reinforces an existing degree of protection against a source for which protection already exists (missile or melee attack) in the form of plate armor. Since these differences depend entirely on the nature of the threat, an analysis of how these systems integrate into the entire army is necessary in order to draw further conclusions about protection.

The English army was better protected than the French army according to two principles of protection (integrated and layered) and worse protected according to the other three (redundant, enduring, and full dimension). England is only adjudged superior according to the layered principle because France chose to attack in waves consisting of a single combat arm at a time, so this is more of a French loss than an English victory. As a result, England only won decisively with respect to one principle: integrated protection. Recalling that the definition of protection concerns protecting combat power, it is clear that England achieved a higher degree of protection at Agincourt than did France

because of the relative number of casualties on each side. With that in mind, one must conclude that England's ability to achieve integrated protection offset its deficiencies in the other principles of protection. Although *FM 3-37* (*Protection*) does not weigh any one principle more highly than the others, this analysis suggests that integration was the most important principle for the English army at Agincourt.

Although this analysis does not consider other means of evaluating protection, it is important to consider survivability—one of the twelve critical tasks of protection.[3] Survivability concerns protecting sources of combat power and deceiving the enemy for the purpose of "mitigating friendly losses to hostile actions or environments."[4] The author selected this critical task from the FM's list of twelve, as opposed to any of the other eleven, because of its relevance to the specific context of Agincourt. The four areas of survivability are mobility; situational understanding; hardening; and camouflage, concealment, and deception. Of these four areas, mobility and situational understanding are the most relevant.

England's use of wooden stakes to disrupt France's cavalry charge is evidence of Henry's understanding of the tactical situation. He ordered that all longbowmen carry and employ these stakes earlier in the campaign because of his knowledge of French tactics and methods of employment and wanted to offset this potential source of French overmatch.

The relatively low degree of protection afforded England's longbowmen at Agincourt enhanced their mobility. This in turn made it easier for them to maneuver through the woods and harass the French position with missile fire at the onset of the battle and also permitted the longbowmen to quickly join in the melee battle with hatchets near the battle's end. While neither of these actions enhanced the protection of the longbowmen themselves, the actions contributed to England's overall degree of integrated protection and eventual victory.

Firepower projection. Stated in terms of an overmatch capability, projected firepower is an offset to melee firepower. FM 3-09 (*Field Artillery Operations and Fire Support*) describes projected firepower's contribution to warfare as the ability to mass "fires in space and time on single or multiple targets with precision, near-precision, and area fire capabilities."[5] Projected firepower fits into the conception of battle through eight effects: deceive, defeat, delay, destroy, disrupt, divert, neutralize, and suppress.[6]

The Agincourt longbowmens' low level of protection greatly increased their mobility. ***(Photo by The Royal Armouries.)***

The "protection" section of this article used a relative comparison between England and France due to the importance of protection on both sides of the battlefield, and because of the different means by which each army sought to protect itself. With respect to firepower projection, a relative comparison would convey little since France's crossbowmen did not contribute to the outcome of the battle.[7] As a result, this analysis considers the longbow and the English army from an absolute, rather than relative, point of view.

It is difficult to separate some of the effects of firepower projection from one another in the context of Agincourt, given the limited range of missions available to units in that era. For example, the effects of defeat, delay, disrupt, neutralize, and suppress all apply to the interaction between England's longbowmen and France's cavalry. Some effects might be more applicable than others, but none is inapplicable. With that said, the most notable conclusions from Agincourt involve defeat, disruption, and diversion.

English longbowmen were adept at defeating formations. The combined effects of arrow volleys and a field of wooden stakes defeated France's cavalry advance. During other battles of the Hundred Years' War, England's armies defeated entire enemy formations by virtue of their longbow fires with little to no contact between men at arms from either side.

Perhaps the most applicable mission for English longbowmen was disruption. England disrupted France's formation at Agincourt by goading them into attacking (because of England's harassing arrow fire), disrupted the French cavalry advance with arrow fire, and disrupted the formation of French men at arms with yet more arrow fire.

One mission for which England's longbowmen were not well suited was deception. Although arrows were indirect fire weapons, they were usually also line-of-sight weapons. It was difficult for a formation of longbowmen to achieve any type of deception regarding the impact of their arrows and the future intentions of other friendly forces. The modern example of firing smoke on a false landing zone in order to deceive an enemy regarding the point of friendly arrival would not work on a 15th century battlefield. That modern example only works because it takes advantage of enemy capabilities in observation and communication as well as friendly capabilities in mobility and munition effects, which did not exist at the time of Agincourt.

With the capabilities of individual formations of longbowmen in mind, this article next considers whether or not Henry achieved those effects at Agincourt. A direct comparison of the longbow's potential and the achievements of Henry's army at Agincourt shows that Henry used his longbowmen to maximum effect. When it was possible to achieve a certain effect, his

longbowmen did so. This is a testament to the training of his forces and his own ability to employ them in battle.

Future operating concepts. With respect to the *Marine Corps Operating Concept*, there is little mention of protection or survivability. The most noteworthy example is in a section titled "Battle of Signatures," which says that in the future, "our units will need to adapt how they fight, emphasizing emissions control and other means of signature management to increase their survivability."[8] In general, the document's tone is far more offensive than it is defensive, asserting that the best way to operate in a contested environment is through power projection. However, the document does little to address how those projected forms of power could protect themselves or whether or not they should.[9]

The *Marine Corps Operating Concept* is very descriptive regarding its vision of fires in the future. In general, the document says that the fires enterprise must shorten the kill chain, develop a mix of precision and saturation effects, increase mobility and range, develop multiple layers of unmanned aerial sensors, and defend against enemy fires through both active and passive means.[10]

Unlike the *Marine Corps Operating Concept*, the *Army Operating Concept* places a much larger emphasis on protection and survivability. For example, the section on "Technologies with military application" suggests that "new materials may deliver greater protection at lighter weights" and that "autonomous and semi-autonomous operational capabilities may increase lethality, improve protection, and extend Soldiers' and units' reach."[11] In other sections not dedicated to technology, the importance of achieving protection and survivability through the combination of multiple arms is woven into the text.

With respect to fires, the Army's emphasis is on range. The document states that "fires with extended range and enhanced precision [will] enable the Joint Force to overcome anti-access and area denial threats and project power from land into the air, maritime, and space domains."[12] The Army's concept believes that five characteristics will have a significant impact on future operating environments, one of which is the "[p]otential for overmatch." In this section, the document states that potential overmatch technologies include "long-range precision fires, air defense systems, electric fires, and unmanned aerial systems (UAS)."[13]

Finally, there is a section in the Army concept titled "Mobile protected precision firepower," which is of particular importance to this article. In this section, the document advocates for lighter, smaller, faster, and less logistically reliant systems. New systems with these attributes would reduce deployment timelines, increase the size of security areas, and improve survivability for the systems themselves. The section goes on to discuss the integration of these systems into formations with both manned and unmanned options and concludes with a mention of the importance of better sensor technology, key to detecting enemy actions.[14]

Initial concept. Taken together, the conclusions of the protection and firepower projection analyses, and the review of existing operating concepts, create something like an operational needs statement. In order to offset an advantage in enemy mass, a future firepower projection system need not be well protected so long as it is part of a larger formation, which affords it a type of complementary protection. This system can have a unique method of protection, but if it is unique, it will only work against a narrow set of threats. The effects of its fires must be diverse and must also aid in self-preservation when needed. A destructive capability is necessary in the absence of a defeat capability. The system must be mobile and rapidly deployable in order to project combat power effectively, thus negating enemy A2/AD capabilities. It should have a long-range precision capability, and it should be small, light, potentially autonomous, and have a low logistical requirement.

With these design specifications in mind, the author researched existing systems and emerging technologies to determine whether or not existing programs could meet the systems' needs. Ultimately, a blend of an existing program in development and a non-existent system coalesced in the form of an initial concept. The existing program is the Hawkeye Howitzer program, and the non-existent system is an artillery delivered swarm UAV concept.

AM General demonstrated its Hawkeye Howitzer at the 2016 AUSA conference in Washington, DC. At its core, this system is a HMMWV with a 105mm howitzer mounted in

Mobile long-range surface fires may deliver similar tactical advantages as the 15th century longbowman. *(Photo by Sgt Christopher Garibay.)*

the bed. The howitzer can traverse on a 360-degree turret, and the HMMWV has stabilizing legs, which descend and provide a steady base from which to fire, negating the requirement to dig-in spades during occupation of the piece. The system is light (2,400 lbs), requires user-level maintenance for most issues, and has electronically controlled traverse and elevation for the tube. The system currently requires a crew to load rounds, like a conventional howitzer.[15]

The delivery platform for this initial concept is based primarily on the Hawkeye Howitzer with some slight modifications. The firing mechanism on all vehicles will be fully automated, requiring no crew intervention for loading rounds or selecting types of munitions, fuze settings, or charges. A future platoon will have four howitzer trucks, three of which will be fully autonomous and slaved to the movement patterns of the single manned HMMWV in the platoon. Each howitzer section will work with an associated ammo truck, which will be fully automated for all four sections. Thus, in a platoon of eight vehicles, only one will have a crew.

The second part of the initial concept is the family of munitions. The initial concept is a blend of the Fire Shadow loitering munition, the Excalibur howitzer munition, and the Perdix drone swarm program, with other capabilities added.

Fire Shadow is a rail launched, folding fin missile with long range, high endurance, and the ability to loiter in a target area prior to transitioning to a terminal guidance phase. The missiles are billed as high precision and low collateral damage, with the ability to retarget in flight. This means that they are either capable of terminal guidance using coded laser energy, or that they can receive updated GPS coordinates for a target while in flight. Based on the stated ability to engage mobile targets, it is likely that the munition has the capability for either GPS or laser guidance in the terminal attack phase.[16]

The Excalibur munition is a howitzer launched precision munition with GPS guidance. The munition has fins which fold out from the body after launch, which allow for course corrections in flight. This helps to shape the munition's trajectory and minimizes the circular error of the munition at the target. The munition is GPS guided only.[17]

Future swarming-enabled armed drones may provide the most disruptive fires overmatch. ***(Photo by LCpl Chase Drayer.)***

The final piece of existing technology which contributes to this paper's initial concept is the Perdix drone swarm. A pod attached to an aircraft delivers these drones at a designated operating altitude. Once deployed, the drones communicate with one another to dictate flight paths and altitudes in order to accomplish a set of pre-determined missions. The swarm requires no human input to accomplish its mission, and when members of the swarm cease functioning in flight, or break apart from the swarm, the drones remaining in the swarm communicate with one another to change their flight patterns, compensate for the gap, and still accomplish the mission.[18]

The author combined all these ideas together to come up with the Artillery Delivered Swarm System (ADSS) concept. The ADSS is a family of two munition types, a visual sensor platform, and a platform with a visual sensor and a laser target designator. The author envisioned a munition fired from a howitzer which deploys folding-fin wings at a designated altitude. Once the wings deploy, an onboard propeller keeps the munition in flight, and a camera rotates down from the body, protected during launch, in order to view the battlefield. The first drone to deploy takes commands in realtime from an operations center and coordinates the efforts of all other deployed drones in order to accomplish a given mission. Since none of the drones are armed (they are ISR platforms only), the author also envisioned a recovery capability wherein they could return to a firing point for refueling and basic maintenance.

The combination of autonomous platoons of the Hawkeye Howitzer, together with the ADSS concept, comprise this project's initial concept. Once developed, the author sought to develop a scenario that would test this initial concept in a near-future Agincourt.

Operational Decision Game

With an initial concept defined, the author developed a decision game set in the modern or near-future era, which sought to reproduce the dynamics of Agincourt but not the battle itself. This is a key distinction.[19] Modern doctrine and technology render moot the tactics of Agincourt, so the decision game was intended to produce a situation where the same type of overmatch found at Agincourt might work, even if the composition of forces and battlefield layout differed.[20]

Design. With the intended overmatch condition in mind (mass versus multiple forms of protected and integrated firepower), the author developed a Baltic scenario where an American light infantry battalion with artillery and attack aviation support must defend against a Russian mechanized and armored force with limited organic indirect fire and no aerial. The author presented respondents with two games: one where both America and Russia have extant technologies, and another in which America employs the future artillery concept described above.

With Agincourt in mind, the author thought that the initial concept's capabilities would allow the defenders to place an engagement area on the enemy, (as opposed to waiting for the enemy to drive into a pre-planned engagement area), thus controlling the terrain and forcing the enemy to choose certain routes of advance that would provide an advantage to the defending force. Furthermore, the author thought that the automated nature of the artillery delivery systems would provide protection, in the form of survivability, through speed: rapid occupation and displacement between fire missions would reduce the effectiveness of both counterbattery fire and direct fire counterattack against friendly artillery. Finally, the author thought that having autonomous delivery systems would give the decision game respondent more flexibility in methods of employment, or proximity to enemy forces, because of the mitigated hazard of friendly human casualties.

To test these assumptions, the author chose a section of terrain with many natural obstacles (rivers and tree lines) designed to favor the defense. The author thought that the presence of the Neman River to the north of the decision game's play area, coupled with Russia's stated mission to seize control of the town of Sakiai, came as close as possible to replicating the effect of canalization between tree lines at Agincourt. Based on Russia's starting position, lack of aerial support, and available routes, their avenues of approach to Sakiai were limited.

Effectiveness of the initial concept. In total, the author received 21 completed games from 16 different respondents (5 respondents played both the "U.S. current" and "U.S. future" versions). The author received ten responses to the "U.S. current" version and eleven responses to the "U.S. future" version. Based on solution trends, the respondents believed that the advanced artillery initial concept would assist in overmatching Russia's advantage in mass. This is clear from overall trends from all respondents and from an analysis of solutions from respondents who played both versions of the game.

Regarding overall trends, the largest indicators for confidence in the system are a willingness to pursue more aggressive tactics in general and a wider range of perceived of options available to friendly forces. See Figure 1 for a graphical representation of central ideas across all solutions.

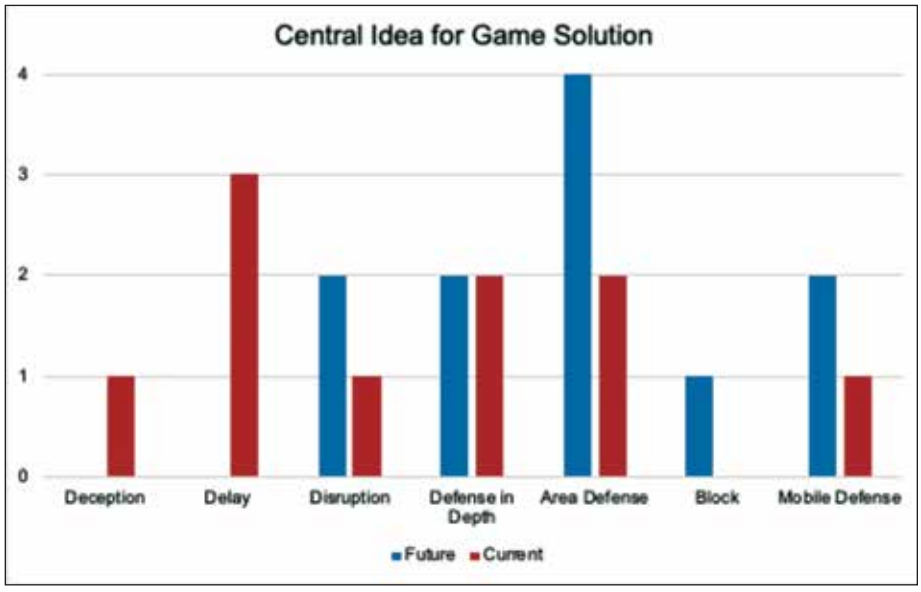

Figure 1. Central idea for decision game solution amongst all respondents.[21] ***(Figure provided by author.)***

The categories are arrayed from least aggressive on the left to most aggressive on the right. The chart demonstrates that respondents were more conservative in their responses for the current scenario and more aggressive in their responses for the future scenario. The mean response for the current scenario fell halfway between "Disrupt" and "Defense in Depth," while the mean response for the future scenario fell halfway between "Defense in Depth" and "Area Defense."

With respect to a wider range of perceived options in the future scenario, Figure 1 appears to suggest that this is not the case. There were six central ideas employed for the current scenario and only five for the future scenario. This does not account for the variety amongst schemes of maneuver for future scenario respondents compared to current scenario respondents. In general, current scenario solutions had similar analytical approaches even though the central ideas varied. Most respondents focused on the enemy's mobility as their primary target, and most friendly courses of action involved methods to limit the enemy's mobility in some way.

This is not the case for responses to the future scenario. These responses exhibit a broader range of problem frames and a larger variety in friendly courses of action. Some respondents focused on terrain, and solutions that were enemy focused varied in their approaches. Some focused on limiting enemy mobility, while others focused on destroying enemy combat power.

Finally, it is instructive to note how the five respondents who played both games adjusted their strategy when given the advanced artillery system. Four

out of five respondents who played both versions demonstrated a much more aggressive attitude in the future scenario. Respondent 2's future scenario solution did not require the destruction of local infrastructure in order to delay the enemy, instead relying on the advanced artillery system to destroy key enemy systems prior to contact with friendly forces. Respondent 3 planned a mobile defense with a deliberate counterattack in the future scenario, whereas the Respondent's solution to the current scenario relied upon a defense in depth. Respondent 4 switched from a delay tactic to a block tactic once given the advanced artillery system, choosing to focus on eliminating enemy capabilities rather than trading space for time. Finally, Respondent 5 viewed the advanced artillery initial concept, paired with attack aviation, as a modified deep air support capability in the future scenario, a marked departure from the respondent's elastic defense approach in the current scenario. Respondent 5 also stressed the importance of holding ground through the application of multiple simultaneous actions on the advancing enemy in the future scenario, as opposed to trading space for time in the current scenario.

Comparison between the longbow and the initial artillery concept. With these results in mind, this analysis revisits the qualities of protection and firepower examined earlier in this article with feedback gleaned from respondent solutions. The similarities between the longbow and the advanced artillery system, relative to their respective opposing systems, are clear. The advanced artillery system is more well protected than a similar system in the Russian force in two categories (layered and redundant) and less well protected in three (integrated, enduring, and full-dimension), whereas the longbow was equal to its opposing system in two categories and worse in three. Thus, the advanced artillery system has more protection at a system level than did the longbow but still contributes a negative overall protection value to a composite force.

At a composite force level, the U.S. degree of protection relative to its Russian opponent is no different than England's was relative to France. The only major change is that the U.S. force is less well protected with respect to integration, and better protected with respect to redundancy when compared to England. The nature of the swarm system increases redundancy but decreases integration because of the physical separation of the swarm from the rest of friendly combat power.

The primary differences in firepower projection capabilities between the longbow and the advanced artillery concept are found in their respective abilities to deceive, defeat, and divert. Deception and diversion are aided by the presence of the swarm, and the development of special types of munitions which can produce vastly different signatures than could a longbow arrow. On the other hand, longbow arrows were well suited to piercing some armors and killing horses, enabling longbow formations to defeat enemy formations. For 105mm howitzers, there is nothing in the conventional inventory or in the advanced artillery concept, which can have a reliable defeating effect on a mechanized or armored formation.

The only major difference between what Henry's army achieved and what the aggregated solutions to the future scenario achieved is that present armies are much more well suited to deceiving their opponents. This is likely more attributable to the way modern armies fight with an emphasis on dispersion and a reliance on long-range communications and mission command, giving rise to more situations under which deception might be possible. With that said, both England and the U.S. force in the future scenario were equally adept at achieving the other fires effects with one notable exception. Many respondent solutions included a diversion of enemy attention through either maneuver or firepower projection, which was not one of Henry's achievements at Agincourt.

Based on these results, it is safe to conclude that the advanced artillery initial concept inspired confidence in the respondents who played this decision game. In general, future scenario solutions were more aggressive than current scenario solutions. Those who employed the initial concept viewed it as a way to effectively target specific enemy capabilities. Recalling the "Target Selection and Discrimination" section of the first article in this series, proper and uninhibited target selection and prosecution was one of the primary reasons why England's army was able to offset France's advantage in mass at Agincourt.

In terms of a direct comparison between systems, the longbow and the advanced artillery concept were very similar. Both had similar liabilities and provided similar benefits. From a composite force perspective, both forces enjoyed similar offsets, with the noted exception that England drew on integration for protection whereas the U.S. force from the future scenario drew on redundancy for protection.

Ways to improve the initial concept. The author received eleven solutions to the future scenario version of the decision game. From those eleven solutions, most of the recommendations for ways to improve the concept fell into three categories: organic precision targeting capability for armor defeat, signature management, and kill chain optimization.

By far, the most common comment was that the concept should include a kinetic kill capability. Eight of the eleven responses included some type of comment relating to kinetic kill. One response specified the need for an anti-armor munition, a sentiment shared by six others. In addition to requesting a kinetic kill capability for armored vehicles, some also suggested a kinetic kill capability for counter-air, suggesting that an armed swarm "could be used for counter UAV via midair collisions and swarming the target and blowing up." This would be ideal for targeting very advanced UAVs, especially if friendly swarm munitions are inexpensive in comparison.

The concept of signature management came up with respect to both the Hawkeye Howitzers and the ADSS. The initial concept specified a recovery capability for the drones, making them reusable, and Respondent 3 astutely identified that any returning drone could be tracked, thus revealing the location of the recovery team, firing unit, or both

if they are co-located. The other side of signature management regarded the swarm drones themselves. One response identified the need for low observable technology to reduce successful tracking of the drones during launch, and thus the system firing them. Two responses suggested that each drone should have a range of signature options from no signature to a signature for a formation of conventional aircraft. The ability to choose a signature based on the battlefield situation would provide a commander with ways to enhance military deception in support of an overall concept of operations, or as a way to draw or avoid enemy targeting attention as needed.

Finally, there were two main suggestions related to kill chain management. One respondent suggested that AH-64s should have the ability to either incorporate the drone swarm into their independent hunter/killer targeting process or gain control of a portion of the swarm for independent control. Either option would increase targeting options and would expedite the kill chain with respect to AH-64 targeting. The other comment regarding the kill chain identified that a swarm of hundreds of drones all sending full motion video to an operations center would very quickly exceed the bandwidth capability of any expeditionary headquarters. This respondent's suggestion was to use GMTI for tracking and targeting purposes, which would also reduce bandwidth requirements for a supported operations center.

Having validated the timeless nature of integrated protection and firepower projection and armed with suggestions for how to improve the initial concept, this series concludes with a refined concept, and recommendations for paradigm shifts that might be necessary in order to implement this and other similar concepts in future combat.

Notes

1. Headquarters U.S. Army, *Protection, FM 3-37*, (Washington, DC: September 2009).

2. Ibid.

3. Ibid.

4. Ibid.

5. Headquarters U.S. Army, *Field Artillery Operations and Fire Support, FM 3-09*, (Washington, DC: September 2009).

6. Ibid.

7. England may have accounted for the presence of France's crossbowmen on the battlefield in deploying its forces or issuing orders. However, since France's crossbowmen did not target England's formation, and since they were not targeted by England, their influence is not considered in this analysis.

8. Headquarters Marine Corps, *Marine Corps Operating Concept: How an Expeditionary Force Operates in the 21st Century,* (Washington, DC: September 2016).

9. Ibid.

10. Ibid.

11. Headquarters U.S. Army, *The U.S. Army Operating Concept: Win in a Complex Word, 2020–2040, TRADOC Pamphlet 525-3-1*, (Washington, DC: October 2014).

12. Ibid.

13. Ibid.

14. Ibid.

15. Defence Blog, "AM General Displays New Hawkeye Lightweight 105mm Howitzer at AUSA 2016," *Defence Blog*, (October 2016), available at http://defence-blog.com.

16. Lockheed Martin, "Fire Shadow Loitering Munition," *Lockheed Martin*, (2017), available at http://www.lockheedmartin.com.

17. Raytheon, "Excalibur," Raytheon, (2017), available http://www.raytheon.com.

18. Kyle Mizokami, "The Pentagon's Autonomous Swarming Drones Are the Most Unsettling Thing You'll See Today," *Popular Mechanics*, (January 2017), available at http://www.popularmechanics.com.

19. There are many reasons why a modern recreation of Agincourt, with tanks taking the place of cavalry, howitzers replacing longbowmen, and infantry fighting vehicles (IFV) replacing men-at-arms, would not make sense. An attempt to recreate the "squishing" effect which rendered the French men-at-arms unable to raise their arms is not realistic because IFVs do not fight like knights. Another example is that with modern advances in maximum ranges of all weapon systems, employing artillery along the flanks of maneuver forces does not help to achieve the same kind of combined arms benefit that the English enjoyed at Agincourt. An employment like this would fail to take advantage of a howitzer's range advantage when compared to a tank or IFV and would expose this relatively exposed portion of a friendly formation to an enemy envelopment. Furthermore, envelopment is more likely now than it was in 1415 due to advances in methods for C2 such as radios, increasing dispersion and the number of possible sub-formations without sacrificing an inordinate amount of control.

20. Daniel Mahoney and Dr. Benjamin M. Jensen, "Gaming the Future with #NextWar: Kaliningrad Fires," *The Strategy Bridge*, (May 2017), available at http://thestrategybridge.org. A modified version of this decision game is available for readers to play at their leisure on the *Strategy Bridge* website, at the following link: https://thestrategybridge.org/the-bridge/2017/5/7/gaming-the-future-with-next-war-kaliningrad-fires.

21. There was a degree of subjectivity in this portion of the analysis. Because responses in the solution portion of the game were open-ended and left to the discretion and interpretation of the respondent, results varied.

22. Sometimes respondents stated their central idea very clearly, and in other cases, the author needed to interpret a central idea based on a respondent's answers to other questions in their solution.