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Military Transformation and Legacy Forces

Williamson Murray

Thomas O'Leary

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**Military Transformation and
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INSTITUTE FOR DEFENSE ANALYSES

Theodore S. Gold – Joint Advanced Warfighting Program

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This paper examines the 1940 German offensive in the West and the US Air Force's introduction of stealth and precision in OPERATION DESERT STORM to make the point that it is not necessary to transform the entire force in order to achieve transformed capabilities. Instead, revolutionary new ways to fight can be realized by discovering and exploiting synergies between a relatively small portion of the total force, empowered with new capabilities, and the so-called "legacy" forces. This was a major argument offered by the recent Defense Transformation Study in support of its recommendation that the Secretary of Defense pursue the "tip of the spear" joint response force capabilities.

The authors, military historian Williamson Murray and Colonel Tom O'Leary, USMC (ret.), argue that transformation should not be viewed as the steady conversion of the entire force—a process more descriptive of modernization. Transformation, especially given the pace of technological change and uncertainties about future threats, likely will follow a more turbulent process, featuring aggressive experimentation, a continual insertion of new capabilities in relatively small packages, and the concurrent retirement of portions of the legacy force.

This JAWP paper is one in a series in which Dr. Murray and his co-authors have provided a look at transformation throughout different periods of military history, highlighting attributes of success and "lessons learned" for our use in the twenty-first century:

Experimental Units: The Historical Record

Experimentation in the Period Between the Two World Wars: Lessons for the Twenty-First Century

An Historical Perspective on Effects-Based Operations

New Perspectives on Effects-Based Operations: Annotated Briefing

War and Urban Terrain in the Twenty-First Century

Thinking About Innovation

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FY2000 End of Year Report: Volumes I, II, and III, Theodore S. Gold et al., IDA Paper P-3571, November 2000.

Preface

This paper was prepared under the task order Joint Advanced Warfighting Program (JAWP). The primary sponsor was the Assistant Secretary of Defense for Strategy and Threat Reduction. It addresses the task order objective of generating advanced joint operational concepts and joint experimentation to assist the Department of Defense in transforming U.S. military capabilities.

The JAWP was established at the Institute for Defense Analyses (IDA) by the Office of the Secretary of Defense and the Joint Staff to serve as a catalyst for stimulating innovation and breakthrough change. The JAWP Team is composed of military personnel on joint assignments from each Service and civilian analysts from IDA. The JAWP is located principally in Alexandria, Virginia, and includes an office in Norfolk, Virginia, that facilitates coordination with the United States Joint Forces Command.

This paper does not necessarily reflect the views of IDA or the sponsors of the JAWP. Our intent is to stimulate ideas, discussion, and, ultimately, the discovery and innovation that must fuel successful transformation.

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Executive Summary

In this paper, the authors show how revolutions in military affairs have started with the transformation of relatively small portions of force structures, which, in turn, significantly magnified the capabilities of the legacy forces. The authors conclude that it is not necessary to transform the entire force in order to achieve transformed capabilities.

Two case studies are examined, the 1940 German offensive in the West and the US Air Force's introduction of stealth and refinement of precision in OPERATION DESERT STORM. The *Wehrmacht* and the US Air Force realized revolutionary new ways to fight by discovering and exploiting synergies between small parts of the force, empowered by new capabilities and legacy forces. Both case studies reveal the complexities and issues involved in the processes of transformation and substantive change, and show how transformation of small portions of force structures improved the capabilities of the whole force. Their approach to transformation yielded disproportionate results—and victory—on the battlefield.

By following this approach to transformation (that it is not necessary to transform the entire force to achieve transformed capabilities), the Department of Defense can more rapidly move forward with capabilities needed to meet a broad spectrum of challenges. It is important to note what transformation is not. It is not replacing one set of platforms with new, more expensive sets. It does not necessarily occur when all new equipment is in place, or when new technologies replace old ones.

Case Study No. 1: The Wehrmacht's Panzer Force. Laboring under the constraints of the Treaty of Versailles, which

took force in 1920, the Germans were left with no choice but to innovate intelligently. When the *Wehrmacht* began rearmament, it possessed not a single tank, had few officers with any experience with armored fighting vehicles, and had only the most rudimentary designs for tanks on the drawing board.

By 1923, the Germans had distilled the lessons of World War I into a coherent doctrinal framework of combined-arms tactics that emphasized leadership, mission-type orders, and ruthless training. A new doctrinal manual, *Die Truppenführung*, was published in 1933 and became the basis for the army's approach to combat throughout the Second World War. Though the army did not possess a single tank, *Die Truppenführung* explicitly foresaw armored fighting vehicles as playing a key role in the achievement of operational freedom.¹

By September 1939, Adolf Hitler was able to launch his rearmed military forces against Poland. Out of fifty-four active duty and reserve German divisions that participated in that campaign, only six were panzer divisions. Four more were light divisions, while four were motorized infantry divisions. The remaining forty divisions were infantry or mountain divisions that differed only slightly

¹ This despite the fact that the army had virtually no experience with tanks after 1919. When Heinz Guderian was appointed to be the General Staff officer in charge of armored warfare in 1926, he was shipped off to Sweden to look at what the Swedes were doing with tanks. As Guderian makes clear in his memoirs, it would be the first time he had ever seen a tank.

from the German Army's attack divisions on the Western Front in spring 1918.²

Almost immediately after the end of the Polish campaign, the army's high command disestablished the four light divisions and converted their troops into new panzer divisions.³ In the Western campaign in May 1940, the *Wehrmacht* (including *Waffen SS*) would consist of 10 panzer divisions, 8 motorized infantry divisions, and 118 regular infantry divisions.⁴ Thus, panzer divisions made up less than 8 percent of the force structure, while the bulk of the *Wehrmacht*'s divisions were equipped and looked much like the formations of other European armies. But the panzer divisions offered a set of capabilities for maneuver war that no other European army could match.

Case Study No. 2: Operation Desert Storm. The 1970s and 1980s were a period of enormous technological change in the U.S. military capabilities. Many research and development efforts had serious implications—not at all clear at the time—for the tactical fighter forces. This case study focuses on two of the more significant advances in warfighting: precision and stealth. Even by the beginning of OPERATION DESERT STORM on the night of 17 January 1991, military concepts and doctrine had not yet caught up to the possibilities that precision and stealth offered. The technological development of precision bombing took longer than either its engineers or the military leaders had expected. The F-117's position in the “black

world” also kept its stealth capability from working its way into the larger framework of Air Force operational concepts. This case study examines how planners leveraged these new capabilities to extend and expand the capabilities of the legacy forces.

Conclusions. The leaders and planners in the Department of Defense should pay attention to the model of transformation as illustrated by the 1940 German offensive in the West and the US Air Force's use of stealth and precision in OPERATION DESERT STORM. The lesson from recent history is simply this: It is not necessary to attempt some radical transformation of the entire force to achieve transformed capabilities.

In this model, transformation did not involve the steady conversion of the entire force—a process more descriptive of modernization. Transformation, especially given the pace of technological change and uncertainties about future threats, invariably follows a more turbulent process featuring aggressive experimentation, a continual insertion of new capabilities in relatively small packages, and the concurrent retirement of portions of the legacy force. It also depends, to a considerable extent, on the continued updating and effectiveness of legacy forces.

Finally, the most powerful enablers in past revolutions in military affairs have been changes in concepts and doctrine. If the past is any guide, the real challenge lies in leveraging emerging technologies with new concepts and doctrine, to maximize the potential not only of new forces but of the legacy forces as well.

² Klaus Maier et al., *Das Deutsche Reich und der Zweite Weltkrieg*, vol. 2, *Die Errichtung der Hegemonie auf dem Europäischen Kontinent* (Stuttgart: Deutsche Verlags Anstalt, 1979), p. 93.

³ One of which Erwin Rommel would lead in the armored thrust through the Ardennes.

⁴ Telford, Taylor, *The March of Conquest: The German Victories in Western Europe, 1940* (Baltimore, MD: Nautical & Aviation Pub. Co. of America, 1991), p. 184.

Military Transformation and Legacy Forces

Introduction

The Secretary of Defense, with the enthusiastic support of the President, has embraced the need for “transformation.” Unfortunately, considerable confusion remains as to what exactly transformation of U.S. military forces may entail. For some in the Services, transformation suggests replacing one set of platforms with a new, more expensive set. To others, it means focusing the Department’s efforts on technology. In other words, they believe the process of transformation is either platform centric or driven by technology. And there are those who believe that transformation occurs only when *all* the new equipment is in place, or until new technologies replace the old. Consequently, the processes of transformation may well stretch out for years, if not decades, into the future, and involve huge costs in the procurement of new equipment and the replacement of the old.

Yet history suggests that such views of transformation are not only *ahistorical*—i.e., with no basis in actual history and experience—but *misleading*.⁵ In fact, more often than not, real revolutions in military affairs have started with the transformation of relatively small portions of force structures. The transformed portion, in turn, has then significantly magnified the capabilities of legacy forces.

The most powerful enablers in past revolutions in military affairs have been changes in concepts and doctrine.⁶ Such changes tied emerging capabilities to legacy forces within a coherent and intelligent framework of warfighting. If the past is any guide, the real challenge lies in leveraging emerging technologies with new concepts and doctrine to maximize the potential not only of new forces but legacy forces as well.

This paper examines how the transformation of relatively small portions of military forces has yielded disproportionate results—and victory—on the battlefield. It focuses

⁵ For a general examination of the complex processes involved in transformation and innovation, see Williamson Murray and Allan R. Millett, eds., *Military Innovation in the Interwar Period* (Cambridge, UK: Cambridge University Press, 1996). See also Allan R. Millett and Williamson Murray, eds., *Military Effectiveness*, three volumes, *World War I*, *The Interwar Period*, and *World War II* (London: Allen and Unwin, 1988).

⁶ For the pattern of past revolutions in military affairs and their constituent parts, see MacGregor Knox and Williamson Murray, *The Dynamics of Military Revolution, 1300-2050* (Cambridge, UK: Cambridge University Press, 2001), chpt.1.

on how such an approach to transformation might significantly improve the capabilities of the whole force, at considerably less cost and time, than needed to replace current inventories with massive new procurements.

The next chapters will present two case studies from the military history of the twentieth century: the German Army's transformation strategy during the 1920s and 1930s, and the US Air Force's struggles and accomplishments in adapting its operational approach to the new possibilities offered by changes in technology in the months before the start of fighting in the Gulf War. Both case studies suggest a realistic model for looking at the processes of transformation and substantive change.

Case Study No.1. The Wehrmacht's Panzer Force

In 1920, the German Army confronted the military and political consequences of the *Reich's* defeat in World War I. The Treaty of Versailles imposed a series of seemingly crushing terms on the new German Republic. For the army, the treaty set a limit of 100,000 men with no more than 5,000 officers. The peace terms also forbade weapons systems such as tanks, aircraft, submarines, and heavy artillery. In other words, the treaty forbade the German military from possessing the crucial new weapons that had emerged from the conduct of military operations in World War I. How the Germans set about changing that situation provides a relevant and interesting study in *intelligent innovation*.

To begin with, under the perceptive leadership of General Hans von Seeckt, the German Army turned to learning the real lessons of the last war.⁷ By 1923 the Germans had distilled the lessons of World War I into a coherent doctrinal framework of combined-arms tactics that emphasized decentralized leadership, mission-type orders, and ruthless training.

In 1932 three of the *Reichsheer's* senior generals rewrote and refined the 1923 regulations. Of those three officers, one, General Werner von Fritsch, became the army's commander-in-chief in the following year as German rearmament began; a second, General Ludwig Beck, became the chief of the Great General Staff, arguably the most prestigious position in the army. The resulting doctrinal manual, *Die Truppenführung*, was published initially in 1933, and became the basis for the army's approach to combat throughout the Second World War.

Interestingly, while the army did not yet possess a single tank, *Die Truppenführung* explicitly foresaw armored fighting vehicles as playing a key role in the achievement of

⁷ Historians often argue that military institutions study the last war and that is why they do badly in the next. Nothing could be farther from the truth. In most cases military institutions do *not* study the last war, and that is why they do badly in the next. Seeckt appointed no less than fifty-seven different committees to study what had happened in World War I and then set in motion a series of programs to ensure that the lessons learned were inculcated deep into the army's psyche, training, and preparations for future war. This involved an emphasis not only on the writing of a coherent combat doctrine, but also on changing the culture of the army to focus on the serious study of the profession of arms. See in particular James S. Corum, *The Roots of Blitzkrieg, Hans von Seeckt and German Military Reform* (Lawrence, KS: University of Kansas Press, 1992), p. 37.

operational freedom—in other words, translating the infantry exploitation of the 1918 battles onto a wholly new plane.⁸

In January 1933, Adolf Hitler came to power as chancellor, and German rearmament began in earnest. In the initial years of the Nazi state, Hitler focused on creating his dictatorship and overturning the diplomatic provisions of the Treaty of Versailles.⁹ *Der Führer*, knowing full well that his plans and goals would lead eventually to a general European war, provided the Services, including the newly created *Luftwaffe*, with blank checks to begin their massive programs of rearmament.¹⁰

For the army the processes of rearmament could not take place within a theoretical framework. The *Reich* confronted hostile and suspicious neighbors, made doubly suspicious by the revolutionary nature of the new Nazi regime. These neighbors might well have taken matters into their own hands by launching a preventive war against Germany. Certainly, Hitler recognized that possibility. In the first days of his regime, he warned the army's senior generals that France—if it possessed any real leaders—would attempt to throttle the Nazi regime at its birth.¹¹ Thus, the strategic imperative was to create a force that could defend the *Reich's* frontiers in the immediate future as well as prepare for a war of conquest in the long term. The immediate emphasis in the initial stages of rearmament had to be on the creation of forces that reflected the army's current strengths and experience levels—in other words, an army that emphasized conventional infantry and artillery.

Moreover, two difficulties would have confronted the Germans had they considered turning the entire army into a revolutionary, mechanized, combined-arms force: (1)

⁸ Chef der Heeresleitung, *Die Truppenführung* (Berlin: E. G. Mittler & Sohn, 1936), paragraph 339, p. 133.

⁹ Some historians have claimed that Hitler played a major role in encouraging the development of an armored force. He did no such thing. Instead, he remained entirely removed from major doctrinal and force structure issues with the exception of his decision that the German Army would expand to thirty-six divisions in 1936. Friedrich Hossbach, *Zwischen Wehrmacht und Hitler, 1934–1938*, (Hanover, 1949), p. 39.

¹⁰ There was never any coherent framework for German rearmament, and as early as the mid-1930s, the Nazi state was confronting major economic difficulties. See Williamson Murray, *The Change in the European Balance of Power, 1938–1939: The Path to Ruin* (Princeton, NJ: Princeton University Press, 1984), chpt. 1. For how the Nazi state formulated its strategic policies in the 1930s, see Williamson Murray, “Net Assessment in Nazi Germany in the 1930s,” in *Calculations, Net Assessment and the Coming of World War II*, Williamson Murray and Allan R. Millett, eds., (New York: The Free Press, 1992).

¹¹ “Aufzeichnung Liebman,” *Vierteljahrshefte für Zeitgeschichte*, 2 no. 4 (October 1954). For a suggestion that the Germans had reason to worry, see Zygmunt J. Gasiorowski, “Did Pilsudski Attempt to Initiate a Preventive War?,” *Journal of Modern History*, 27 (June 1965).

Germany's resources and (2) the state of knowledge within the army as to mechanized tactics, operations, organization, and training. In the case of the former, the *Reich* had virtually no access to petroleum, at least during the early stages of rearmament. The nearest major petroleum source was Rumania, and the Rumanians, along with the Czechs and the Poles, were hostile to Germany. Thus, a new German Army that was wholly mechanized might not have sufficient fuel even to defend itself.¹²

But equally important to German planners as rearmament began was the fact that the army had had virtually no experience with tanks after 1919.¹³ In 1926, when Heinz Guderian was appointed to be the General Staff officer in charge of armored warfare, he was shipped off to Sweden to look at what the Swedes were doing with tanks. As he makes clear in his memoirs, it would be the first time he had ever seen a tank.¹⁴ Admittedly, during the late 1920s and early 1930s the Germans maintained a secret military relationship with the Soviets, where they were able to experiment with tanks and aircraft. But the small scale of the enterprise between two suspicious partners placed considerable constraints on what the Germans were able to learn.

In short, as rearmament began, the German Army possessed not a single tank, had few officers with any experience with armored fighting vehicles, and possessed only the most rudimentary designs for tanks on the drawing boards. The first two tanks the *Wehrmacht* received from Krupp, the Mark I (six tons and armed with machine guns) and the Mark II (ten tons and armed with a 20mm cannon), were already obsolete when they entered serial production in 1934. Not until 1938, with the arrival of the first Mark IIIs (initially armed only with a 37mm cannon) and Mark IVs (armed with a 75mm low-velocity gun), did the Germans possess their first modern tanks.

Nevertheless, even in 1940 the great majority of the army's armored fighting vehicles would be Mark Is and Mark IIs, while in 1941 obsolete Mark IIs and Czech tanks made up a substantial portion of the panzer divisions' equipment in the invasion of the Soviet Union. The most recent study of the Battle of France indicates an overall tank strength for the *Wehrmacht's* panzer divisions of 2,439 tanks—523 Mark Is, 955 Mark IIs, 106

¹² The shortage of fuel would hinder Germany's strategic choices throughout the Second World War. For the difficulties the Germans confronted with regards to petroleum, see Murray, *The Change in the European Balance of Power, 1938–1939*, pp. 6–8.

¹³ Even the German experience with tanks in the First World War had been largely on the receiving end of Allied tank attacks. The Germans produced virtually no tanks during that war—one of the great oversights of that conflict.

¹⁴ Heinz Guderian, *Panzer Leader* (New York: Ballentine Books, 1956) p. 12.

Czech 35 (t)s, 228 Czech 38 (t)s, 349 Mark IIIs, and 278 Mark IVs.¹⁵ Opposing them were 674 modern French tanks (in most respects superior to the German Mark IIIs and IVs), with a further 2,535 French tanks, the capabilities of which were similar to the more obsolete tanks in the German inventory. In addition, the British brought an additional 310 armored fighting vehicles to the fight, all of which were superior to the Mark Is and IIs in virtually every aspect from armor to fire power. *Thus, the Western allies possessed an advantage of over 1,000 tanks when the 1940 campaign began.*

The disparity in tank strength in 1941 between the *Wehrmacht* and the Red Army was even greater. Against a Soviet tank park that consisted in excess of 20,000 armored fighting vehicles, including the awesome T-34, the *Wehrmacht's* panzer divisions possessed only 3,255 tanks. Of the German tanks, 281 were Mark Is; 743 Mark IIs, 157 Czech 35 (t)s, 651 Czech 38 (t)s, 979 Mark IIIs, and 444 Mark IVs.¹⁶ Thus, over 50 percent of the armored inventory in June 1941 still consisted of obsolete armored fighting vehicles.¹⁷

Despite the inability of German industry to produce a first-class armored fighting vehicle in 1933, the Germans pressed ahead. By the end of the first year, the army possessed its first tank battalions. In 1935 Fritsch and Beck were sufficiently impressed with the performance of the first tank units to establish the army's first three panzer divisions.¹⁸ Along with those divisions they also established a number of independent tank battalions for infantry support; several division-sized formations (called light divisions) that combined infantry, tanks, and cavalry to perform the task of reconnaissance; and several motorized infantry divisions.

From 1935 through 1938 the army experimented with these different types of armored formations in exercises. At the same time the General Staff was executing staff rides and war games to test the possibilities that armored warfare would extend and enhance

¹⁵ Karl-Heinz Frieser, *Blitzkrieg-Legende, Der Westfeldzug 1940* (München: R. Oldenbourg Verlag, 1995), pp. 48-49. Alistair Horne provides the following estimate of German armor strength in May 1940: 640 Mark Is, 825 Mark IIs, 396 Czech tanks, 564 Mark IIIs, and 258 Mark IVs. Alistair Horne, *To Lose a Battle: France 1940* (Boston: Little, Brown, and Company, 1969).

¹⁶ Horst Boog et al., *Das Deutsche Reich und der Zweite Weltkrieg*, vol. 4, *Der Angriff auf die Sowjet Union* (Stuttgart: Deutsche Verlags Anstalt, 1983), p. 185.

¹⁷ Here it is worth noting the role of the Mark IIIs and Mark IVs in extending the capabilities of the weaker portions of the panzer divisions.

¹⁸ R. O'Neill, "Doctrine and Training in the German Army," in *The Theory and Practice of War*, ed. by Michael Howard (New York: Cassell & Co., 1966), p. 157.

the tempo of the exploitation phase of breakthroughs. In spring 1935, Beck conducted a staff ride that featured a panzer corps—at a time before the army possessed a single armored division. The following year, the General Staff studied the possibilities for employment of a panzer army.¹⁹ However, not until summer 1938 was the army’s leadership confident enough about the capabilities that armored formations would offer and secure enough about access to sources of petroleum to establish three additional panzer divisions. At the same time, it did away with the independent panzer battalions but kept the four light divisions (a combination of cavalry and motorized troops) to see how they would perform on the battlefields of the coming war.

In September 1939, Hitler launched his rearmed military forces against Poland. Out of fifty-four active duty and reserve German divisions that participated in that campaign, only six were panzer divisions. Four more were light divisions, while four were motorized infantry divisions. The remaining forty divisions were infantry or mountain divisions that differed only slightly from the German Army’s attack divisions on the Western Front in spring 1918.²⁰

Yet that relatively small panzer force exploited crucial breakthroughs: by the third day of the war, it was able to destroy any chance of a prolonged resistance by the Poles. Until the Polish campaign there had remained considerable skepticism among the senior German generals as to the possibilities of deep penetration exploitation by armored formations.²¹ The Polish campaign convinced most of the army’s senior leadership as to the possibilities that armored, combined-arms exploitation offered.

Almost immediately after the end of the Polish campaign, the army’s High Command disestablished the four light divisions and converted their troops into new panzer divisions.²² In the western campaign in May 1940, the *Wehrmacht* (including *Waffen SS*) would consist of 10 panzer divisions, 8 motorized infantry divisions, and 118 regular infantry divisions.²³ Thus, panzer divisions made up less than 8 percent of the force

¹⁹ Erich von Manstein, *Aus einem Soldatenleben, 1887-1939* (Bonn, 1958), pp. 241–242.

²⁰ Klaus Maier et al., *Das Deutsche Reich und der Zweite Weltkrieg*, vol. 2, *Die Errichtung der Hegemonie auf dem Europäischen Kontinent* (Stuttgart: Deutsche Verlags Anstalt, 1979), p. 93.

²¹ General Gerd von Rundstedt commented to Guderian after one maneuver with panzer divisions: “Alles Unsinn, mein lieber Guderian, alles Unsinn (all nonsense, my dear Guderian, all nonsense).” M. Plettenberg, *Guderian: Hintergründe des deutschen Schicksals, 1918–1945* (Dusseldorf, 1950), p. 14.

²² One of which Erwin Rommel would lead in the armored thrust through the Ardennes.

²³ Taylor, Telford, *The March of Conquest: The German Victories in Western Europe, 1940* (Baltimore, MD: Nautical & Aviation Pub. Co. of America, 1991), p. 184.

structure, while the bulk of the *Wehrmacht's* divisions were equipped and looked much like the formations of other European armies. The panzer divisions offered a set of capabilities for maneuver war that no other European army could match. Yet one should not disregard the fact that conceptions and doctrine of the *Wehrmacht's* regular infantry divisions were the same as those of the armored force.²⁴

The synergy between the two forces proved devastating in the French campaign. FALL GELB (CASE YELLOW), the codename for the offensive to destroy the ground forces of the Western powers, rested on the assumption that the French would protect the Ardennes with a relatively thin force, while the bulk of Allied ground forces moved rapidly into Belgium to defend that country.²⁵ Therefore, the Germans planned to attack through the rugged, forested terrain of the Ardennes, but needed to distract French attention away from that area until their forces had crossed the Ardennes and reached the Meuse River. Army Group B, under Colonel General Fedor von Bock, received that mission. Bock possessed three panzer divisions (one assigned to the invasion of the Netherlands), as well as a picked force of paratroopers to attack the fortress of Eben Emael. Nevertheless, the bulk of his forces consisted of twenty-six infantry divisions, which relied almost entirely on horse-drawn equipment, with their men marching to the sound of guns.²⁶

While Bock's Army Group B hammered its way forward through northern Belgium, Colonel General Gerd von Rundstedt's Army Group A pushed three panzer corps with seven panzer divisions through the Ardennes. When the mechanized forces reached the banks of the Meuse, they were to make an immediate attempt to cross the river.²⁷ If they failed to achieve a breakthrough, follow-on infantry forces would make the breakthrough, allowing further exploitation by the panzer divisions.

²⁴ A fact that helps to explain why regular German infantry or artillery officers were able to take over and command armored, mechanized formations with little difficulty. The classic case was, of course, Erwin Rommel, who assumed command of the 7th Panzer Division as it was transitioning from its organizational structure as a light division. At the time Rommel had *no experience at all* with panzer formations. Within months of that new command assignment, he was commanding the 7th Panzer Division so successfully that the French called it "the ghost division."

²⁵ The most thorough account of the operational planning for the Western Campaign remains Taylor, *The March of Conquest*.

²⁶ Taylor, *The March of Conquest*, p. 184.

²⁷ There are a number of first class accounts of the 1940 campaign: Taylor, *The March of Conquest*; Robert Doughty, *The Breaking Point, Sedan and the Fall of France, 1940* (Hamden, CT: The Shoe String Press, 1990); Horne, *To Lose a Battle, France, 1940*; and Frieser, *Blitzkrieg-Legende, Der Westfeldzug, 1940*.

The plan worked far better than the Germans expected, so well in fact that the panzer general Heinz Guderian described the success as “almost a miracle.”²⁸ Army Group B’s advance indeed kept French attention focused on the Netherlands and northern Belgium. Bock’s thrust, aided considerably by the skillful use of small paratrooper and glider-borne units, broke through Belgian and Dutch defenses. With the forward thrust of his infantry formations, Bock managed to create the impression that the main German emphasis lay in the north—exactly where the French expected it.

Meanwhile to the south the German mechanized forces advanced through the Ardennes and reached the Meuse on the evening of 12 May. The next day the Germans launched their motorized infantry regiments (an integral part of each panzer division) across the river. Within twenty-four hours they had succeeded in breaking through the French defenses. Interestingly enough, these infantry units, supported by artillery and in some cases the *Luftwaffe*, made the initial breakthrough. German armor did not cross the Meuse until the engineers had finished constructing bridges approximately fifteen hours after the initial crossing. Even here the *Wehrmacht*’s transformed, leading-edge formations depended on legacy forces to achieve the crucial breakthrough of French defenses on the Meuse, the first step in creating a breakthrough the panzer divisions could exploit. And it is worth noting that the attacking German infantry units suffered heavy casualties—in some cases upwards of 50 to 70 percent among the lead companies.

The ensuing exploitation, which carried the panzer divisions to the Channel Coast, cut off the Allied left wing, composed of the best divisions of the French Army and the entire British Expeditionary Force. The Allies were able to extract 330,000 troops from the resulting envelopment through the Dunkirk evacuation. But those troops lost all their equipment and much of their cohesion. The direct result of the German victory in 1940 was the collapse of France, while only the English Channel and Fighter Command saved Britain from a similar fate. Thus, the 1940 campaign was one of the most devastating, one-sided victories in military history.

The 1940 victory over France appeared to most military observers at the time—except to the Germans themselves—as a revolution in military affairs.²⁹ In fact, it resulted from the combined efforts of legacy forces, which, in terms of division-sized units, made up over 90 percent of the *Wehrmacht*’s force structure, and the 10 percent transformed

²⁸ Guderian, *Panzer Leader*, p. 84.

²⁹ For an analysis of the uncertainties in that campaign, see Williamson Murray, “Contingency and Fragility in the German RMA,” in Knox and Murray, *The Dynamics of Military Revolution*.

force. This combination increased the pace of exploitation to a tempo to which the French proved incapable of adapting. The glue that held both forces together was a common doctrine emphasizing speed, decentralized leadership, mission-type orders and command and control, and rapid exploitation of any opportunity.

Equally important was German planning in which the *Wehrmacht* utilized a combination of units with revolutionary capabilities to open the door to legacy forces, and vice versa. Even in the north, small transformed units were able to help the legacy forces significantly. The glider-borne assault of eighty paratroopers who took out the Belgian fortress at Eben Emael in the opening hours of the offensive enormously aided the advance of Bock's infantry.³⁰ Even more to the point, infantry units in the south, supported by artillery, largely enabled the breakthrough by Rundstedt's panzer divisions in an operation that was fully in accordance with German tactical practices of March 1918.

One significant question could be raised regarding German transformation during this interwar period. Might not the Germans have done better had they invested even more heavily in panzer divisions? Such an approach is, at best, Monday-morning quarterbacking; as we have suggested, the Germans confronted daunting uncertainties and ambiguities as they began their rearmament effort in the 1930s. We know how well the panzer divisions would work out—they did not. With limited resources available from an economy that the Great Depression had ravished, the Germans made prudent choices and developed capabilities that came close to destroying the European balance of power. Responding to the circumstances of the time, they developed a combination of new and legacy forces that proved all too effective on the battlefields of the early years of World War II. Their defeat in World War II came not from a lack of panzer divisions but from a grand strategy that failed to connect means and ends.

³⁰ For the attack on Eben Emael, see James E. Mrazek, *The Fall of Eben Emael* (Novato, CA: Presidio Press, 1970).

Case Study No. 2. Desert Storm: The Opening Night's Attack on Iraq's IADS

When the crisis in the Gulf exploded with Iraq's invasion of Kuwait in August 1990, American airmen of all the Services were just beginning to grasp the possibilities that major technological changes had brought about in the air war in the period since the end of the Vietnam War. A relatively small percentage of the fighter force structure was capable of using precision-guided munitions (PGM) capabilities, while a minuscule percentage of the fighter force possessed stealth capabilities. Yet the imaginative and innovative fashion with which a small group of air planners utilized these new technological capabilities reveals how a small transformed portion of the force could significantly enhance the overall capabilities of legacy forces.

Pundits have often depicted the Gulf War as heralding the dawn of a new era with its use of PGMs. It was not. The air campaign in the Gulf utilized approximately 9,300 PGMs, but the two great air campaigns in 1972 during the Vietnam War—LINEBACKER I and LINEBACKER II—saw the use of nearly 29,000 PGMs against targets in North and South Vietnam.³¹ Moreover, the greatly increased accuracy of U.S. tactical aircraft was crucial to blunting the North Vietnamese “Easter Offensive” as well as enabling the devastating attacks that finally pushed North Vietnam to sign the Paris Peace Accords.

While precision weaponry obviously helped bring the Vietnam War to a conclusion (at least from the American perspective), it was one of a whole host of problems and potential new capabilities that the tactical air forces of the United States (Air Force, Army, and Marines) confronted in the aftermath of the war. The largest of those was the harsh reality that the Soviet Union not only refused to disappear as a major threat to the security of the United States, but that the Soviets had engaged in a massive buildup in their conventional forces over the course of the decade after the Cuban missile crisis. That buildup had involved a massive quantitative increase in Soviet conventional and nuclear forces as well as a qualitative one. Thus, the U.S. military, in the midst of the difficult reconstitution of the post Vietnam War period, confronted one of the most serious challenges to American national security in its history.

³¹ Personal conversation with Barry Watts, 14 July 2001; figures based on data collected during research in support of the Gulf War Air Power Survey.

From the perspective of the Air Force leadership that challenge was embodied in the continued improvement of the Soviet surface-to-air missile (SAM) threat—a threat that had already inflicted heavy casualties over a prolonged period on attacking U.S. aircraft during the various air assaults on North Vietnam (ROLLING THUNDER, and LINEBACKER I and II). The casualties that the Syrian and Egyptian SAMs were able to inflict on Israeli aircraft during the Yom Kippur War only further underlined the dangers posed by the threat. Luckily for the United States, the 1970s and 1980s were a period of enormous technological change in the capabilities being developed by the U.S. defense industries and scientific laboratories. These included considerable efforts in research and development, most of which had considerable implications—not all of which were clear at the time—for the developing capabilities of the tactical fighter forces.

Ironically, the Soviets were the first to catch the implications of those vast improvements on the emerging balance in the mid-1980s. Soviet military thinkers and leaders argued that these changes represented a potential revolution in military affairs—which the Soviets with their emphasis on the concrete soon termed a “military technological revolution.” In an interview, given in 1984, Marshal of the Soviet Union, Nikolai V. Ogarkov, characterized the advances in non-nuclear weaponry—including “automated reconnaissance-and-strike complexes” (a reference to the American Assault Breaker Program), long-range and high-accuracy munitions, and electronic-control systems—as “mak[ing] it possible to sharply increase (by at least an order of magnitude) the destructive potential of conventional weapons, bringing them closer, so to speak, to weapons of mass destruction in terms of effectiveness.”³²

It was this broad spectrum of capabilities that embodied the revolutionary changes in U.S. capabilities. But how and in what combination the new technologies might be used to leverage the general capabilities of U.S. forces was clear to no one at that time.

Thus, precision was only one of the technological possibilities that were available to Air Force leaders in confronting the Soviet threat. Moreover, precision was only one of a number of capabilities that the Warsaw Pact-NATO environment demanded. The leadership of Tactical Air Command (TAC, the predecessor to Air Combat Command) did understand from the mid-1970s that the 20-meter circular error probable (CEP) of the first PGMs offered an order-of-magnitude improvement in conventional bombing accuracy. But they also understood that significant improvements were needed—down

³² Interview with Marshal of the Soviet Union N. V. Ogarkov, “The Defense of Socialism: Experience of History and the Present Day,” *krasnaya zvezda*, 1st ed, 9 May 1984, pp. 2–3.

to a three-meter CEP—in order to gain a really significant improvement in capabilities. And like most things in technological development, the promise took longer to develop into performance than either the engineers or military leaders expected.

Similarly, in terms of the development of the F-15E, an aircraft whose main mission was air-to-ground strike, the Low Altitude Navigational and Targeting Infrared for Night targeting pods were not yet operational in 1989, when the F-15Es were deployed to Saudi Arabia, despite intensive efforts in the previous years to eliminate the bugs in the system. Thus, the U.S. forces that deployed to fight the Gulf War had received or were receiving significantly improved precision systems, but usually well after the scheduled delivery dates. Moreover, in most cases the concepts and doctrine had not yet caught up to the possibilities that were available. Finally, one should also note that in the end the threat that the Iraqis posed to U.S. aircraft proved to be significantly less effective than the threat posed by Soviet air defenses to NATO air operations in the Central European theater.

The introduction of stealth also suggests the importance of understanding the context of the threat for which the F-117 was developed, as well as the fact that stealth remained in the black world until the mid- to late 1980s. The F-117 program itself was set in motion to address a specific threat—the SA-5—that threatened to shut down the entire concept of operations for U.S. conventionally armed aircraft against Warsaw Pact targets.³³ While those Air Force leaders briefed into the program knew the F-117 carried two laser-guided bombs (LGBs), most were not fully aware of the implications or possibilities until JUST CAUSE, the invasion of Panama in 1989.³⁴ The limited production run of the F-117 was the result of the context of the European theater, where that aircraft would be used mostly at night in an arena of 24-hour a day operations. The combination of both the context of Central European NATO operations and the fact that so few of the senior leadership had been exposed to the aircraft's capabilities because of its position in the “black world” explains why stealth had not worked its way into the larger framework of Air Force operational concepts.

Therefore, it should not be surprising that the initial responses of the Services to the Iraqi invasion of Kuwait were not particularly innovative. The Navy, which had almost

³³ General Larry Welch, USAF (ret.), interview by Williamson Murray, Institute for Defense Analyses, Alexandria, Virginia, 25 January 2002.

³⁴ General Larry Welch, USAF (ret.), interview by Williamson Murray, Institute for Defense Analyses, Alexandria, Virginia, 25 January 2002.

entirely ignored precision over the previous decade, suggested that the “Route Pack” system of the Vietnam War be resurrected.³⁵ That operational approach had simply divided Vietnam into geographic sectors, with each sector owned by either the Navy or the Air Force. The results were independent air campaigns that lacked even elementary coordination and cooperation, minimized U.S. capabilities, and exacerbated inter-Service competition of the worst sort.³⁶ Fortunately for the conduct of the air war in the Gulf, the theater commander, General Norman Schwarzkopf, refused to accept such an approach, and enforced the concept of a single Joint Forces Air Component Commander (JFACC).³⁷

Nevertheless, for reasons discussed above, parts of the Air Force showed little understanding of how the technological possibilities could extend a potential air campaign against Iraq. The planners at TAC headquarters suggested a combination of a rollback campaign with efforts to signal Saddam Hussein and the Iraqis America’s resolve to see Kuwait liberated. To all intents and purposes their proposed campaign represented a badly thought-through replay of the ROLLING THUNDER air campaign, a campaign that had achieved so few results against the North Vietnamese between 1965 and 1968. TAC’s proposed campaign would have begun “with demonstrated attacks against high value targets...[and the escalation] as required until all significant targets were destroyed...” The briefing then went on to argue that “this strategy allows time and opportunity for Hussein to reevaluate his situation and back out while there is still something to save.” The air effort would concentrate on targets “that reduce [Iraq’s] ability to project power, [i.e.] field armies and infrastructure to support offensive operations.”³⁸

None of this displayed an appreciation for the impact of stealth, precision, or that stealth combined with precision could allow a significantly different approach to an air war against Iraq. However, we should remember that what is obvious today was not so

³⁵ Interview with (then) Major General Buster Glossen with the Gulf War Air Power Survey Team (Williamson Murray, Barry Watts, and Thomas Keaney), 9 April 1992.

³⁶ Along these lines, see particularly Jack Broughton, *Going Downtown, The War Against Hanoi and Washington* (New York: Orion Books, 1988), pp. 118–119.

³⁷ The concept of the JFACC had first emerged while General P. X. Kelley, USMC, was in command of Central Command, and had been pushed through by Colonel Robert Gaskin of the Air Staff’s doctrine shop in the mid-1980s.

³⁸ Fax from General Griffith TAC/XP to General Alexander, AF/XOX, 11 August 1990, ACENTCOM Air Campaign Plan, Gulf War Air Power Survey Archive, CHSH-14. After the war the briefing could not be found in the TAC records.

obvious at the time. It took an element of chance in the equation to use the just-emerging technological capabilities to their full effect in the upcoming campaign, and to leverage the capabilities of a small portion of the force to the greater benefit of overall Coalition air power. When all is said and done, the leaders and planners of the air campaign proved exceptionally imaginative and effective in developing a concept of operations that utilized the potential offered by technological change to enhance the overall impact of Coalition air power in the Gulf War.

The JFACC, Lieutenant General Chuck Horner, empowered (then) Brigadier General Buster Glosson and (then) Lieutenant Colonel David Deptula to come up with a very different operational approach to attacking Saddam and his forces.³⁹ Both Glosson and Deptula were well acquainted with the new stealth and precision capabilities,⁴⁰ and willing to look for new approaches that could leverage stealth and precision in ways that would improve the overall impact of the legacy forces as well as incorporate the new technological capabilities. By early September, Glosson and Deptula were in charge of a special planning cell, the “Black Hole,” so called because of bright officers disappearing into the planning effort and not returning to their regular jobs.

The largest challenge confronting Glosson and Deptula was Saddam’s Integrated Air Defense System (IADS). The Iraqis had integrated French and Soviet technology into what appeared to be a formidable system. The Iraqis also possessed some of the most up-to-date Western and Soviet radars and missiles, tied together by a sophisticated French computer system, codenamed KARI (“Iraq” spelled backwards in French). From the first, Glosson and Deptula rejected roll-back as the basic approach in favor of a combination of inside-out attack of ECM–SEAD⁴¹ attacks on early warning radars. The initial attack by Coalition aircraft would aim at taking down the forward radars and the communication centers in the center of Iraq. Here stealth would play the crucial

³⁹ Neither airman was a part of Horner’s Ninth Air Force staff. The former had been posted to the Gulf earlier, while Deptula had arrived in Riyadh, Saudi Arabia, as part of a planning cell from HQUSAF. Horner had promptly sent most of the team back to Washington, but kept Deptula on because he respected Deptula and his operational and planning savvy.

⁴⁰ Glosson was the commander of an F-15 wing deployed to a RED FLAG exercise in the late 1980s. His wing was given the mission of intercepting F-117s over the Nellis range in Nevada—a mission which, in his words, they “accomplished with a notable lack of success.” Interview (then) Major General Buster Glosson with the Gulf War Air Power Survey Team (Williamson Murray, Barry Watts, and Thomas Keaney), 9 April 1992.

⁴¹ Electronic Counter Measures (ECM) are electronic and other means used to spoof or deceive enemy radar sites. Suppression of Enemy Air Defenses (SEAD) is the Air Force term for defeating the enemy’s air defenses.

role. And unlike a number of other airmen, Glosson and Deptula believed that stealth F-117s could reach undetected deep into Iraq—in fact all the way to Baghdad and the very heart of the KARI system.

In planning the opening night's attack, Deptula provided an additional insight: What mattered was not the level of destruction achieved but rather the level of disruption and confusion that the initial attacks would sow throughout the Iraqi air defense system. Plans featured stealth F-117s dropping LGBs and Navy Tomahawk Land Attack Missiles (TLAMs) to attack a number of the command and control nodes in the Iraqi air defense system. After these had disrupted the air defense system, non-stealth forces would then complete the take-down of the remainder of the system. The emphasis on disruption showed most clearly in the attacks on the sector operating centers. Air Force intelligence had recommended the use of upwards of six LGBs on each center to achieve complete destruction. The planners in the Black Hole, on the other hand, reasoned that one LGB on each center would be sufficient to discourage the survivors from remaining in the building and continuing to operate their systems.⁴²

The first attacks came twenty-one minutes before H-Hour, with Army Apache helicopters attacking frontier radar sites and opening the way for a large package of F-15Es, supported by EF-111 jammers, to strike Scud bases in western Iraq.⁴³ By that time the F-117s, some supported by EF-111s, some on their own, were already in Iraqi airspace while Navy ships had already launched TLAMs. The first F-117 strike came nine minutes before H-Hour with an attack on the Nukhayb Intercept Operations Center, the reporting node with the best chance of picking up the F-15E mission aimed at the Scuds in western Iraq. At H-Hour, F-117s attacked the first targets in the environs of the capital; the hits on the AT&T Building and the telecommunications center took CNN off the air and immediately alerted planners in Riyadh that the F-117s had successfully struck their first targets. Within the next six minutes, other F-117 strikes hit the Iraqi Air Force's main headquarters (twice), the Air Defense Operating

⁴² The crucial point was understanding that the headquarters staff of an air defense center that received a direct hit from an LGB—even if the weapon did not penetrate the hardened concrete—would receive a severe shock and would hardly be enthusiastic about continuing to operate in the facility if they survived at all. The Tallil Sector Operating Center received three hits from F-117s in the first two days of the war. When the airfield fell into American hands, as a result of ground operations, postwar inspection revealed that the Iraqis could have continued to use the facility. In fact, they failed to use it for the remainder of the war, largely as a result, one would assume, of the threat of further air attacks. Interview with Major Allan W. Howey, member of the Black Hole, 12 July 1992.

⁴³ The following account is largely based on Williamson Murray, *Operations*, Vol. 2, Report 1, *Gulf War Air Power Survey*, Eliot Cohen, ed., (Washington, DC: Government Printing Office, 1993). pp. 115–138.

Center, the presidential palace, the Tallil Sector Operating Center, and the Salman Pak Intercept Operations Center.

Shortly after the first F-117 strikes, the first Tomahawk missiles began to hit their targets throughout Iraq, including leadership, electric, Ba'th Party headquarters, and chemical facilities. By now the Iraqis knew they were under a full-scale attack, but had no idea from what direction the attacks were coming or what weapons the attackers were using. At this point, the full weight of U.S. SEAD attacked the Baghdad area. The assumption underlying this attack with legacy forces was that the opening F-117 and TLAM attacks would have disrupted the enemy's defenses, while at the same time having brought those air defenses to a state of full alert and readiness to engage Coalition attackers.

The planners provided the Iraqis with what looked like a massive conventional air assault on their capital. Almost immediately after the F-117 and Tomahawk attacks on Baghdad, Iraqi early warning radars indicated that large, non-stealth formations were moving into Iraq from a number of directions. To the Iraqis, their radars indicated formations of large numbers of conventional fighter bombers on their way to launch a massive assault on targets in the Baghdad area—one that the Iraqis had expected the Americans would launch, if they attacked at all.

In fact, it was not the fighter bombers. Instead, both packages, including EA-6 and EF-111 jammers (to force Iraqi radars to come up to full power), consisted of SEAD aircraft. The package attacking from the west consisted of Navy aircraft launched from carriers in the Red Sea, while the package attacking from the south consisted of Air Force F-4G Weasels. The Navy SEAD package fired off twenty-five Tactical Air-Launched Decoys (TALDs) within the space of twenty minutes.⁴⁴ BQM-74 drones, like the TALDs, magnified the size of the attacking force as well as the closeness of attackers to the Iraqi capital. Leading the Air Force package attacking from the south, the BQM-74 drones continued on to the Iraqi capital where they went into orbit.

Once the drones started to orbit over Baghdad, the Iraqi target acquisition/tracker/ fire control radar activity not only became steady but in-

⁴⁴ Center for Naval Analysis, "Desert Storm Reconstruction Report," vol. 8, *C³/Space and Electronic Warfare*, p. 3–9.

creased...[P]ost-attack analysis confirmed that Iraqi “lethal” activity increased dramatically in the immediate area of the drones.⁴⁵

All of this activity was precisely the result for which Air Force planners had hoped. At this point the HARM (High-Speed Anti-Radiation Missile) shooters began to fire their missiles. F/A-18s and A-7s from the Navy SEAD package fired off forty-five HARMs in preset mode against known SAM sites and six more at targets of opportunity. The Air Force Weasels fired twenty-two HARMs at operating sites, with ten assessed as having destroyed their targets (a 46 percent success rate).⁴⁶

At the same time that the main SEAD packages were attacking the Baghdad air defenses, two similar packages struck, one in the west against the air defenses near the Scud bases, and the other in the east against the air defenses around Basra. Again the initial moves had spooked the Iraqis to come up to full alert when their radars and sites were again clobbered by large numbers of HARMs. As the Weasel wing commander noted:

The key is that very early on while the F-15s maintained air superiority, the Weasels maintained suppression of enemy air defense[s]...because they beat them down quickly, efficiently, and the enemy knew if he turned his radar on he's dead. As a result of that, they are not turning their radars on...They're firing their missiles off ballistically. For the most part they are completely ineffective...⁴⁷

While we still lack a full account of what happened within the confines of the KARI system, there was clearly enormous confusion and misinformation among Iraqi commanders and staffs responsible for the air defense of their country. Undoubtedly, they found it difficult to grasp or evaluate the extent of the damage. To add to their confusion, the second F-117 strike followed on the heels of the SEAD strike. Now with no apparent aircraft overhead, bombs were again falling on major headquarters and communications centers.

⁴⁵ Message from Air Force Electronic Warfare Center (AFEWC), Kelly AFB, 182100Z Sep 1991, Subj: “Constant Light Report No. 11—Air Force Unmanned Aerial Vehicle (UAV) Effectiveness,” Gulf War Air Power Survey Archive CH3, 3-4A.

⁴⁶ Air Force Intelligence Command, Air Force Electronic Warfare Center, “Operation Desert Storm, Electronic Combat (EC) Effectiveness Analysis,” January 1992, p. 11–9.

⁴⁷ Charles L. Starr, “Special Study, History of the 35th Tactical Fighter Wing (Provisional): Operations Desert Shield and Desert Storm,” Gulf War Air Power Survey Archive, NA 277, p. 179.

Sometime during the first hours of the war, the entire KARI system collapsed, never to recover fully for the rest of the conflict. The plan and its execution leveraged the technological and tactical possibilities of stealth and precision to maximize the more conventional possibilities of the remainder of Allied air forces. The result was a devastating victory that largely eliminated the anti-aircraft capabilities on which Saddam had lavished so many resources and so much effort over the preceding decade. The fact that the attackers lost only one aircraft during the first night's operation (an F/A-18 to a MIG 29) underlines the extent to which clear conceptions and thinking had extended the transformed capabilities of the leading edge units to the whole force. The first night's attack on the Iraqi air defense system was one of the most decisive operational victories for air power.

The Implications of Transformation

There are still many in Department of Defense who believe that transformation involves uniform change driven towards a common goal. With this view, once military organizations achieve their goal in transforming their whole force, then transformation will be complete. Such an understanding of transformation is almost entirely linear in its depiction of the processes of change, and reflects a general misunderstanding of transformation and innovation. Moreover, to point at some time in the future where the transformation of the force will be complete is to miss the reality: by that time, a whole host of factors will undoubtedly have changed (e.g., the strategic environment, the appearance of new technologies, decreases in the defense budget, as well the overall concepts that underlie peacetime preparation for war). Transformation occurs in human organizations on an ongoing basis. Organizations that do not change become ineffective.

There is also the belief that either technological change or new platforms are the primary drivers of transformation.⁴⁸ History suggests otherwise. More important than either technological changes or the procurement of new weapons systems has been the development of new and innovative concepts and the intellectual and doctrinal underpinnings of combat organizations. Such change results from the ability of military organizations to draw on their experiences and combine those experiences into a coherent picture of future war—one that is realistic and adaptable to the ever-changing nature of the battlefield. All of this demands change in the widest sense: the transformation of the intellectual and conceptual understanding of future war throughout the entire officer corps and the forces themselves.

Technological change can help extend such a vision, but it is only an enabler. Without that coherent vision, developed into a broad, realistic doctrine that informs the force, transformation becomes platform driven at best, and flawed reaction to the external stimuli of battle at worst. A clear example of this is the development of air power doctrine in the United States and Britain between the two world wars. The Royal Air

⁴⁸ With regard to the belief that technological change should drive transformation, see Admiral William Owens with Edward Offley, *Lifting the Fog of War* (New York: Farrar, Straus, Giroux, 2000). See also James Blacker, “Understanding the Revolution in Military Affairs: A Guide to America’s 21st Century Defense,” Robert A. Manning, ed., Progressive Policy Institute, Defense Working Paper No. 3, January 1997.

Force, as well as the US Army Air Corps, was so focused on the strategic bomber as *the* platform of choice that both missed significant contributions that air power could make to the joint battle.⁴⁹ As a result, the Germans gained a significant advantage in the early battles of World War II through their innovative use of combined-arms tactics involving infantry, tanks, and air power.

In most cases, technology and new platforms have been enablers that allow military forces to maximize the potential of intangibles such as doctrine, training, and leadership. Moreover, there are a number of historical cases where the side that most successfully transformed its military forces and then won major victories on the battlefield was the side possessing distinctly inferior platforms and technology.⁵⁰ From these examples, we can conclude that crucial to the effective development and eventual utilization of military forces are the development, institutionalization, and refinement of a doctrinal framework for war that reaches across the forces, however incomplete that technological transformation might be.

There is also the reality that military organizations innovate during times of peace within an atmosphere of considerable ambiguity and uncertainty. Military leaders and planners rarely know when war will occur.⁵¹ Nor, at times, do they even know against

⁴⁹ The RAF did create Fighter Command with capabilities that eventually won the Battle of Britain in summer 1940, but it did so only at the direction of British political leaders and the vision of an innovative airman, Sir Hugh Dowding, whose career pattern and attitudes differed substantially from the prevailing *ethos* in the RAF. For the overall focus on the strategic bomber, see Williamson Murray, *The Air War, 1914–1945* (London: Cassell, 1999), chpt. 2. See also Williamson Murray, “Strategic Bombing: The British, American, and German Experience,” in *Military Innovation in the Interwar Period*. As for the results that were obtained when military organizations have no intellectual framework within which to change or adapt, see particularly MacGregor Knox, *Mussolini Unleashed* (Cambridge, UK: Cambridge University Press, 1983).

⁵⁰ We have two clear examples of the side with inferior technologies winning impressive victories in the early years of World War II. The German panzer divisions overwhelmed French defenses along the Meuse in May 1940, and then exploited that victory to destroy the Allied left wing. However, they possessed distinctly inferior armored fighting vehicles to those of the French Army. (See Case Study No. 1 in this paper, “The Wehrmacht’s Panzer Force.”) In the same year, Fighter Command defeated the *Luftwaffe* in the Battle of Britain despite its radars being inferior to the Germans’ radar. The difference was the British employed radar as a part of an air defense *system*, which the Germans did not do until after the destruction of Hamburg at the end of July 1943. For a comparison of the development and utilization of radar in the years leading up to World War II, see Alan Beyerchen, “From Radio to Radar: Interwar Military Adaptation to Technological Change in Germany, the United Kingdom, and the United States,” in *Military Innovation in the Interwar Period*, Allan R. Millett and Williamson Murray, eds.

⁵¹ Military historians do, of course, know when war is going to occur, and what is going to happen. And that is what makes them such wonderful Monday-morning quarterbacks.

whom they will fight. Some questions are perennial: What will the context of future war be? What might the war's objectives be? How might potential enemy forces evolve and prepare for war? What tactical and technological changes might occur, and how might they influence the conduct of operations? The answers to these questions have never been clear to those involved in transforming military forces in peacetime—nor will they be clear in the future.⁵²

Admittedly, military leaders and their staffs consistently confront difficult choices in peace as well as war. As the British general, James Wolfe, the Conqueror of Quebec, once noted, “War is an option of difficulties.”⁵³ New concepts and new ideas, however attractive, do not necessarily guarantee that a military organization can address the actual strategic and operational questions it will confront in the future.⁵⁴ Consequently, few military leaders or planners are willing to bet all their resources on a single, new, and untried form of war. In the 1920s and 1930s, as suggested previously, the Royal Air Force invested most of its resources in strategic bombers, a decision which flew in the face of any reasonable analysis of air war in the First World War, and which made British air power singularly incapable of intervening in the ground battles during the attempts to defend France in May 1940.⁵⁵ The loss of forty British bombers out of the

⁵² Even the German military in the 1930s, which clearly understood that Hitler was preparing for a major conflict, was never clear as to the actual date when war would break out. As late as spring 1939, Hitler was assuring the head of the Kriegsmarine, Admiral Erich Raeder, that war would not occur until 1943. As Raeder's initial entry into the navy's war diary makes clear, the navy's whole planning program was aimed at preparing for war at that much later date: “Today the war against England and France broke out...It is self-evident that the [German] navy is in no manner sufficiently equipped in fall 1939 to embark on a great struggle with England...Surface forces...are still so few in numbers and strength compared to the English fleet that they...can only show that they know how to die with honor...” Oberkommando der Kriegsmarine, Berlin, 3.9.39, “Gedanken des Oberbefehlshabers der Kriegsmarine zum Kriegsausbruch,” National Archives and Records Service Microfilm number T-1022/2238/PG33525.

⁵³ For an examination of the problems that Wolfe confronted, see Fred Anderson's brilliant study, *Crucible of War, The Seven Year's War and the Fate of Empire in British North America, 1754–1766*, (New York: Alfred A. Knopf, 2000).

⁵⁴ Both J. F. C. Fuller and B. H. Liddell Hart, the British military reformers, entirely missed the fact that their proposed armored, mechanized divisions had little relevance for a British defense strategy that did not plan for committing ground forces to the defense of Britain's allies on the European Continent until March 1939. Liddell Hart argued vociferously against a Continental commitment throughout the 1930s. Such a force, of course, would have little relevance to war on the Northwest frontier of India or the jungles of Malaya. See particularly J. P. Harris, *Men, Ideas, and Tanks* (Manchester: Manchester University Press, 1995).

⁵⁵ Much of this had to do with the RAF's outright rejection of the lessons of military history. See particularly the 1924 memorandum where the Air Staff explicitly commented on two potential courses of action for an air offensive: “The latter alternative is the method which the lessons of

seventy dispatched to attack the German bridges across the Meuse on 14 May 1940, suggests the dangers of betting on a single horse.⁵⁶ Not only were the losses devastatingly heavy, but the attacking aircraft failed to destroy the bridges.

There is, of course, the danger that a partially transformed force will possess formations, units, and capabilities that are incapable of combining together in a synergistic fashion. Nevertheless, despite the considerable disparity between the *Wehrmacht's* panzer arm and the battered infantry units that made up the bulk of the *Wehrmacht* in 1944, the German High Command was able to still knit together a highly effective scheme in defending Normandy.⁵⁷ Here, the crucial thread in holding forces with quite different capabilities together, while maximizing their potential, was a common, realistic warfighting doctrine.

The lesson from recent history is simply this: It is not necessary to attempt some radical transformation of the entire force to achieve transformed capabilities. In the model suggested by the two case studies in this document, transformation did not involve the steady conversion of the entire force—a process more descriptive of modernization. Given the pace of technological change and uncertainties about future threats, transformation invariably follows a more turbulent process featuring aggressive experimentation, a continual insertion of new capabilities in relatively small packages, and the concurrent retirement of portions of the legacy force. It also depends, to a considerable extent, on the continued updating and effectiveness of legacy forces.

Not to be overlooked though is also the lesson that the most powerful enablers in past revolutions in military affairs have been changes in concepts and doctrine. If the past is any guide, the real challenge lies in leveraging emerging technologies with new concepts and doctrine, to maximize the potential not only of new forces but of the legacy forces as well.

military history seem to recommend, but the Air Staff are convinced that the former is the correct one.” United Kingdom, Public Record Office, Air 20/40, Air Staff Memorandum, No 11A, March 1924.

⁵⁶ Williamson Murray and Allan R. Millett, *A War To Be Won, Fighting the Second World War* (Cambridge, MA: Belknap Press of Harvard University Press, 2000), p. 74.

⁵⁷ For the most recent examination of German fighting abilities in Normandy, see Russell Hart, *Clash of Arms, How the Allies Won in Normandy* (Boulder, CO: Lynne Reimer Publishers, 2001). See also Max Hastings, *Overlord, D-Day and the Battle for Normandy, 1944* (London: Book Club Associates, 1984); and for a general discussion of German military effectiveness in World War II, Martin Van Creveld, *Fighting Power, German and U.S. Army Performance, 1939–1945* (Westport, CT: Greenwood Press, 1982).

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Acronyms and Abbreviations

CEP	circular error probable
ECM	Electronic Counter Measure(s)
HARM	High-Speed Anti-Radiation Missile
IADS	Integrated Air Defense System (Iraqi)
IDA	Institute for Defense Analyses
JAWP	Joint Advanced Warfighting Program
JFACC	Joint Forces Air Component Commander
KARI	“Iraq” spelled backwards in French
LGB	laser-guided bomb
NATO	North Atlantic Treaty Organization
PGM	precision-guided munitions
SAM	surface to air missile
SEAD	Suppression of Enemy Air Defenses
TALD	Tactical Air-Launched Decoy
TLAM	Tomahawk Land Attack Missile

Notes

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