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

Williamson Murray

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Abstract: The period between the two World Wars has special relevance to DoD's joint experimentation efforts. During the interwar period, U.S. and foreign military innovators provided long-term and successful transformations of military capabilities. This paper provides a look at these experimentation efforts, highlights the attributes of success, and offers lessons for current and future DoD joint experimentation tasks over the next decade. First, elements of innovation were identified; i.e., establishing a framework for intellectual creativity over the long haul, testing concepts to the breaking point, and learning from the past (the culture of experimentation). The author then developed six lessons for DoD joint experimentation tasks: (1) focus on big change over the long term; (2) focus on identifying potentially important new concepts and enabling capabilities; (3) recognize that the purpose of experimentation is change; (4) tie experimentation to the implementation process; (5) focus on jointness and coalition war in all experimentation; and (6) focus on protecting the innovators and experimenters.

Subject Terms: Joint experimentation, World Wars, red teaming, coalition warfare, military innovation, naval air power, panzer divisions, maneuvers, tanks, Hans von Seeckt, close air support (CAS), Heinz Guderian.

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

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The Department of Defense (DoD) faces formidable challenges, intellectual as well as bureaucratic, in creating a joint experimentation program to help fulfill the ambitious goals of Joint Vision 2020 and related transformation objectives. Indeed, it is not an exaggeration to view experimentation as an unnatural act for DoD, particularly in a time of relative peace when our military success appears unchallenged. Therefore it is useful to look back at previous warfighting experimentation to see what may be relevant today.

Andy Marshall, DoD's Director of Net Assessment, has pointed to the period between the two World Wars as having special relevance, and has sponsored a body of work about military innovation in the 1920s and 1930s. A key feature of successful military innovation in that period was the attention paid to doctrine, organization, leader development, and training (i.e., the co-evolution of Doctrine, Organization, Training, Materiel, Leadership, and Personnel, or DOTMLP, in today's terminology).

America's recent experiences in the Cold War (in part, driven by the introduction of nuclear weaponry and intercontinental missiles) shaped attitudes and processes in DoD toward the view that technology is the overriding enabler of new military capabilities. But if the technologies of the Information Age are to provide revolutionary enhancements in military capabilities, we must step beyond a limited focus on materiel. Instead, as called for in Joint Vision 2020, we must seek to co-evolve new capabilities in multiple dimensions. Thus, we can learn from the experimentation efforts of U.S. and foreign military innovators in the 1920s and 1930s—perhaps more than from our own Cold War experience. In this paper, historian Williamson Murray draws on his own work, as well as upon the works of other leading military historians, to (1) provide a look at experimentation during this period, (2) highlight attributes of success, and (3) offer lessons for our own time.

Comments and questions are invited and should be directed to

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Preface

This report was prepared for the Director, Defense Research and Engineering, in the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, under the task order Joint Advanced Warfighting Programs (JAWP). It addresses the task order objective of generating advanced joint operational concepts and joint experimentation to assist the Department of Defense in attaining the objectives of Joint Vision 2020. Members of the JAWP contributed to the ideas and review of this report.

The JAWP was established at 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 as well as 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 report does not necessarily reflect the views of the Institute for Defense Analyses or the sponsors of the JAWP. Our intent is to stimulate ideas, discussion, and, ultimately, the discovery and innovation that must fuel successful transformation.

Recent and Forthcoming Publications of the Joint Advanced Warfighting Program

Red Teaming: A Means for Transformation, John F. Sandoz, author, IDA Paper P-3580, forthcoming, January 2001.

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

US Army and US Marine Corps Interoperability: A Bottom-up Series of Experiments, Rick Lynch, Tom O'Leary, Tom Clemons, and Doug Henderson, authors, IDA Paper P-3537, forthcoming, November 2000.

Developing Metrics for DoD's Transformation, Joel B. Resnick, IDA Document D-2528, October 2000.

Experimentation in the Period Between the Two World Wars: Lessons for the Twenty-First Century, Williamson Murray, author, IDA Document D-2502, October 2000.

Lessons Learned from the First Joint Experiment (J9901), Larry D. Budge and John Fricas, authors, IDA Document D-2496, October 2000.

Military Operations in Urban Terrain: A Survey of Journal Articles, D. Robert Worley, Alec Wahlman, and Dennis Gleeson, Jr., IDA Document D-2521, forthcoming, October 2000.

The Joint Experiment J9901: Attack Operations Against Critical Mobile Targets. Joint Advanced Warfighting Program, September 29, 2000. Prepared for the US Joint Forces Command.

Joint Strike Force Operational Concept, Joint Advanced Warfighting Program, forthcoming, September 13, 2000.

Joint Warfighting Experimentation: Ingredients for Success, James H. Kurtz, author, IDA Document D-2437, September 2000.

Joint Advanced Warfare Seminar, James H. Kurtz, Daniel E. Moore, and Joel B. Resnick, authors, IDA Document D-2346, July 1999.

Workshop on Advanced Technologies and Future Joint Warfighting, April 8–10, 1999: Summary of Proceedings, William J. Hurley, Phillip Gould, and Nancy P. Licato, authors, IDA Document D-2343, May 1999.

Framework for Joint Experimentation—Transformation's Enabler, Karl Lowe, author, IDA Document D-2280, January 1999.

Contemplating Military Innovation, IDA Document D-2191, Dennis J. Gleeson, author, August 1998.

Contents

Introduction

At the dawn of a new century, the U.S. military services confront new challenges. Vast technological changes have already engulfed the society at large, and there is no sign that the pace of technological change will slow. Moreover, there are no real competitors on the horizon against whom the services can compare and evaluate their capabilities. In a nutshell, the United States does not know where, when, or against whom the next great test of its military forces will come.

Thus, it is difficult to judge issues such as readiness, force structure, logistical capabilities, and doctrine in a world of ambiguity and uncertainty, in which the full impact of technological change remains uncertain and military organizations will have to operate more jointly than ever before. The effectiveness of U.S. military power in the twenty-first century will depend on the interoperability and synergies among different sets of service capabilities. In other words, the integration of military power in joint campaigns will be essential at every level of war: the tactical, operational, and strategic.

How then will the American military achieve the battlefield effectiveness on which this country depends, and which will determine much of the strategic and political environment in the next century? Clearly, we are talking about a long-term transformation of military capabilities during an interwar period of indeterminate length. The last prolonged period of military transformation came in the 1920s and 1930s. The Director of Net Assessment in the Pentagon, Andrew Marshall, was among the first to believe that the world's military organizations are going through a similar period of change and that the U.S. military is only in the first stages in the creation of a possible revolution in military affairs.[1]

A number of issues emerge from a study of the period between the two World Wars in regards to transforming military organizations. These suggest important points that the American military need to consider in its efforts at transformation. In the 1920s and 1930s, the most important component in successful military innovation was the culture

1 Andrew W. Marshall, "Some Thoughts on Military Revolutions," *Office of Net Assessment (OSD/NA)* Memorandum, 27 July 1993, p. 2.

of the military organizations that attempted to achieve major breakthroughs in their operational and tactical capabilities.[2] An important aspect of those cultures was the willingness to experiment with new concepts and ideas in annual maneuvers and exercises.

The purpose of this Joint Advanced Warfighting Program paper is to examine the process and philosophy of experimentation through which new operational concepts and capabilities were developed in the past, resulting in improved combat effectiveness. This examination should provide some help to senior military and civilian decision makers in thinking about how the U.S. military needs to go about experimentation in the joint arena in the twenty-first century—an area where much work remains to be done.

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[2] For the most thorough look at innovation in the interwar period see Williamson Murray and Allan R. Millett, eds., *Military Innovation in the Interwar Period* (Cambridge, 1996). See also Harold R. Winton and David R. Mets, *The Challenge of Change, Military Institutions and New Realities, 1918–1941* (Lincoln, NB, 2000).

The Elements of Innovation

There were a number of crucial elements in the process of successful experimentation during the interwar period. Before embarking on an examination of the actual record of experimentation in the 1920s and 1930s, we have established a list of those elements that contributed most to successful innovation during this period.

- Emphasis on the creative rather than on the evaluative measures of effectiveness as well as on the long haul rather than the short term.
- Experimentation as a part of a sustained campaign rather than a single event.
- Tolerance for surprise as well as failure.
- Consistent emphasis on red teaming to test fully concepts and emerging capabilities.
- Consistent emphasis on learning from past military experience through careful and thorough lessons-learned analysis.
- Finally, willingness to utilize and protect the forward thinkers in the organization throughout the process of experimentation and innovation.[3]

Where military organizations possessed the majority of these attributes, their experimentation process resulted in successful innovation; where they did not, experimentation floundered or resulted in fundamentally flawed innovations.

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3 This list of enablers for successful innovation has been shortened from the list in James H. Kurtz's *Joint Warfighting Experimentation: Ingredients for Success* to make the historical record more accessible and understandable. Kurtz lists the following enablers for joint experimentation over the coming decade: "Experiment in the proper context: 1) Focus on discovery and creation, not merely evaluation; 2) Learn from past experiments and experience; 3) Recognize 2010 and 2020 as azimuths, not destinations; 4) Integrate, leverage, and seek to influence service efforts; 5) Include international and interagency participation; 6) Protect the process…and the participants; 7) Provide for early immersion in the future; 8) Feature red teaming at every stage; 9) Treat experiments as extended campaigns, not one-time events; 10) Be tolerant of 'failure' and open to surprise. Use the results smartly; 11) Seek early success without sacrificing bold goals; 12) Be prepared to exploit success; 13) Involve stakeholders and provide persuasive results; 14) Aim at coevolution of doctrine, organization, training, materiel, leaders, people, and facilities." James H. Kurtz, *Joint Warfighting Experimentation: Ingredients for Success*, Institute for Defense Analyses, IDA Document D-2437 (Alexandria, VA).

The framework: intellectual creativity over the long haul

An emphasis on the creative

The opening sentences in the German Army's basic doctrinal manual of 1933, *Die Truppenführung*, underlined an emphasis on the creative over the evaluative in its approach to war as well as the preparations for combat:

> The conduct of war is an art, depending on free, creative activity, scientifically grounded.... The conduct of war is based on continuous development. New means of warfare call forth ever changing employment. Their use must be anticipated, [while] their influence must be correctly estimated and quickly utilized.[4]

Not surprisingly, a belief that experiments, exercises, and operations *must* emphasize the creative is at the heart of the German concept of war. In other words, the testing of concepts must allow maximum room for the participants to display their creative talents in order to understand the possibilities. This as much as any other single attribute separated the *Wehrmacht* from the other major armies of the period.

Experimentation as a campaign

Successful innovation in the interwar period also rested on a willingness or the necessity of taking a long-term perspective. Admittedly in the 1920s, military organizations possessed the luxury of time. For the Germans, the Versailles Treaty had reduced their army and navy to the point where serious military operations were not a possibility. During the Ruhr crisis of 1923, when the French occupied Germany's main industrial areas,[5] the *Reichswehr*'s leadership, particularly the army generals, advised the Weimar Republic's leaders that there was no prospect of successful military resistance to the French invasion.[6] Yet, the long perspective allowed the Germans to study the lessons of World War I in great detail and develop a combined-arms doctrine into which armored mobility even-

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4 *Die Truppenführung* (Berlin, 1933), paragraphs 1 and 2, U.S. War Department translation.

5 As a result of the failure of the German government to pay the reparations due to the French according to the Versailles peace settlement, the French Army invaded and occupied the Ruhr.

6 Walter Goerlitz, *History of the German General Staff, 1657-1945* (New York, 1962), p. 234.

tually fit with relatively little difficulty.[7] The result was the development of a set of devastating military capabilities that virtually destroyed the European balance of power in 1940.

The Germans were willing to embark on experiments with motorization well before any of the other European armies. The German efforts in this direction evolved over a lengthy period from the early 1920s to the late 1930s, but once they were clear on the issues—e.g., that panzer divisions were the way to go—they were willing to move ahead with great rapidity. At the time of the Czech crisis in September 1938 the *Wehrmacht* possessed only three panzer divisions. By September 1939, the *Wehrmacht* possessed six armored divisions, doubling the panzer force in a year; by May 1940, the *Wehrmacht* had ten; and by June 1941, twenty. In other words, careful experimentation over a sustained period eventually produced new capabilities—proven in battle—that the Germans then reinforced with the commitment of major resources.

Similarly, European, American, and Japanese military organizations that successfully innovated approached the problem of transformation as a long-term campaign rather than as a short-term effort to develop capabilities of immediate use. Carrier aviation in the U.S. Navy progressed in stages from spotting fires for the battle line, to providing long-range reconnaissance, to pulses of striking power that could damage the enemy's battle fleet before a fleet engagement took place, and eventually to striking power that could reach out on its own to wreck the enemy's fleet and land bases. By December 1941, the U.S. Navy possessed a carrier fleet that would revolutionize the conduct of war in the Pacific.

The initial thinking about the possibility of naval air power occurred before the First World War. By the early 1920s, the Naval War College was wargaming the potential of carriers even before the navy possessed a single carrier. These simulations indicated that carrier air power would do the most damage as pulses of air power.[8] Thus, when the fleet acquired its first carriers, U.S. naval innovators already possessed insights into the capa-

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7 See Williamson Murray, "Armored Warfare," in *Military Innovation in the Interwar Period*, chapter 1.

8 Thomas C. Hone, Norman Friedman, and Mark D. Mendales, *American and British Aircraft Development, 1919–1941* (Annapolis, MD, 1999), p. 34.

bilities they needed to develop. As a result, the naval officers created the landing and take-off procedures, the deck park, and the air tactics necessary to translate the capabilities of carrier-based airplanes into pulses of air power. Inextricably intertwined with this process of innovation were the fleet exercises and experiments that suggested further possibilities as well as new approaches.[9] Thus, the process of experimentation represented an extended campaign over decades rather than a single event.

The danger of over-emphasis on single events could not be clearer than the results of the British Army's experiments with armor in the late 1920s and early 1930s. The British never possessed a coherent framework—either conceptual or doctrinal—within which to cast their experiments with armor.[10] Thus, the army failed to learn from year to year as the experiments took place. Some smaller technological possibilities, such as the importance of radio communications, emerged and were not forgotten. But the larger possibilities, such as deep exploitation attacks, quite simply disappeared from the army's collective memory.

The results of the 1934 maneuvers serve to underline the dangers of an event-based approach to experimentation. In this exercise, the advocates of the tank—in particular B.H. Liddell Hart and J.F.C. Fuller—had raised the expectations of the observers, only to have those expectations dashed by an exercise format that aimed to train the soldiers and units rather than validate a concept. The result was that much of the army's leadership walked away from the experiment with the belief that the concept had failed and that the tank would not play a major role in the coming war.[11] Only the events in May 1940 eventually disabused the British Army's leadership of that view.[12]

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9 One might also note that the United States had begun working on the problems of underway replenishment as early as 1917 and continued in its fleet exercises throughout the interwar period to work on this capability, which was to prove a crucial enabler in the great fleet operations of 1944 and 1945. In this regard, see Fleet Admiral Chester W. Nimitz, "The Navy's Secret Weapon," *Surface Warfare* (reprint), March/April 1999.

10 For the best overall study of the British Army in the interwar period, see Brian Bond, *British Military Policy Between the Two World Wars* (Oxford, 1980). See also Williamson Murray, "British Military Effectiveness Between the Wars," in *Military Effectiveness*, vol. 2, ed. by Allan R. Millett and Williamson Murray (London, 1988).

11 The most thorough discussion of the conduct and result of the 1934 maneuvers is in Harold R. Winton's *To Change an Army, General Sir John Burnett-Stuart and British Armored Doctrine, 1927–1938* (Law-

There was also an additional issue with the 1934 armored experiment: those who designed the exercise presented the experimental armored force with a set of challenges that aimed to test the force's capabilities to the greatest extent possible, while extracting the maximum training from the effort—exactly what one should expect in terms of intelligent peacetime training. Fuller and Liddell Hart, who severely criticized the experiment's design, were unwilling to recognize that training must be an integral part of any program, including experimentation. Ironically, during this same period, although the Germans had no tanks (at least until their 1935 maneuvers), they were able to fold the lessons of tempo, speed, and the importance of coordination from the British experiments into their own conceptions of combined-arms, maneuver war.[13]

Testing concepts to the breaking point

Tolerance for surprise and failure

There is a larger point here. To be successful in the process of experimentation, military organization must be as willing to learn from "failure" as from success. That requires hard, rigorous testing on ranges and exercise grounds—a process that may result in as many failures as successes. And in the end, military organizations may learn as much, if not more, from experiments that fail as from those that succeed. The purpose of experiments should not be to prove a particular approach or concept "wrong." Crucial to an atmosphere conducive to successful experimentation must be an emphasis on creating the future rather than on grading current capabilities. True experimentation must possess a tolerance for failure; the 1934 British maneuvers appeared to fail.

However, the German "lessons learned" analysis of the 1934 British maneuver revealed that despite the apparent failure of the armored force, there were a number of positive lessons on the use of armor that suggested how best to extend armored warfare by an emphasis on combined arms. Moreover, the biggest gains in experimentation often came

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rence, KS, 1988), chapter 7. See also J.P. Harris, *Men, Ideas, and Tanks: British Military Thought and Armored Forces, 1903–1939* (Manchester, 1995).

12 See Winton, *To Change an Army*, chapter 7 on this point.

13 Williamson Murray, *The Change in the European Balance of Power, 1938-1939; The Path to Ruin* (Princeton, 1984), pp. 34-35.

from the unexpected. Thus, the emphasis throughout the German experimental process was on encouraging officers to pursue the creative possibilities.

Military organizations that attempted to control experiments invariably ended up limiting both the potential of technology as well as insights into the possibilities for future military capabilities. Here, the French Army offers a sobering example of how not to experiment.[14] French efforts in experimentation aimed to confirm existing doctrinal concepts and army preparations. The French military simply had no interest in challenging the senior leadership's decrees that had defined the "proper" method of force employment.

The French senior leadership made clear that it would brook no challenges. In the mid-1930s, General Maurice Gamelin, the army's commander-in-chief, banned any writings by his officers that were critical of the army's official positions. As the postwar general and military commentator, André Beufre, commented in his memoirs after the war, "Everyone got the message and a profound silence reigned until the awakening of 1940."[15] Thus, not only did French experimentation take place within a tightly scripted framework, but even within that controlled framework the French made little effort at stretching their forces.[16]

A consistent emphasis on red teaming

A substantial portion of the most success experimentation in the interwar period involved extensive red teaming. Here again the French came in last. They were simply unwilling to recognize that their future opponents, the Germans, might select another approach. The result was doubly disastrous. On one hand, they failed to test their own conceptions in a realistic environment. On the other, they ensured that French commanders facing the Germans in May 1940 had little understanding that the Germans might operate within a very different framework—one that emphasized speed, tempo,

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14 The two best books on the French Army's intellectual and tactical preparation for the coming war are Robert Doughty, *The Seeds of Disaster, The Development of French Army Doctrine, 1919-1939* (Hamden, CT, 1985); and Eugenia Kiesling, *Arming Against Hitler* (Lawrence, KS, 1997).

15 André Beufre, *1940, The Fall of France* (New York, 1968), p. 43.

16 See Kiesling, *Arming Against Hitler*, chapters 3 and 4.

and drive to a degree that French doctrine could not accommodate.[17] As the great French historian Mark Bloch, a staff officer during the campaign, noted in the late summer after the disaster:

> Our leaders, or those who acted for them, were incapable of thinking in terms of a *new* war.... The ruling idea of the Germans in the conduct of this war was speed. We, on the other hand, did our thinking in terms of yesterday or the day before. Worse still: faced by the undisputed evidence of Germany's new tactics, we ignored, or wholly failed to understand, the quickened rhythm of the times.... Our own rate of progress was too slow and our minds too inelastic for us ever to admit the possibility that the enemy might move with the speed which he actually achieved.[18]

Military organizations that posited an effective and well-trained opposing force capable of acting as an independent agent were invariably more successful at innovation than those that did not. Virtually all of the major American fleet exercises involved problems of fleet-on-fleet engagements. In these experiments, the presence of an opposing fleet created the opportunity to evaluate realistically the improving capabilities of aircraft and carriers. In a U.S. Navy fleet exercise in the early thirties, one side launched an air attack that caught and destroyed the opposing fleet in Pearl Harbor. In a tactical and operational sense, the Navy steadily gained new insights into the evolving possibilities of carrier aviation—an operational understanding that proved its worth in the naval combat that unfolded after the destruction of the battle fleet in December 1941.

Not surprisingly, the Germans were also quite good at involving red forces in the experimental process. In the case of armored development, their evaluations of the British Army's 1934 maneuvers suggested that all-armored forces could run into substantial difficulties on the modern battlefield. Thus, they pushed the development of the panzer divisions down a combined-arms path. It was the honesty of the red-teaming effort that made possible the crucial insight that the new armored force in the German Army's

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17 For a summation of the evidence of the impact of the French preparations for war on the 1940 campaign, see Williamson Murray and Allan R. Millett, *A War To Be Won, Fighting World War II* (Cambridge, MA, 2000), pp. 66–76.

18 Marc Bloch, *Strange Defeat* (New York, 1968), pp. 36-37, 45.

buildup should come within a combined-arms framework—rather than in terms of the all-armor formations that tank advocates like B.H. Liddell Hart and J.F.C. Fuller were touting in Britain.[19]

Learning from the past: the culture of experimentation

A consistent emphasis on learning from the past and the present

By pushing the envelope on concept development in experiments, military organizations can open the way to an understanding of the possibilities of future battlefields. Here military culture is essential to the process of successful experimentation. The Germans executed a major change in their military culture under General Hans von Seeckt in the early 1920s that placed the values of the general staff at the heart of the "German way of war."[20] The initial result was that they studied the actual lessons of the First World War's battlefields in great detail.

In the early 1920s, Seeckt established no less than fifty-seven different committees to study those lessons. As he noted to his subordinates: "It is absolutely necessary to put the experience of the war in a broad light and collect that experience while the impressions won on the battlefield are still fresh and a major proportion of the experienced officers are still in leading positions."[21] The *Reichswehr*'s leadership then ensured that its commanders and staff incorporated those lessons into an honest, realistic doctrine their officers and NCOs understood and practiced. Unlike the French, the Germans treated doctrine as a vehicle they could modify and expand in accordance with technological advances and as experiments suggested new possibilities.

This doctrinal framework was codified in a 1932 rewrite of the *Reichswehr*'s basic doctrinal manual, *Die Truppenführung*, by three of the army's senior generals (one, Werner von

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19 For all the immense interest focused on the German military in the interwar period, there has been very little written about the conduct of German military exercises throughout the period. Nevertheless, the comments of external observers as well as the documents underline a ruthless system of free play aimed at testing and refining doctrine and concepts. It was only after the outstanding performance of the test panzer regiments in the summer 1935 maneuvers that the German Army decided to establish the first three panzer divisions.

20 Here James S. Corum, *The Roots of Blitzkrieg, Hans von Seeckt and German Military Reform* (Lawrence, KS, 1992) is particularly good.

21 Ibid., p. 37.

Fritsch, soon became the army's commander in chief; another, Ludwig Beck, its chief of staff). The manual formed the basis for the *Wehrmacht*'s tactical and operational skills on the battlefields of Europe and North Africa in the Second World War. It emphasized combined-arms warfare, decentralized operations, leadership, and rapid exploitation on the battlefield.[22] But only constant experimentation and exercise ensured that the army's commanders and units practiced what they preached. Experimentation was a learning process that sought to expand the envelope of German thinking and to define doctrinal concepts. As Seeckt suggested about an early experiment with motorization in the Harz mountains in 1922:

> I fully approve of the Harz exercise's conception and leadership, but there is still much that is not clear about the specific tactical use of motor vehicles. I therefore order that the following report be made available by all staffs and independent commands as a topic for lectures and [further] study. Troop commanders must see to it that experience in this area is widened by practical exercises.[23]

The Germans tied the results of experimentation directly into their school system as well as their doctrinal framework—as did the U.S. Navy in its development of carrier aviation. Experimentation, doctrinal development, and the refinement of tactical and operational concepts went hand in hand. On the other hand, the British Army allowed its experiments in armored war to remain outside of its force development and doctrinal processes. As a result, the British, even during the Second World War, were never able to gain a handle on how best mechanized warfare might function.[24] The experimental process short-circuited because it was in no fashion connected to the actual business of soldiering in the British Army.

In the end, the development of German combined-arms, mechanized warfare was a twenty-year process in which the army carefully evaluated the lessons of the past and

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22 *Die Truppenführung* (Berlin 1933).

23 Reichswehrministerium, Chef der Heeresleitung, Harzübung, 8.1.22, National Archives and Records Service (NARS), microfilm roll number T-79/65/000622.

24 For further discussion on this point, see Williamson Murray, "British Military Effectiveness in World War II," in *Military Effectiveness*, vol. 3.

then folded those lessons in with the current experiences of experiments and exercises. The experiments and exercises of 1935 and 1936 pointed the way toward including tanks in the *Wehrmacht*'s combined-arms doctrine and moving battlefield exploitation from the speed of infantry to that of motor vehicles. Throughout this period, the Germans, including the tank pioneers, remained ruthless critics of the performance of their forces. The aim was to push the possibilities, rather than to maintain the status quo—evolutionary change tied to realistic evaluations of past experiences.

With the Germans, the learning process of experimentation did not end with the coming of war. Instead, as with peacetime exercises and experiments, the Germans studied their combat experience with the same careful lesson-learned approach that they used in peacetime to extend the possibilities that tactics and technological change offered. Thus, in April 1940, immediately before the opening of the Western campaign, the *Wehrmacht* carried out a series of experiments to enable close air support (CAS) during mobile operations.[25] The tests suggested that with forward air controllers assigned directly to the armored spearheads, the Germans could bring CAS directly to the support of advancing panzer columns.

However, because the French campaign was so close to its launch date, the Germans decided not to implement the results of the experiment. But beginning in summer 1940, they finished working out the process of air support in a mobile environment, folding in the lessons learned from the April experiment with the combat experiences of the May-June 1940 fighting. The result was that when they invaded the Soviet Union in June 1941, the Germans possessed the first modern CAS system to support mobile operations.[26]

Finally, the Germans were willing to alter and improve their conceptions on the basis of ruthless experimentation. During the *Wehrmacht*'s initial buildup, they established a number of different tank formations: panzer divisions, light divisions for reconnaissance, motorized infantry divisions, and independent tank brigades for infantry support. But as

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25 Up to this point the *Wehrmacht* possessed only the most primitive means to identify and support ground forces from the air. For a discussion of the development of German close air support see Williamson Murray, "The *Luftwaffe* Experience, 1939–1941," in *Case Studies in the Development of Close Air Support*, ed. by Benjamin Franklin Cooling (Washington, DC, 1990), chapter 2.

26 Murray, "The *Luftwaffe* Experience," chapter 2.

experiments continued over the course of the buildup, they narrowed the focus of their efforts to create mechanized forces. The success of the initial three armored divisions was such that the *Wehrmacht* created an additional three armored divisions and did away with the independent armored brigades in summer 1938.

The 1939 campaign in Poland reinforced the experience gained by experiments and exercises. Thus, in October 1939, on the basis of combat experience in Poland, the army converted four light reconnaissance divisions into panzer divisions, the most famous of which, the 7th Panzer Division, Erwin Rommel would lead during the French campaign.[27] By using the experimental process the Germans exploited their doctrinal and developmental successes to the maximum and developed combat capabilities that came close to winning the war.

There is a crucial comparison to be made between the German Army and the Royal Air Force (RAF). Throughout the 1930s the RAF carried out a number of experiments and exercises with its bomber squadrons.[28] The results were almost uniformly suggestive that British technological capabilities for the RAF's bomber force were inadequate to support the strategic bombing of enemy industries and population centers, a strategy that was at the heart of the RAF's conceptions of war throughout the interwar period. In May 1938 the assistant chief of air staff admitted that

> it remains true ... that in the home defense exercise last year, bombing accuracy was very poor indeed. Investigation into this matter indicates that this was probably due very largely to failure to identify targets rather than to fatigue.[29]

Yet the considerable number of exercises and experiments that indicated serious deficiencies in the bomber forces had little impact on the RAF's Bomber Command's preparations for war. It would not be until August 1941 that the Butt report, a careful analysis

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27 For the most recent evaluation of Rommel's performance during that campaign, see Karl-Heinz Frieser, *Blitzkrieg-Legende* (Munich, 1995).

28 For the Royal Air Force during the interwar period, see John Terraine, *The Right of the Line, The Royal Air Force in the European War, 1939–1945* (London, 1985), Part I. See also Williamson Murray, "Strategic Bombing, The British, American, and German Experiences," in *Military Innovation in the Interwar Period*, chapter 3.

29 Public Records Office, AIR 2/2598, Air Ministry File #541137 (1938).

of mission photographs by individuals outside of the RAF, indicated that Bomber Command was hitting few of its targets even under the best of night-time conditions.[30] Only then did the RAF's leadership become interested in solving the technological and tactical problems that had been affecting its forces in experiments well before the war.

This pattern of dismissing past experience (including wartime) as of being of little utility was a hallmark of the RAF's approach throughout the interwar period. In fact, in 1924 the Air Staff went so far as to reject history explicitly as of being no use in thinking about future war.[31] The result was that the RAF's leaders entirely missed the two crucial lessons of air power employment in World War I:

- First, that air superiority was absolutely essential to the conduct of any of the basic missions of an air force, including strategic bombing.
- And second, that finding and hitting targets accurately was an extraordinarily difficult business in bad weather or at night.

The underlying lesson would seem to be that if military organizations are unwilling to evaluate their experiments and exercises honestly in peacetime, they will find it almost impossible to evaluate their experiences in combat effectively under the far more unforgiving conditions of war.

Protecting the innovators

Finally, those military organizations that successfully innovated in the interwar period protected those who were responsible for the process of experiments and innovation. Successful experimentation and innovation required a command atmosphere that ensured that those who were thinking outside the box received suitable rewards from the promotion systems. Not only did military organizations, like the U.S. Navy, the U.S. Marine Corps, and the German Army, encourage innovators and experimenters, but partici-

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30 Sir Charles Webster and Noble Frankland, *The Strategic Bombing Offensive Against Germany*, vol. 4, *Annexes and Appendices* (London, 1962), appendix 13, p. 205.

31 Public Record Office, Air 20/40, Air Staff Memorandum 13A, March 1924.

pation in the process of experimentation was in many cases career enhancing.[32] In the case of the development of carrier aviation, the Congress of the United States[33] stepped into the Navy's promotion process in the mid-1920s, and by legislation ordered that command of carriers go only to those who had earned their wings as aviators.[34]

In the case of the Germans, Heinz Guderian, one of the leading figures in the development of the panzer arm, held a justifiable reputation not only for the ferociousness with which he advocated innovation with armored warfare, but for his rudeness to his superiors. At one point during an exercise/experiment with the panzer forces, the future Field Marshal Gerd von Rundstedt was reduced to commenting: " *Alles Unsinn, Alles Unsinn, meine lieber Guderian* (all nonsense, all nonsense, my dear Guderian)."[35] Yet the *Wehrmacht* tolerated Guderian throughout the 1920s and 1930s, and by the 1941 invasion of the Soviet Union, he was not only a full general, but commander of a Panzer Army. Guderian was not the only maverick in the German Army who advocated the concept of armored, maneuver war; there were a number of other irascible and enthusiastic innovators that the German military tolerated throughout the interwar period.

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32 For the U.S. Marine Corps in the interwar period, see particularly Allan R. Millett, "Amphibious Warfare," in Military Innovation in the Interwar Period, chapter 2.

33 This was done at the urging of the Morrow Board, which was established to examine the larger questions of military aviation.

34 Hone et al., *American and British Aircraft Carrier Development, 1919–1941*, p. 40.

35 M. Plettenburg, *Guderian: Hintergründe des deutschen Schicksals, 1918–1945* (Düsseldorf, 1950), p. 14.

The Focus for Joint Experimentation over the Next Decade

What lessons might the U.S. military draw from the experiences of the last great interwar period in thinking about where to focus future joint experimentation?

Focus on big change over the long term

Successful innovation requires an experimental process that aims to create new capabilities and concepts rather than grade current ones. Change, no matter how dramatic, requires hard, relentless work over long periods of time. For those involved in change, such as German officers during the interwar period, change may appear evolutionary, but to those on the receiving end, such as British and French officers in 1940, the results will appear revolutionary.

The services and those charged with supporting the process of joint experimentation need to think in terms of the long haul—in other words, both in terms of campaigns (rather than events) and long-term changes (rather than quick fixes). Quite simply, the experimentation process is not reducible to a single event or short period. Continuity, an evolutionary process, and attention to detail have all been essential to the achievement of successful revolutions in military affairs in the past, and there is no reason to expect that future military innovation will be much different.[36]

Focus on identifying potentially important new operational concepts and enabling capabilities

The services and the joint community need a more coherent vision (than is currently available) of what kind of operational concepts (and capabilities) they will require in the future. And that vision needs a strong sense of the realities of war in the past as well as the present. The experimentation in naval aviation in the interwar period underlines the importance of identifying new operational concepts early in the experimentation process in order to understand the enabling capabilities that will be needed. Without the concept of "pulses of air power," the enabling capabilities such as arresting wires and deck parks

36 For a discussion of this and other issues see MacGregor Knox and Williamson Murray, *The Historical Parameters of Revolutions in Military Affairs* (forthcoming, Cambridge, spring 2001).

might never have been developed—as was the case with the Royal Navy during the same period.

Recognize that the future opponents of the United States have choices

Those charged with experimentation cannot lose sight of the fact that future U.S. opponents will use every ounce of their human computers (brains) to dissect U.S. weaknesses, play to their own strengths (including political), and disable or mitigate U.S. technological superiority. Nor should experimenters lose sight of the fact that, as Clausewitz underlined, war is a brutal business that involves the death of our own soldiers as well as those of the enemy. No matter how attractive new technologies and concepts may seem, American experimenters should not forget the Prussian theorist's dire warning:

> Kind-hearted people might of course think there was some ingenious way to disarm or defeat an enemy without too much bloodshed, and might imagine this is the true goal of the art of war. Pleasant as it sounds, it is a fallacy that must be exposed: war is such a dangerous business that the mistakes which come from kindness are the very worst.[37]

Thus, the experimentation process requires healthy opponents: red teams that possess the knowledge, imagination, and capabilities to attack putative blue forces in new and imaginative ways. Red teaming must underline and expose the weak points as well as the strengths of U.S. forces.[38]

Recognize that the purpose of experimentation is change

The aim of experimentation should not be to validate current doctrine and concepts, but rather to challenge them—and change them. Experimentation is not about reaching a new stasis. In war, as in life, there is no constant or end state: everything is in flux. Failures may be as revealing in the experimentation process as "success." And, in some ways,

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37 Carl von Clausewitz, *On War*, trans. and ed. by Michael Howard and Peter Paret (Princeton, 1975), p. 75.

38 The philosophy of the opposing force (OPFOR) at the National Training Center at Fort Irwin, California, underlines the approach that U.S. forces need to take towards red teaming.

failures may be more useful than successes because they can suggest weaknesses that exist for future U.S. opponents to attack.

Tie experimentation to the implementation process

Experimentation that remains locked inside of itself, with no connection to the actual day-to-day business of preparing military forces for future war, is, at best, useless—and, at worst, harmful. It may well mislead senior U.S. leaders into thinking that the United States possesses capabilities that in fact have not been implemented in the regular forces. In this sense, the relationship among the Naval War College during the 1920s and 1930s, the fleet exercise planners, and the exercises themselves should prove particularly useful for those charged with thinking about experimentation and innovation in coming decades.

Focus on jointness and coalition war in all experimentation

The American military confronts a far more complex problem than during the 1920s and 1930s: the conduct of true joint operations, not as a singular event, but on a consistent, day-in, day-out basis. This very complexity makes it that much more difficult for those on the outside who provide the resources (i.e., the civilians in charge in the Pentagon and particularly those in the Congress) to understand what the issues are and how best to help push the process of innovation along.

But beyond the difficulties involved in joint operations (and at times, at least from Washington, they appear to be almost insurmountable), for the foreseeable future the United States is going to operate its military forces as a part of a larger coalition. Thus, the challenge in joint experimentation will not just lie in the integration and influencing of service efforts, but in thinking through the problems associated with coalition warfare. This will require U.S. forces and their commanders to think through the problems associated with working with military organizations and non-governmental organizations that possess different technologies as well as considerably different cultures and doctrines (not to mention political goals and conceptions of war).[39]

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39 A series of U.S. Marine war games involving Allied participation over the past year have served to underline that cultural and doctrinal issues are easily as important as technological differences in combined operations.

Focus on protecting the innovators and experimenters

Finally, the U.S. military must focus more distinctly on the problem of protecting those who are engaged in experimentation and innovations in entirely new ways of doing business. In the interwar period in the U.S. Navy and the German Army, those on the leading edge of innovation and experimentation were protected and encouraged by the organizational culture—to the greater benefit of military effectiveness. But the experience of the French Army in that same period underlines the penalties involved when military institutions remain entirely within the box in their thinking and fail to protect those who are willing to advocate new ways of doing business or new technologies.

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13. ABSTRACT (Maximum 200 words)
The period between the two World Wars has special relevance to DoD's joint experimentation efforts. During the interwar period, U.S. and foreign military innovators provided long-term and successful transformations of military capabilities. This paper provides a look at these experimentation efforts, highlights the attributes of success, and offers lessons for current and future DoD joint experimentation tasks over the next decade. First, elements of innovation were identified; i.e., establishing a framework for intellectual creativity over the long haul, testing concepts to the breaking point, and learning from the past (the culture of experimentation). The author then developed six lessons for DoD joint experimentation tasks: (1) focus on big change over the long term; (2) focus on identifying potentially important new concepts and enabling capabilities; (3) recognize that the purpose of experimentation is change; (4) tie experimentation to the implementation process; (5) focus on jointness and coalition war in all experimentation; and (6) focus on protecting the innovators and experimenters.

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