HIGH SCHOOL EDITION
Journal of Student Research
Volume 14 Issue 1 (2025)

The Role of Logistical Challenges in the Ardennes Offensive's Failure

Jiawei Huang

YK Pao School, China

ABSTRACT

This essay draws on the writings of Sun Tzu and Carl von Clausewitz, whose works have laid the foundation for modern warfare theory, to analyze the extent to which logistics were responsible for the failure of the German Ardennes Offensive of 1944-45. I will first discuss and define what I mean by "logistics" in this context before moving on to a relevant literature review drawing from Sun and Clausewitz. I will then contextualize the general situation of the German side in 1944, the general planning of the offensive as well as its execution. Next, I will analyze this event as a case study, systematically addressing the direct impacts of logistical shortcomings and exploring how classical theories fit into this decidedly modern battle. Lastly, I conclude by arguing that the German failure in logistics decisively contributed to the Ardennes Offensive's collapse before examining the operation through the lens of classical theories to determine the validity of German actions as well as how they might have been improved.

Introduction

The last years of World War II amounted to an unhindered rampage by the Allies, with Germany already firmly on the losing side, being slowly but surely pushed out from all occupied territories. However, there was one point where a desperate last-ditch effort might have made a difference: the Ardennes Offensive. Launched in December 1944, it aimed to break through the Allied frontlines in the Ardennes region. While several factors contributed to the eventual failure of this plan, one crucial aspect was the failure of logistics in the plan. This essay aims to determine how far logistical challenges were responsible for the eventual failure of the Ardennes Offensive.

To judge the extent of its impact, classical war theories can be employed to gain a more complete picture. Among many classical war theories, the two seminal works of Clausewitz and Sun Tzu, *On War* and *The Art of War*, respectively, have been especially significant in illuminating warfare and logistics for countless generals in the intervening years, and I will employ both here to judge the impacts of logistics on the Ardennes operation.

Juxtaposing classic theories and modern battles can produce unique conclusions and insights that I hope may be of some historical and contemporary relevance. In doing so, the timelessness and adaptability of the theories are tested, and we also gain an idea of how far they need to be altered to remain useful today. The impacts that technological advancements have are highlighted, helping us understand how traditional strategies might be enhanced by new technologies. More specifically, studying how logistical theories from the past hold up in light of modern supply chain technologies can be both fascinating and illuminating.

Definitions

Logistics plays a foundational role in all that we do, from the supply chains behind daily consumption of goods in daily life to backing gargantuan military operations. According to the *Oxford English Dictionary*, can be defined as "the detailed organization and implementation of a complex operation." On the surface, the function of logistics in war seems straightforward, providing for everything a military system needs to be operational, be it food for soldiers,

ammunition for firearms, transportation, clothing, or a wide range of other needs. However, an exact, unanimous definition of "logistics" remains elusive, as it has morphed throughout human history. Changing times, as well as the continual development of military technologies, result in many competing interpretations of logistics.

A definition from RAND, a nonprofit research institute and think tank, puts it this way: "Logistics is the transfer of personnel and material from one location to another, as well as the maintenance of that material." The issue with this definition is the ambiguity of the duration of logistical operations. The first part of the definition points to a singular activity, without specifying either the space or time in which it takes place. It does not mention the nature of the transportation, how long it lasts in a given operation, or its relationship to the military campaign it supports. What's more, there is no consideration as to how far the logistic chain stretches, whether it reaches back to the production facility for a certain weapon or it starts from the storage facility whence the weapon will be shipped to the front lines. Lastly, it is limited in scope, seeing logistics as secondary to kinetic operations.

Other interpretations exhibit similar limitations. French military thinker and analyst Antoine-Henri Jomini, one of the first to attempt to define logistics put it as "the practical art of moving armies" (Jomini & Jomini, 2001), which is too loose and free-standing to be of any realistic use. On the other hand, George C. Thorpe, a U.S. marine lieutenant and notable contributor to logistics who built on Jomini's theories, separated logistics into two arms: applied logistics and pure logistics (Thorpe, 1997). This was an innovation on the traditional approach to logistics that put it as secondary to other factors of war such as strategy and tactics. Pure logistics, he writes, is the "is merely a scientific inquiry into the theory of logistics—its scope and function in the Science of War" (Thorpe, 1997). Thorpe's pure logistics is considered along strategy and politics as a major constituent of war. Applied Logistics deals with the specific circumstances in each combat operation. As each operation is unique from one another, the specific tasks of logistical operations are defined as follows, as shown by the definition by the U.S. Joint Chiefs of Staff:

That part of the entire military activity which deals with: (1) design and development, acquisition, storage, movement, distribution, maintenance, evacuation and disposition of material; (2) induction, classification, training, assignment, welfare, movement, evacuation and separation of personnel; (3) acquisition or construction, maintenance, operation and disposition of facilities; and (4) acquisition or furnishing of services. It comprises both planning, including determination of requirements, and implementation. (A graduate of the U. S. Naval Academy in 1922, 2021)

Thorpe notes that, ever since the days of spontaneous tribal conflict for territory where logistics was effectively nonexistent, the need for logistics in war has become much more complicated. He asserts that it has grown beyond merely supply, transportation, and maintenance to involve myriad other factors, such as making provisions for reconnaissance and the organization of communications. His definition is thus more comprehensive, as it clears up much of the ambiguity in scope and specifics from the first definition, yet still has its shortcomings; namely, it is unable to present a general framework for logistics, which in his theory boils down to a "general supply reinforced by auxiliary operations based on the circumstances at hand" (Thorpe, 1997). This framework is insufficiently defined to allow the exploration of this paper's research question, that is, what role logistics played a part in the Ardennes Offensive.

For the purposes of this essay, I am using the definition of logistics derived from Clausewitz by Proença, Junior, and E.E. Duarte (2005): "[A]ll activities that are pre-conditional to military forces being in operation, which becomes a tactical or strategic concern to the exact extent that it affects the engagement or the use of engagements in war." "Pre-conditional" indicates that the activities in question, be they transportation, maintenance, or provisioning, are necessary to the subsequent result, which is kinetic activity (military action involving active warfare, including lethal force). This definition is more complete than what Thorpe offers, as it is applicable to all warfare, and it also covers the elements of logistics not directly concerning combat. It defines "logistics" as "activities necessary in order for kinetic engagement." In doing so, it provides a criterion for determining whether an activity would be necessary, asserting that everything a military needs to put in place to implement given set tactics, and therefore achieve an overall strategy, is necessary. Furthermore, this definition presents logistics as something going on constantly, not a single operation. This paints a more comprehensive picture of logistics.

Literature Review

Having laid the framework for the scope and roles that the term "logistics" includes, this section will focus on different interpretations of how to implement logistics to achieve certain goals.

This essay will be focusing on the theories from two different eras and locations – early modern Europe and ancient China. As these two theories were conceived thousands of years and continents apart, the risk of bias arising from focusing on a single cultural or regional perspective is mitigated, showcasing a wider array of strategic thought. It also makes both more adaptable for analysis that holds under varied conditions.

One of the most influential military thinkers, Carl von Clausewitz, wrote his seminal work *On War* in 19th-century Europe. In Clausewitz's thinking, logistical activities outside of combat are split into two categories: activities involving combat, such as marches, camps, and billets, which are directly linked to combat operations, and activities for maintenance, which are focused purely on the subsistence of the military. This includes taking care of the sick or injured, supplying ammunition and artillery, transporting equipment, as well as repairing arms. While they do not directly involve combat, these activities affect troop readiness and condition, thus they have an indirect impact on the outcome of battle.

Clausewitz deals first with the part of logistics directly involving combat. Clausewitz splits this category into two phases: movement, which is when the army is marching, and mobile, and when it is stationary. When the army is mobile, he asserts that tactics, strategy, and logistics are interdependent and cannot be considered in isolation. When the force is in motion, it must be logistically prepared to engage with the enemy at any moment. Here, preparations for the march are divided into two different branches – the strategic branch and the tactical-logistical branch. While strategy is the action plan that takes you where you want to go, the tactics are the individual steps and actions that will get you there (Laoyan, 2024). Strategically, the march is the consideration of a force's next destination. Tactically and logistically, the movement and condition of the troops should allow it to withstand a surprise attack. More specifically, logistical aspects such as terrain, weather, and force movements are constantly considered to ensure the best possible condition of the force in event of an engagement.

According to Clausewitz, only when strategy, logistics, and tactics are considered in tandem will they be able to succeed, which is also why moving the force is essentially the same as fighting, even though there is no actual combat taking place. When the fighting force is stationary, logistics plays a dual role in warfare. Its first role has to do with kinetic engagement in combat. If the force is standing to protect a fixed position from falling into enemy hands, the camp now serves as a base for future operations in defending the position, becoming the pre-condition to further engagement. Its second role logistics plays here is the construction of the camp itself. In this second aspect, logistics contributes to the non-kinetic side of war too. Camps could also serve for soldiers to rest or train. This is not part of strategy or tactics, yet it is vital that there are sufficiently trained soldiers who know how to erect the camps and provide a place for the army to stand. Logistics lays the foundation for a successful army operation to be carried out.

Having covered the aspect of logistics that directly concerns combat, Clausewitz then addresses maintenance of the fighting force, which is the strand of logistics not directly associated with combat itself. According to him, the logic of supply is concerned with the efficient and effective management of all resources, ranging from the initial procurement of raw supplies to the storage of those supplies, to manufacturing the items needed, then finally transportation and distribution. This implies that a weak link in any part of the supply chain could easily impact the effectiveness of a force, while, on the other hand, a well-coordinated, reliable chain of supplies could give it a huge advantage, giving them more choices and flexibility in their strategy, as well as the potential to win against the enemy in a war of attrition. Supply logistics are also worked into the strategic concerns of a force too, as both sides of the conflict will engage in activities to manipulate supplies and alter the balance of power between the two sides. Maintenance thus decides both the ceiling of the army's performance and the basic availability of this force. Clausewitz's broad view on non-kinetic logistics is that, throughout history, as technology has developed and the equipment being

maintained has changed countless times, maintenance is still too rarely taken into account when making strategic decisions. Doing so will greatly boost the force's performance.

Clausewitz's theories were based on his experiences fighting with the Prussian army in its regional conflicts, as well as the Napoleonic wars. He joined the Prussian army at the age of 12, and participated in several campaigns, including the Rhine Campagin and the disastrous Battle of Jena-Auerstedt, in which he was captured. He later participated in the Russian campaign against Napoleon until the latter was defeated in 1815. Sun Tzu was a military strategist during the Eastern Zhou period of ancient China. Having lived thousands of years before him in a completely different environment, he offers a different view of logistics.

One of the overall differences between Sun Tzu and Clausewitz was on their approaches to offensives. Unlike Clausewitz, Sun Tzu didn't see a direct offensive as the only pure means to a war, and instead states that defeating the enemy without ever fighting is, in fact, the most ideal form of war. For example, the enemy could employ subterfuge to render the enemy incapable of fighting. He also puts emphasis on the importance of the indirect offensive, which he places alongside the direct offensive as an equally important part of warfare.

When a general carries out direct actions such as lining up an army in opposition to the enemy forces, or laying siege to a city, he should also be planning indirect actions. This could include staging a fake retreat to lure the enemy forces to advance beyond the city walls, or to give away a strong position on the battlefield. While direct action is the kinetic warfare we usually see, many strategies in indirect warfare are done almost exclusively with logistical means. Thus, Sun Tzu sees logistics as something capable of dealing damage to the enemy, in contrast to Clausewitz regarding it as merely a prerequisite to waging war.

Sun Tzu's emphasis on logistics starts with his theories on preparation before an offensive (both direct and indirect actions). He believes that preparation wins the battle for a general—the side that has considered and planned the matter more thoroughly will come out on top. Though this does not mean that the general will be expected to foresee every development in the battle, it does imply that based on the leaders' wisdom, insight and contingency planning, the outcome can still be roughly determined in advance.

Once the offensive has begun, Sun Tzu's logistics require more consideration than Clausewitz's as well. In contrast to Clausewitz's focus on utilizing the military's existing resources to supply the army, Sun Tzu repeatedly brings up the importance and benefits of plundering the enemy as the offensive moves forward. This means that a battle plan done in Sun Tzu's way would specifically consider how much enemy material they are expected to pick up along the way, thus lowering the amount they need to bring at the outset. Prior planning for plundering when in enemy territory rules out the need to train new men for transporting supplies as well as any wasting of resources. Supplies taken from the enemy are worth much more than those supplied from the base due to the effort saved for men and animals that would have to carry them. This reflects Sun Tzu's concern with prevailing in the war instead of in a single battle, as exhibited by his constant consideration as to whether victory in a certain battle is worth the logistical sacrifice for the entire home state. This makes for an all-round victory, as the home state is not overburdened or weakened by war logistics for an extended time.

To explain Sun Tzu's emphasis on an overall victory, it is necessary to understand what he means when he indicates that war is best won as soon as possible. Doing this, Sun Tzu writes, has multiple benefits. First, it keeps both financial and human costs to a minimum, eliminating any potential weaknesses in the force that the enemy could exploit to gain an advantage. Second, it ensures that the most powerful portion of the attack is delivered before morale tapers off. Lastly, as war is a huge drain on the country's resources, such an attack keeps damage to the nation's economy to a minimum. In practice, executing a fast attack is not an easy feat – it requires advanced decision-making way beforehand, detailed planning, effective execution, and skilled leadership from the general. Here, again, Sun Tzu repeats the importance of considering war from the country's perspective, stating that it is merely a means to an end for the country. If the country survives in disarray, the purpose of the conflict is no more, as nothing remains to reap the benefits, and the country loses anyway.

Case Study

In the next paragraphs, a summary and in-depth case study of the German Ardennes offensive in World War II will be conducted. This operation was chosen because of its importance as one of the largest German offensives on the Western front. Looking at this historical event in detail and examining its logistical elements juxtaposed with classic theories, a comparative analysis framework can be used to identify the extent to which logistics were responsible for the failure of the operation, and the nature of logistical failure. In my research, I mainly reference *The Ardennes: Battle of the Bulge"* by Hugh M. Cole and *American Military History, Volume II*.

By summer 1944, six months before the Ardennes offensive, World War II was not looking too good for the Germans. On the Western front, the Allies had set foot back on mainland Europe with Operation Overlord on the 6th of June. Despite stiff resistance, they went on to establish a firm bridgehead in the Normandy region, then push through a momentary impasse to advance further into occupied France. By early August, Allied forces had stormed rapidly through Northern France and were drawing ever closer to the German border with plans to breach the Siegfried Line, a defensive line on Germany's western border.

In the East, the situation was equally as precarious. The Soviet Union built on its massive Operation Bagration to push Germans even further back in Eastern Europe. As its swift operations reached one occupied country after another, Germany's past allies also scattered: Romania and Finland turned their backs, cutting off sources to valuable strategic positions and oil supplies.

To the South, on the Italian front, Allied forces were continuing their slow, grinding push north, after landing in Sicily the previous year. Though progress was proving difficult, the stalemate in Italy drained Germany's scarce resources, and tied many German forces into Italy as well, giving them even less men to fight with on other fronts.

Internally, Nazi high command was far from peaceful either. Hitler was still physically shaken from a bomb blast that was intended to take his life. He became even more narcissistic, raving, and volatile. Though the Nazi party's grip on power was as firm as ever, morale within the country was beginning to show signs of deterioration as Germany's armies suffered one defeat after another on all fronts.

It was then that Hitler began to formulate a large-scale counteroffensive on the Western front. Many factors led into this operation. First, Hitler had always emphasized the importance of Germany's Ruhr industrial area, the heart of the Nazi war industry, and as the Allies advanced, he feared for the Ruhr's safety. A western counteroffensive would ensure the safety of that area.

Second, Hitler viewed the Western alliance as weak. In his mind, the Western leaders were incapable of holding their peoples together in the face of danger, even as events in England have comprehensively proved him wrong. Thus, Hitler decided that if one of the Allies were to receive a significant enough hit, the alliance would easily be broken up. Third, after three horrific winters on the Eastern front, Hitler had realized, apparently, that the huge numbers of Soviet forces proved too much to handle for the Nazi empire's forces. Consequently, he looked West and aimed to achieve a quick, decisive victory that would bear immediate fruit. Lastly, as the Allies broke out of Normandy's hedgerows, Hitler viewed them as more of a threat to German borders, a prediction that would be vindicated by the Allies' rapid dash through France.

By mid-August 1944, the rough form of a strategic counteroffensive began to take place. The attack would take place in November and would be a major commitment of men to wrest the initiative from the enemy.

By September, forces were beginning to be pulled from the front line to be refit and reformed. Hitler also created an "operational reserve" consisting of 25 divisions, in preparation for the Western offensive. Priority was also given to tanks, artillery, and assault guns on all assembly lines.

On September 16, Hitler announced that the attack would be delivered in the Ardennes, with Antwerp being the objective. The reasons for these decisions are not fully clear, though the major one was that Hitler did not accept any opinion other than his own. The enemy front in the Ardennes was also relatively thinly manned, and the configuration of that area also meant that there was little room for movement, thus requiring fewer divisions. The thick forest

also provided secrecy and cover from endless Allied air raids. As the Ardennes terrain was generally regarded as difficult countryside, the Allies did not expect a German attack through that area.

Ultimately, the plan contained the following key points. First, the attack would be made through the Ardennes aiming to seize bridgeheads over the Meuse. Second, it would push on to Antwerp, and fight a battle north of Antwerp, Liege and Bastogne to eliminate British and Canadian forces. Lastly, support will be provided by all the artillery Germany could muster, along with the Luftwaffe. The whole plan was made to be as speedy as possible, in complete secret.

On December 16, the German counteroffensive begun, taking advantage of its absolute secrecy to make menacing progress in the early days. The weather was also in Germany's favor. Low cloud and fog grounded Allied Air Power, which could have bombarded German panzers.

German forces created alarm and confusion for the Allies. Being a two-pronged attack, one force advanced through the North of the sector, while the center attack aimed straight for the US VIII Corps' headquarters in Bastogne. From December 19 to 21, the center thrust reached and bypassed Bastogne, then continued through the center of the Ardennes sector, forming a narrow corridor northwest to Marche.

However, the town of Bastogne was heavily defended by U.S. forces, who held out bravely despite being surrounded for many days. The Germans had not foreseen this level of resistance from the Americans, having envisioned a fast and easy advance, and were underprepared as a result. This was a key engagement in the battle that contributed hugely to the eventual stalling of the German forces. While the Germans were able to bypass Bastogne and continue their progress despite not capturing it, they were halted further north in the battle of Elsenborn Ridge, which is the only place where they failed to push back the American line. Poorly coordinated attacks and difficult terrain rendered German efforts very ineffective to the Allies. These two engagements blocked German access to roads that they depended on to achieve further advancement.

By late December, the German drive faltered. Improved weather conditions, stubborn defense and endless reinforcements made it impossible to carry on. The next month of the battle was essentially the Allies pushing German forces back to their initial positions.

Looking at the German war plans for the Ardennes through the lens of Clausewitz and Sun Tzu, both strengths and weaknesses are revealed that cast light on the question regarding the matter of just how decisive logistics were in determining the outcome. In addition, loopholes in each of the theories are revealed as well.

One of its major strengths was the achievement of total surprise from the initial conception of the plan in mid-1944 to planning, preparing, and eventually carrying it out. A firm believer of Clausewitz's doctrine that the offensive was the purest and only decisive form of war, Hitler was sure that a large counteroffensive would be the key to solving Germany's quagmire. An important factor to Germany having any chance of successfully completing the operation was surprising the Allies. In this segment of the operation, the German military system worked seamlessly, vindicating many of Sun Tzu's ideas on indirect warfare. First, they set up a decoy area in Rheydt-Jülich-Cologne, making the Allies believe there was a concentration of forces there, when this was only partially true. The actual concentration of forces was being done in strict secrecy south of the decoy area. Secondly, plans for troop movements were displayed for soldiers in the north at the very last minute which effectively eliminated any chance of movement being discovered by the Allies. Third, the Germans, through misinformation, inclinations in commands and double agents, painted the story that they were mostly concerned about the Allies breaking through between Cologne and Bonn, and that they were preparing a counteroffensive there. Doing this aligns with Sun Tzu's take on indirect warfare; Hitler, while setting the stage for his offensive, is using logistics to engage in indirect warfare, to the benefit of his direct offensive. In the months leading up to the Ardennes offensive, clever logistics work benefited the Germans hugely. It acted not only as a preliminary for war, the way Clausewitz envisioned, but also to increase Germany's chances of victory.

Indirect warfare was not the only strength of Germany's logistics. As Clausewitz wrote, a weak link in any supply chain greatly impacts the effectiveness of an army while a strong supply chain gives it an advantage. In the management of transportation and distribution of resources, the German military did a great job logistically.

Another German strength is the sheer resilience of their logistics chain, and, in extension, how quickly they can recover from a breach in that chain. Prior to the Ardennes offensive, German logistics managed to move the equivalent of 66 divisions by rail and seven by road, despite a heavy Allied bombing campaign. The bombing campaign was effective, but its edge was taken off by German countermeasures. German engineering teams were able to repair 150 rail breaks, including 100 within the actual concentration area, effectively balancing out the damage caused by the Allied air campaign. The trains themselves would run at night and during difficult weather conditions to avoid planes, light armor was installed to protect train operators, and light flak was even introduced to defend from high-altitude bombing by Allied planes. Careful consideration also went into ensuring Rhine bridges would be able to secure substantial logistical demands, and the head of transportation for German high command was personally brought into planning reinforcements for bridges. Furthermore, ferries were modified to carry trains. Going even earlier into the chain of supply, two mining tunnels were planned under the Rhine to allow troops to march, and the Ruhr's industry was seamlessly integrated into military operations. This meticulous, forward-thinking approach to logistics is something the Germans excelled at and maximized to boost their forces' performance. Sun Tzu's statement that preparation won battles for the general is satisfied by the Germans' high standard for the transportation logistics. They thought of almost everything the Allies tried throwing at them, and quickly produced ways to minimize the damage; they considered flaws in their own infrastructure and showcased surprising operational resilience in their ability to maintain rail transport. They also perfected most of the supply chain, doing their best to avoid the weak link that Clausewitz warned would cause big problems. This adaptability and maintenance of logistics under persistent Allied battering enabled, crucially, the achievement of surprise. As Clausewitz implied, maintenance ultimately decided the ceiling of an army's performance. Here, the Germans' ability to maintain their supply routes allowed their army to deliver a heftier punch than it should have.

So far, everything the Germans have done agrees with both Sun Tzu and Clausewitz's writings. However, critical logistical shortcomings in other aspects would see huge deviations from these theories.

First and foremost, the planning process of the operation was convoluted and heavily debated from its inception. The main point of disagreement was the prescribed end goal for the operation. Hitler insisted that it would be to take the Dutch city of Antwerp. However, Germany's western headquarters, OB West, judged that the plan to take Antwerp was much too ambitious for the forces available. Not only was the time for preparation far too short, but it was impossible to estimate how the Allies would respond to the German attack. If they decided on a counterattack, a continued push for Antwerp would leave Germany's two flanks dangerously open. Stubbornly, Hitler refused to budge on Antwerp and was adamant that he would be able to achieve it using the very limited resources he had. Here, Hitler made dangerous tactical and logistic mistakes. The first issue can be illustrated with Clausewitz's theory that strategy, logistics and tactics must be considered in tandem for any operation to work. The German military was critically short of key supplies, the most glaring of which being ammunition and petrol. Hitler, whether because of his paranoia, narcissism, or priorities, chose completely to ignore the stark logistical limitations of his force, as well as the tactical difficulty of the operation; choosing only to adhere to strategy. Hitler's plan would require double the number of additional new divisions on the Western Front as the twenty-one originally slated to be given by strategic reserve. Furthermore, more forces would have to be stripped from other fronts, the Eastern front in particular. This goes against Sun Tzu's theories. Sun Tzu writes that winning a singular battle should not be the goal. Instead, having a larger perspective that includes the entire war ensures success. What Hitler proposes here could potentially increase the chances of victory in the Ardennes, but fatally weaken the already overstretched forces on other fronts. Replacements and supplies for these fronts would be reduced greatly, leading almost certainly to loss of territory. The marginal gain here is obviously much less than the marginal loss caused on other fronts. Additionally, Clausewitz's writing on a moving force advises that the force should always account for possible engagement with the enemy. This principle was basically disregarded by Hitler. He would not take extreme measures to increase the number of divisions in attack, nor would he set more realistic goals. These decisions combined basically renders the German army vulnerable at any point in the advance.

German high command estimated that it would take double the number of divisions from strategic reserves to carry out the plan. Had Hitler taken these extreme measures necessary for his grander, Antwerp objective, Germany would have had a more realistic chance of victory in the battle, at the expense of lost ground on other fronts. Had he listened to his generals and limited the goals of operations to bridgeheads across the Meuse, he might have achieved more success as well. In forcing the army upon an awkward option that favored neither of the two plans, the logistic restraints basically destined the operation for failure.

Second, logistically, in preparation for the offensive, the German military, under severe strain from the war economy and logistical challenges, wrestled with securing and distributing the necessary ammunition and petroleum, oil, and lubricants (POL). Their efforts to ensure functioning supply routes were ingenious but undermined by a chronical lack of resources. Hitler had allocated 100 trains of ammunition from a special reserve, supplemented by General Major Alfred Toppe's efforts to assemble an additional four units of basic ammunition loads. These were intended to support the initial artillery barrage, breakthrough efforts, and ongoing offensives. However, Allied attacks had already reduced these supplies significantly by December. The logistics teams of Army Group B projected a daily ammunition consumption of roughly 1,200 tons, assuming rapid exploitation following a breakthrough. This projection relied heavily on the absolute success of the operation, which was a huge risk to take. This is hardly logistically sound preparation. Going back to Sun Tzu, who saw preparation as one of the major determinants of victory, failed logistics played a major role in Germany's failure. Such reliance on dwindling resources underscored the challenges faced by the German forces as they prepared for a potentially decisive but risky counteroffensive. As highlighted by Clausewitz, any weakness in the supply chain causes severe limitations for the force. This was the case Germany in the Ardennes.

Plenty of time and opportunities were lost during the offensive due to logistic limitations. Gasoline was a major problem. The Kampf Gruppe Peiper task force, which by the 19th had reached deep far into Allied territory, was held back by a shortage of fuel. Despite the task force still being largely intact, the acute shortage of gasoline limited the force to only a few more miles on the road, or a few hours of battlefield maneuvering, until the tanks were completely dry. In the end, many missteps meant that the five million gallons of fuel could not reach where they were most needed across the battle. Supply lines were difficult to navigate, too. In the extreme northern portion of the sector around Höfen, for instance, the thick woods tangled with gorges and streams made supply lines exceedingly hard to travel upon. They began as substantial all-weather roads, then slowly dwindled, until they became but muddy ruts at the front line. Additionally, securing motor fuel was a significant logistical challenge for Western Front headquarters. German command struggled to trace and ensure the arrival of promised trainloads of POL amidst heavy logistical demands. Between September 9 and December 15, the Seventh Army's main concentration area received 1,502 troop trains and around 500 supply trains, predominantly allocated for the counteroffensive. However, the rail system reached saturation December 17, forcing OB WEST to unload its reserve divisions on the west bank of the Rhine.

These issues run directly against Clausewitz and Sun Tzu's advice. The Germans did not consider logistics, tactics and strategy as a whole. They prioritized strategy, imprisoning themselves in a fabricated version of reality in which logistics was of little concern, and tactics and strategy could be achieved regardless of reality.

Conclusion

Logistics was key to the eventual failure of the battle, but not entirely. Through this analysis drawing on classical theories of war, more light is also shed on how they apply to modern warfare. Mostly, Germany's failure vindicated the writings of Sun Tzu and Clausewitz, wherein the areas where Germany failed to follow the theories provided by the two proved to be the weakest link in their operation. Germany did do some things correctly – its management of resource transportation and indirect warfare in preparation for the war was done meticulously and achieved great results. However, they were undermined by more critical failures in other sectors such as the difficulty in initial procurement and manufacture of resources, as well as the lack of interdisciplinary consideration of logistics, strategy and tactics. For instance, in January 1945, German infantry divisions resorted to using more than 50,000 horses for transport in the Ardennes.

Some classic theories were proved wrong when used in modern warfare. Nazi battle plans did rely heavily on using captured Allied fuel, as Sun Tzu suggested in his book. The Germans were counting on the Allied fuel to supplement their own dwindling supplies and, according to their estimations, it might just have got them to where they wanted to be. However, this strategy ultimately proved unfeasible as the retreating Allied infantry burned much of the supplies as they went.

Ultimately, the Ardennes counteroffensive began with significant logistical deficits, starting "on a logistical shoestring," which would critically impact its sustainability and success.

Looking at the big picture, the fundamental principles of war-making have remained the same, despite drastic changes in technology. The classic theories, when taken in principle and not in detail, are still very useful in making rough battle plans or logistic considerations in modern times. For instance, the lack of Clausewitz's idea of constant vigilance led Hitler to severely underestimate the abilities of Allied forces. However, as soon as one reads into the details, discrepancies start to appear, and relying overly on the specific instructions of these theories could amount to defeat in a modern battle, as demonstrated by the Germans' overreliance on discarded Allied fuel. The results gained from this essay will be useful in deciding whether the evolving nature of conflict and logistics demands a reevaluation of these ancient doctrines, or whether they can still be applied. It also lays the foundation for further research into military logistics management today as well as in the future.

Acknowledgments

I would like to thank my advisor for the valuable insight provided to me on this topic.

References

A graduate of the U. S. Naval Academy in 1922. (2021, August 27). Logistics-what is it?. U.S. Naval Institute. https://www.usni.org/magazines/proceedings/1953/june/logistics-what-it

Jomini, R., & Jomini, G. (2001). Jomini: 1779-1869: Conseiller de Cinq empereurs, Père de la pensée Stratégique américaine. Jomini.

Laoyan, S. (2024, January 25). Strategy vs. tactics: What's the difference? [2024] • asana. Asana. https://asana.com/resources/strategy-vs-tactics

Military logistics | rand. RAND. (n.d.). https://www.rand.org/topics/military-logistics.html

Thorpe, G. C. (1997). Pure Logistics: The Science of War Preparation. Naval War College Press.

Prof. Dr. Domício Proença Júnior & E. E. Duarte (2005) The concept of logistics derived from Clausewitz: All that is required so that the fighting force can be taken as a given, Journal of Strategic Studies, 28:4,645-677, DOI: 10.1080/01402390500301046

Cai, Z., Bruya, B., & Sunzi. (2018). *The Art of War*. Princeton University Press.

Clausewitz, C. von. (2018). *On war all volumes*. Acheron Press.

Stewart, R. W. (2010). *American military history, Volume II: The United States Army in a global era, 1917-2008*. Center of Military History, U.S. Army : For sale by the Supt. of Docs., U.S. G.P.O.

Cole, H. M. (1965). *The Ardennes: Battle of the Bulge*. Office of the Chief of Military History, Dept. of the Army.