

**THE INNOVATIONS IN COMMAND, CONTROL AND COMMUNICATIONS (C3) BY
THE DESERT AIR FORCE: THE COOPERATION BETWEEN THE EIGHTH ARMY AND
THE BRITISH AIR FORCE DURING THE WESTERN DESERT CAMPAIGN**

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ABSTRACT

This paper investigates how the command, control, and communications (C3) system, introduced by the British during the Western Desert Campaign, impacted the cooperation between the Desert Air Force and the Eighth Army. A careful study of how this campaign unfolded revealed that the horizontal cooperation between the Desert Air Force and the Eighth Army was only efficiently executed after the formation of a cohesive C3 system. This system depended on a number of human, as well as material, variables, such as the number of radio units available to the formations, the personal relationships between the commanders, the location of their headquarters, the attachment of air force officers to the land units, the efforts to distinguish friend from foe during air strikes, and the overall speed of transferring information through the chain of command. This C3 system molded the execution of the British combined arms doctrine, enabling the decisive participation in land engagements by the Desert Air Force and improving the efficiency of the British combat efforts.

Keywords: Desert Air Force. Eighth Army. Command and Control. Combined Arms.

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1 INTRODUCTION

Throughout the Western Desert Campaign, fought between the Axis Powers and the British¹ from the end of 1940 to December 1942, the air forces from both warring sides played a decisive role in the engagements, influencing the outcome of battles and the logistical situation of the land units present in the region. In this article, we seek to investigate how the command, control, and communications (C3) system introduced by the Desert Air Force (DAF), the British air headquarter in North Africa, assisted in the employment of aircraft in support of ground forces. Ultimately, the intention is to observe the possible impacts that C3 factors have on the cooperation between a country's land and air forces, effectively altering the efficiency of states' combat efforts.

The war in North Africa was characterized by fast armored and motorized advances, sudden shifts in the fortunes of the warring sides, and the prominence of logistical factors to the employment of armed forces, given that both sides depended upon their relatively fragile maritime lines of communications. In this context, the air forces gained for themselves an important role during the campaign, and the successes of both sides were undoubtedly directly influenced by the employment of their air resources. However, this employment was not uniform, as from 1940 to 1942 both sides continually experimented with new tactics, systems, and processes. The DAF's case, detailed in depth in this article, is paradigmatic, with its operations in 1942 having few similarities with its operations in 1940.

As is detailed in the coming sections, through a long and challenging learning curve in North Africa, the British not only managed to create the first truly effective C3 system to bolster land-air cooperation, but also started practicing combined arms in a more efficient manner than other forces, including the Germans. After a first negative American experience in the cooperation between their land and air units, during the Tunisian Campaign, they adapted the British

1 Here, the term British encompasses all the forces of the Empire. In North Africa, Australian, Indian, South African and New Zealand divisions played a decisive role in the engagements, under the command of the United Kingdom (MOREMAN, 2007).

system, which had already been formalized by the two main British commanders, Arthur Coningham, the DAF's leader, and Bernard Montgomery, commander of the Eighth Army. This system, based on the horizontality between the two services, formed the basis for Anglo-American interservice cooperation for the remainder of the Second World War. As the lessons of the Western Desert Campaign still stand the test of time, the British combined arms doctrine and the C3 system shaped by Coningham and Montgomery continue to influence the cooperation between the two services ever since.

2 THE WESTERN DESERT CAMPAIGN (1940-1942)

The Second World War expanded to Africa after Italy entered the conflict in June 1940. Initially, combat was limited to small incursions on the borders between Libya and Egypt, the first region being an Italian colony and the second, despite having its independence recognized in 1922, being occupied by British forces. In September, the Italians, with 150,000 soldiers and 600 tanks, invaded Egypt and the small British forces, with only 36,000 soldiers and 300 tanks, withdrew from the border (PLAYFAIR, 2009). During these months, Raymond Collishaw, commander of the British air units in the region, started the first attempts in coordinating the two services (BECHTHOLD, 2011). Nevertheless, the lack of logistical preparation, in addition to the expressive size of the Italian forces, led to grave problems in the Axis supply lines and the short advance along the Egyptian coast was halted at Sidi Barrani (BIERMAN; SMITH, 2004).

In the meantime, the Western Desert Force, led by Richard O'Connor and subordinated to Archibald Wavell's Middle East Command, counterattacked the Italians in December 1940, during Operation Compass. The Axis units had fortified themselves in several positions and O'Connor, with his highly mobile units, concentrated his forces on each of these in sequence, defeating them and forcing the Italian retreat from Egypt. Continuing with the attack in light of the great initial success, the British captured eastern Libya, while the Italian Army was surrounded and defeated. At the end of Compass, the British captured approximately 135,000 Italians, losing, in turn, only 1,800 soldiers (PLAYFAIR, 2009). The British advance

ceased after the conquest of Cyrenaica, as the British Prime Minister, Winston Churchill, ordered the withdrawal of the main British units from the region, moving them towards Greece. Furthermore, a large portion of the troops that remained in Cyrenaica was transferred to Egypt to resupply and maintenance (RAUGH, 2013).

Italy, due to its defeat in Operation Compass, requested German help and Erwin Rommel arrived at the theater of operations in February 1941 with, initially, two divisions. Rommel immediately started Operation Sonnenblume, attacking Cyrenaica from El Agheila. The small British forces in the region were defeated and Richard O'Connor was captured. The German advance halted near the Libyan-Egyptian border, east of Tobruk, which, garrisoned by some British units, was besieged by Rommel. Tobruk was besieged from April to November 1941, the British carrying out three different offensives from Egypt to reach the port and break the Axis encirclement (BIERMAN; SMITH, 2004). The failure in the first two offensives, Operations Brevity and Battleaxe, led to Churchill removing Wavell from his position, replacing him with Claude Auchinleck (BECHTHOLD, 2011). Additionally, due to the inefficient cooperation between land and air resources during these operations, the British changed the organization of their air units in Egypt, leading to the creation of the DAF under the command of Arthur Coningham (SHEPHERD, 2016).

Throughout 1941 the two warring sides increased the size of their forces in the region, the British reorganizing their land units with the creation of the Eighth Army. Auchinleck then launched Operation Crusader in November 1941, at a time when the strength of both sides was similar (PLAYFAIR, 1966). A series of battles took place in this operation, the first British armored attack being defeated and, later, Rommel's advance towards the Libyan-Egyptian border being repulsed. Following this, the German commander decided to retreat in El Agheila's direction in December, since his units were about to be encircled. During these battles, the Allies lost 7,000 soldiers and the Axis 30,000, both numbers not including wounded soldiers (URBAN, 2013).

Nevertheless, Rommel advanced again in January 1942, nearing Tobruk. After months of preparation, Rommel launched the Battle of Gazala in May 1942, carrying out a smaller-scale attack on the coast while moving his tanks south of the British defenses, flanking the Allied positions. What followed was the German

capture of Tobruk and Rommel's pursuit of the retreating Allied army, the Axis defeating several British positions until finally being halted just 100 kilometers from Alexandria, at the First Battle of El Alamein (PLAYFAIR, 1966).

With this significant failure, Auchinleck was removed from office by Churchill in August, being replaced by Harold Alexander in Middle East Command, while Bernard Montgomery took control of the Eighth Army (BIERMAN; SMITH, 2004). Montgomery revitalized the Eighth Army, especially in terms of morale and training, as he prepared for his major offensive, in October. In addition, new equipments reinforced the British units (FENNELL, 2011). On the other hand, unable to interfere with the British plans, Rommel found himself with major problems in his lines of communication, his units being outnumbered and in a precarious situation in terms of supplies. When the Second Battle of El Alamein finally began, in October 1942, the British won a decisive victory, first eroding Rommel's armored reserves and then breaking the German-Italian defensive line (PLAYFAIR, 2004). Rommel, noticing that his army was about to be utterly defeated, ordered a retreat, ending the battle in early November. Most of the Axis army was surrounded and captured, while Montgomery arrived in Tobruk and Cyrenaica still in November, concluding the Western Desert Campaign. In January, the Eighth Army captured Tripoli and neared Tunisia, assisting Kenneth Anderson's British First Army, which landed in Algeria and Morocco during Operation Torch, in the defeat of the Axis Powers in that region (STEVENS, 1962).

3 THE ROLE OF THE DESERT AIR FORCE IN THE WESTERN DESERT CAMPAIGN AND ITS COOPERATION WITH THE EIGHTH ARMY

During the Western Desert Campaign, the British forces continually learned new lessons and altered their tactics and strategies in engaging the Axis Powers. Many of these teachings would shape British practices in later engagements, such as in the Italian and Normandy Campaigns. In this section, due attention will be given to the command, control, and communications (C3) practices introduced by British forces in the Western Desert Campaign, with a time frame of June 1940 to December 1942. However, it is first necessary to define the concept of C3 and its

relationship with the practice of combined arms. The application of military power is a problem experienced by all commanders, who require effective control over their units and constant access to information and lines of communications. C3 systems seek to optimize the employment of armed forces through practices that help a commander access information and decrease his response time in a highly volatile scenario (MAIDANA, 1990).

Specifically, a C3 system is a set of processes, equipment, and personnel that allow a commander to analyze, compare, decide, and act. According to Maidana (1990), C3 systems are those that support C2 processes. In this sense, C2 is the process of planning and directing the resources available to a commander in pursuit of his objectives, while C3 is the system, that is, the equipment, facilities, and personnel, which allows the commander to efficiently proceed with the command and control of his forces (EIDSON, 1995). However, such is the importance of communications to the concept of command and control that the terms C2 and C3 are routinely used interchangeably (MAIDANA, 1990).

Fundamentally, C2 cannot be practiced without the presence of communication links between the commander and his subordinates, the former passing orders and the latter producing information and feedback. Thus, C3 systems are human functions, aiding the cognitive functions of individuals, and such systems generally reflect circumstantial needs. Quick access to available information is crucial for combat. If two parties are equal in all other variables, the one that possesses the best intelligence, in terms of accuracy and speed of capture, will prevail in the conflict. This happens because a commander who acts without the necessary information to achieve his objective will be more likely to inefficiently control his resources (OSTENDORF, 1985).

In this manner, C3 systems are crucial for combat efforts and, especially, for the integration of different services and arms. Military units differ from each other by their equipment, logistics, purposes, vulnerabilities, and tactical advantages. These distinctions lead to the emergence of arms, that is, arrangements of equipments, armaments and organization of troops. In turn, these come to have specializations, specialties and distinct combat styles (HOUSE, 2001). Furthermore, although the

concept of arms is limited to land forces, the practice of combined arms incorporates the role of the air force in close air support operations (HOUSE, 1984).

The concept of combined arms refers to the idea that different arms must be used coordinately to maximize their combat and survival capabilities, the strengths of some offsetting the weaknesses of others. For a joint employment of different arms, each with their own peculiarities in terms of logistics, mobility, speed, vision, firepower, and maintenance, among other factors, the presence of an effective C3 system becomes necessary, which will allow the efficacious practice of a combined arms doctrine (HOUSE, 1984). Therefore, the simple desire to employ the air force in support of ground troops is not enough for it to effectively help the land units and for it to influence the outcome of a battle. The Western Desert Campaign exemplifies how a combined arms doctrine, here referring to the air force's support of land units, is realized on the battlefield by a C3 system.

British military doctrine established that land and air units were subordinate to separate hierarchies. Therefore, the commander of the DAF, Arthur Coningham, was subordinate to the Air Officer Commander in Chief, Middle East, Arthur Tedder, while the generals under the control of the ground forces, be it the Western Desert Force or the Eighth Army, were subordinate to the Middle East Command (GAETKE, 2015). It should be noted that the DAF's model was developed to facilitate the flexible use of air resources, which were significantly scarce. The command and control of air units was centralized in an air officer who understood the complexities of the use of such resources and, therefore, could direct and concentrate them in the most important places at the most appropriate times (STEPHENS, 2007). In essence, British doctrine considered that the two services were separate, but hierarchically equivalent (GAETKE, 2015).

Such separation was not unanimous among the armed forces in the Second World War. For example, American air commanders were subordinate to their ground counterparts. The British system was shaped by the analysis that, in any given scenario, the commander best able to command and distribute the resources of a respective service was indisputably the individual trained in it. Behind this doctrine was the vision that interservice cooperation was essential to the conduct of war. However, since commanders were independent from one another, the

system depended on the cooperation between specific individuals. In the case of the Western Desert Campaign, the coordination between the two services was insufficient until the arrival of Montgomery in August 1942. Previous ground commanders generally neglected the air force's role in engagements, preferring British squadrons to attack the Axis aircrafts directly. In this sense, the role of the Royal Air Force, according to these officers, was just in preventing the Luftwaffe from bombing British soldiers (GAETKE, 2015). In addition, there was a dispute over the control of the air resources, as the army was hostile to a shared authority between the two services and Wavell and Auchinleck did not comprehend the interdependency of the air and land operations (HALL, 2002).

In June 1940, Collishaw, the first commander of the British air units in Egypt, had only 81 aircraft in his command, a quantity three times smaller than the one available to the Regia Aeronautica. During the Italian offensive, air support to the Western Desert Force was limited to reconnaissance missions, although on occasion squadrons bombed fixed Italian positions. Meanwhile, during the British offensive in Operation Compass, the planned cooperation between air and ground units was quickly dismantled when the attack began, the squadron only managing to bomb targets that were easily observable, static, and that had been chosen during the planning phase (GLADMAN, 2009). Even so, Collishaw managed to keep the Italian air force in the defensive by practicing offensive patrols and attacking their air bases. During these engagements, the Italian army requested a passive air protection over their ground forces, a tactic known as air umbrella. This protection was highly inefficient and led to a significant wear of the aircrafts and their pilots, since they were ordered to fly over specific ground forces for long periods, regardless of the strategic and tactical context (BECHTHOLD, 2011).

Nevertheless, initial attempts to direct aircraft towards enemy targets proved extremely inefficient, planes dropping practice bombs and the ground forces having to reply with flare guns. This precarious air support was successful during Operation Compass, due to the low mobility and morale of the Italian army (GLADMAN, 2009). Furthermore, despite a good personal cooperation between O'Connor and Collishaw (BECHTHOLD, 2011), there was no constant contact between the officers of the two services, each practicing a separate war. The

result was that, when air squadrons were required to assist in ground operations, the lack of communication, in addition to outdated intelligence, prevented the DAF from decisively participating in the engagements. Given this, its main role, in 1940 and 1941, was that of interdiction, British planes attacking German and Italian convoys (GAETKE, 2015).

The lack of an efficient C3 system was aggravated after the entry of German forces into North Africa. Despite the British air strength in 1941 being significantly superior to their strength in 1940, the methods of close air support that proved sufficient against the Italians revealed themselves to be extremely inadequate against German mobility. In this period, there were frequent issues in identifying friendly land units. During the withdrawal in Operation Sonnenblume, for example, there were numerous cases of friendly fire by air squadrons, as the contact between the two services was limited in the chaos of the engagements. Additionally, some Axis convoys, despite being spotted by the British air force, were not attacked due to the difficulty in identifying them as hostiles (BRONK, 2017). Meanwhile, in technical terms, the existing lines of communication between frontline units and their headquarters were highly unreliable, the radios being initially of a low-frequency and in insufficient numbers, both in the Eighth Army and in the air force. With a breakdown of communications during the engagements, pre-arranged air support was the only one to be expected (GLADMAN, 2009). Be that as it may, the British air force managed to give an important contribution while attacking Axis supply convoys and their units in the outskirts of Tobruk, the British position that was besieged by Rommel (STOCKFISCH, 1991).

With O'Connor being captured during Operation Sonnenblume, interservice cooperation was weakened even further. During the British offensive in Operation Battleaxe, British air units were forced to practice an air umbrella for ground troops, despite opposition from Collishaw and a widespread recognition, by aviators, that this tactic was extremely ineffective vis-à-vis the offensive use of fighters. Due to Battleaxe's failure, Collishaw, although he was not the one responsible for the British problems, was replaced by Coningham (BECHTHOLD, 2011), and shortly thereafter the DAF was created (SHEPHERD, 2016).

Before Operation Crusader, Coningham, and Tedder significantly improved their close air support systems, taking into account the lessons of previous engagements, and the practice of air umbrella was halted. However, on the Eighth Army side, there remained a serious neglect of the horizontal cooperation. In any case, tactical signaling was improved, and air officers, with radio units linked to the DAF, were introduced into the Eighth Army's headquarters, including in divisions and corps. These officers transmitted information, regarding the evolution of the engagements and possible targets, to the air force. Eventually, the same began to happen in the opposite direction, with army officers being deployed to air units (GLADMAN, 2009). With such developments, the DAF began to influence the campaign to a greater degree, contributing to the British victory in Operation Crusader and, later, preventing the total defeat of the Eighth Army, in the retreat in Gazala, through incessant attacks on the German vanguard (HOLLAND, 2019).

By 1942, fighter-bombers had presented themselves as one of the most important assets of the DAF. During the First Battle of El Alamein, these aircraft decisively assisted British ground forces by hindering the advances of the Axis divisions (SHEPHERD, 2016). The creation of the fighter-bomber squadrons was an important change in the British air strategy. In 1940, fighters were ordered to prioritize the achievement of air supremacy by destroying enemy fighters in the air, while the support of ground forces was solely the responsibility of light bombers. However, these bombers did not drop bombs accurately, required long runways, and were slow and vulnerable to enemy fighters, which created the need for a fighter escort during their missions. The outcome was two failures, as the bombers failed to practice an effective close air support, while the British fighters in North Africa failed to achieve air supremacy (BRONK, 2017).

However, the purpose of air supremacy was precisely to facilitate close air support for ground forces. The solution was to redirect fighters towards close air support, first with their machine guns and cannons and, later, with bombs that were installed in their wings (BRONK, 2017). These fighter-bombers had a short response time and could revert to their previous role if necessary, providing Coningham with a flexible equipment that allowed the DAF to win the initiative in North Africa (HALL, 2009). Additionally, rather than primarily trying to combat Axis fighters during high-

altitude engagements, the DAF prioritized attacking enemy airstrips. The success of these strategies was so significant that Coningham ordered, in May 1942, all fighters to focus on close air support and interdiction, the DAF's potential being projected in support of the ground forces and air supremacy being fought over at low altitudes, where the main British fighter in North Africa, the bythen outdated Hurricane², was better adapted to combat German fighters (BRONK, 2017).

Later, Montgomery and his DAF's counterpart, Coningham, established headquarters at the same location, the two working together in the formation and execution of their plans (GAETKE, 2015). For Coningham, the use of his squadrons in close air support, that is, in direct support of the ground forces during their engagements, was pivotal to the maximization of British efforts in the region, and he established an effective system of close air support to the Eighth Army, with ground units pointing specific targets, but the decision to distribute the squadrons remaining in the hands of air force officers (HOLLAND, 2019). Therefore, specific air units were not paralyzed in the hands of specific ground units, and this allowed for a flexible use of squadrons and the maximization of the air effort, their deployment reflecting the evolving nature of engagements (NEWELL, 2015).

Another innovation in C3 was the J Service, introduced by Montgomery, which intercepted messages from vanguard units and relayed them to their headquarters, shortening the time needed for information to reach commanders. This system ultimately increased Montgomery's knowledge of the battles and the status of his units (GLADMAN, 2009). According to Griffin (1991), Montgomery utilized liaison officers in a more robust manner than any other Allied commander in the Second World War, them personally reporting, with precision and in detail, the status of the formations in combat. Furthermore, new practices were introduced for distinguishing friend from foe, with colored smoke bombs being used by ground troops, in addition to the display of symbols and arrows on the ground. Meanwhile,

2 The British already had a superior fighter since 1940, the famous Spitfire. However, these were primarily allocated to the defense of England's airspace until mid-1942, when Spitfires finally began defending North Africa and Malta. Thus, despite Spitfire production being superior to that of Hurricanes between 1940 and 1941, the most modern fighters were concentrated in England (HOLLAND, 2013).

when the British receive more fighters, the combined use of fighters and fighter-bombers was improved, the DAF practicing complex air supremacy and close air support operations concurrently, maximizing their efficiencies. Last, but not least, the British squadrons consistently explored, in an organized fashion, the manner in which the battles unfolded, following the land advances through the changing of air bases between sorties, this to be as close as possible to the ground combat (GLADMAN, 2009).

During the Second Battle of El Alamein, the C3 system was extraordinarily sophisticated and incorporated by both services, the British practicing combined arms in a superior manner to the Germans possibly for the first time in the Second World War, and this became a pattern in the subsequent campaigns. For example, during combat in one of the positions in this battle, air support was requested by ground troops that were facing British tanks captured by the Germans, something that would make the distinction between friend and foe difficult. Even so, in less than an hour, two air strikes took place, British planes destroying or damaging 15 Axis tanks, their identification aided by ground troops' signals (GLADMAN, 2009). Therefore, according to Mayock (1950) Montgomery expanded the already improved cooperation between the British air and land forces in North Africa, while Hall (2002, p. 82) states that, together, Montgomery and Coningham "turned a theory on modern war into battlefield practice". In February 1943, Montgomery and Coningham detailed their ideas about airpower at a meeting in Tripoli with British and American officers, and their statements "were to become the basis for Anglo-American tactical air doctrine for the remainder of the war, and indeed, many of the tenets of that doctrine are as relevant today as they were in 1943" (BECHTHOLD, 2011, p. 3).

It should be noted that indirect support to ground forces was not neglected by the DAF. Thus, interdiction and reconnaissance missions continued to be practiced to great effect, but they were connected to a broader effort, and sorties, whether in indirect or close air support, were employed in cooperation with ground operations (SMYTH, 2007). Therefore, the DAF was decisive during the Second Battle of El Alamein, disrupting Axis mobility, directly hitting their positions during engagements, and attacking their supply lines. Montgomery and Coningham sought

to strike against the Germans throughout the system behind their combat efforts, rather than focusing on a single point (GAETKE, 2015). Indeed, the DAF already cooperated with the Eighth Army in a horizontal manner, all air resources being centralized under its own command (MAYOCK, 1950). This notwithstanding, when Montgomery arrived in North Africa, he immediately planned his operations and fought his battles side by side with the air force, unlike Wavell and Auchinleck. In sum, Montgomery's offensives were largely molded by a joint plan between him and Coningham (HALL, 2009).

When the first American air squadrons arrived in North Africa in mid-1942, the benefits of the British system were increasingly assimilated. Lewis Brereton, commander of the American air force in Egypt, identified that the British arrangement was superior to the American in encouraging cooperation and the efficient practice of combined arms, and he called for its adoption by the United States (NEWELL, 2015). For Hall (2009), at the end of 1942 the DAF's system was significantly superior to that of its enemies, as the German air resources, whether in North Africa or the eastern front, were often subject to the control of ground commanders who repeatedly did not use them efficiently.

Despite the important experience of Brereton's American air units in Egypt, his compatriots decided to follow the doctrine established in the interwar period for the planning of Operation Torch, the Anglo-American landing in Algeria and Morocco. Thus, Dwight Eisenhower did not centralize the command of air units involved in the operation, including British wings, in a single airman, while these units were subordinate to the ground commanders (CLAIR, 2005). Most notably, Anderson, the commander of the British First Army in Tunisia, did not share Montgomery and Coningham's views on airpower, and his units, like American forces in the region, were not as successful in the practice of combined arms (BECHTHOLD, 2004). As a result, both the British and Americans who landed during Operation Torch had problems in coordinating the two services. This decentralized C2 process, with each Army Corps commanding its own air unit, led to the dissipation of air resources in the region, as ground commanders did not coordinate with each other and failed to concentrate aircraft where necessary. As an example, on one occasion the commander of the American Corps refused a request for aerial reconnaissance

in a region, as the location was technically the responsibility of the British Corps (DEGOVANNI, 1989).

In January 1943, with the initial Allied failure in Tunisia and constant problems in land-air cooperation, all tactical air units in the Mediterranean, British or Americans, were concentrated in a new command under Coningham, the Northwest African Tactical Air Force (SCHMIDT, 1998). Air umbrella tactics, used disastrously³ by the Americans in Tunisia, were immediately replaced by the offensive use of fighters against enemy air bases, Coningham taking the air war to the Axis airspace, which led to the Allies regaining the initiative (HALL, 2009). However, American cooperation remained relatively precarious, as British combined arms techniques, in addition to the formulation of joint plans between the two services, were adapted only after the American defeat at Kasserine in February 1943 (FISCHER, 2006). According to DeGovanni (1989), the lack of concentrated airpower and the inexistence of a centralized command structure contributed decisively to the American failure in Kasserine.

According to Johnston (2005), the American problem in Tunisia was not created by a complete negligence, in the interwar period, of the cooperation between the two services in abstract terms, but by the lack of a concrete C3 system to support this cooperation. In this sense, after a first negative experience in Tunisia, the Americans completely adapted the DAF system, one that was already explicitly formalized in that period. Coningham, Tedder and Montgomery would continue with the close coordination between air and ground forces in the campaigns in Tunisia, Italy and in the western front from 1944 to 1945 (HOLLAND, 2019), where British and American air forces came to have relatively uniform practices and structures (JOHNSTON, 2005).

During the Second World War, this C3 system continued to evolve with the introduction of new tendons, such as the Forward Air Control (FAC) in the Tunisian Campaign. The FACs were aviators in frontline ground formations equipped with radios, who received calls for air support and directed the planes to their targets, something that became standard in later campaigns (GLADMAN, 2009). In addition,

³ According to DeGovanni (1989), the Germans simply waited for the American fighters to finish their air umbrella missions to initiate unopposed air attacks against the ground formations.

something that reduced air forces' response times was the introduction of the cab rank, also in Tunisia. During operations, bombers flew close to the battlefield, waiting for the FAC's contact (TAYLOR, 1994). Such tendons proved to be essential for interservice cooperation. As an example, during one of the clashes in Tunisia, a single FAC accurately directed more than 400 airstrikes, decisively impacting the ground combat (ROWLEY, 1976).

Despite a difficulty in capturing these lessons by commanders who did not participate in the Western Desert Campaign, such as the forces that landed in Operation Torch (GLADMAN, 2009), this C3 system was widely employed by the British and Americans from mid-1943 onwards, especially during the Normandy Campaign (HOLLAND, 2019). With the DAF's operations in late 1942 bearing little resemblance to the air operations in 1940, the British managed to create, after two years of learning in North Africa, "the world's first truly effective system for delivering close air support" (BRONK, 2017, p. 52). In short, the British military doctrine in this case study and the manner in which it was employed were "based on enduring principles that have applied ever since" (GLADMAN, 2009, p. 191), influencing combined arms doctrines and C3 systems in the post-war period.

4 CONCLUSION

In this article we sought to analyze the DAF's role in the Western Desert Campaign. In the process, we investigated how the development of a C3 system impacted British interservice cooperation in this theater of operations. It was revealed that the air force was initially relegated to a more indirect role, cooperation being minimal and communication between the services remaining highly unreliable during engagements. However, this precarious cooperation was enough to defeat the Italians in the early days of the campaign.

With the German entry into this theater of operations, the existing C3 system was revealed to be incapable of dealing with German mobility, leading to several friendly fire incidents and dismantling the cooperation between the services. Such lessons, however, were initially assimilated by the air force commanders, Coningham and Tedder, and later by the new and final commander of the Eighth

Army in North Africa, Bernard Montgomery. With his appointment, the C3 system, which had already evolved through air force innovations, was incorporated and extended, the two services cooperating to a high degree. Additionally, several new links were introduced in the system in terms of personnel and equipment, which would come to assist air units' response time, the identification of allies from hostiles, the direction of combat efforts and the exchange of information along the chain of command, among other factors.

We conclude that the horizontal cooperation between the DAF and Eighth Army was efficiently executed only after the formation of a cohesive C3 system, which depended on several human, as well as material, variables. In this manner, the personal relationship between Coningham and Montgomery proved to be as important as the introduction of new practices, equipments and services. Furthermore, it should be noted that the air force's impact upon the ground campaign was not directly related to the raw number of available planes. Ultimately, the complexities behind the tactical and strategic cooperation between the two services here analyzed were revealed, and the lessons of the Western Desert Campaign still stand the test of time.

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