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The Force Management Challenge: Balancing Modernization and Readiness

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U.S.ARMY

THE UNITED STATES ARMY WAR COLLEGE

The Force Management Challenge
Balancing Modernization with Readiness

Key Insights:

- Modernization cannot truly begin to any great degree without Congressional funding, though it can continue when budgets decline.
- Modernization requires investment in headquarters and installation infrastructure.
- Modernization includes significant support requirements for major systems.
- Key support requirements include multidisciplinary New Equipment Training Teams representing AMC, TRADOC, and other agencies to field complete syste1ms.
- Modernization inevitably causes personnel friction as units reorganize.
- Training, doctrine, and modernization usually develop at the same time and thus inform one another.
- There is never enough modernization to go around.
- These big bursts of modernization that occur every 40 years or so result in more than just a better force, they transform it.
- Modernization never really ends.
- Reports on the status of modernization must be able to distinguish between readiness and capability.

The main levers that Army leaders control to apply budget dollars to shape their force are organizational structure, modernization, and readiness. Obviously the size of the force has a major impact on its capabilities, but the greatest challenge for leaders has been to keep the force ready for all current threats while also incorporating new technology for the future. This is an ongoing process, but has become even more complex in the modern era with the increasing scope and impact of technological change. During the last century, the Army has experienced magnified transformational bursts of modernization about every 40 years. The first was during the mobilization for World War II in the1940s, and the second involved the fielding of the Big 5 and associated systems in the 1980s. Both were enabled by a significant amount of innovative thinking in times of tight budgets that could be funded by a later influx of money. These opportunities for mass modernization always put considerable strain on the development of corresponding training, doctrine, and organizations for their application, and in maintaining contemporary combat capability, especially in the 1940s when Army leaders were also trying to massively increase the size of the service.

World War II

Despite limited budgets in the decades after World War I, there was much innovative thought in the various branches of the Army, and significant expenditures in research and development. This was most apparent in the Army Air Corps, but all branches developed new ideas for vehicles, weapons, and systems. The service did find enough funds to field the superb M1 Garand rifle, but most concepts waited on the shelf. This changed when the buildup for war started in 1940. The Army Air Forces would be transformed from an organization equipped with P-40s and B-17s to one with P-51s and B-29s, but change was just as evident in ground forces. For the purposes of this study, we will focus on the development of new armored divisions, and in particular the fielding of the M4 Sherman tank.[1]

Tank Developments from 1920 to 1940

Prior to the outbreak of World War II (WWII), the United States (U.S.) Army had not developed an armor doctrine or established a tanker-training program. The poor state of tank doctrine and equipment occurred because the Army remained uncertain over the proper role and place of the tank and because Congressional funding failed to meet modernization needs. These two factors meant that American tank technology, training, and doctrine lagged behind European nations. It was not for a want of ideas or interest in armor that America was behind, but because Congress significantly underfunded the Army in the 1920s and 1930s. Once budgets expanded in the late 1930s and early 1940s, the Army quickly funded existing modernization programs that rapidly expanded and improved based on battlefield experiences. Only by examining these interrelated circumstances can one understand the relationship between modernization and readiness of American tank forces in the 1940s.

While Congressional funding and modernization lagged during the interwar years, tank development was not stagnant, and existing programs proved fundamental to the rapid modernization and development of American armor in the early 1940s. In 1920, the National Security Act assigned the remnants of the World War I era Tank Corps to the Chief of Infantry, where the Infantry conducted tank modernization efforts through its Infantry Tank Board. By 1933, the Infantry Tank School, which had moved from Camp Meade, Maryland, to Camp Benning, Georgia, included a yearlong course in instruction for both officers and enlisted men who studied tactics, operations, and mechanics. The Cavalry also adopted and experimented with mechanized units during this time. The Mechanized Cavalry Board performed functions similar to those of the Infantry Tank Board, but considered mechanization and motorization as a substitute for the horse. The Cavalry, which was not given a tank development mission in the 1920 National Security Act, designated its heavy full-tracked vehicle the “combat car” to work

[1] Conrad C. Crane, Michael E. Lynch, James D. Scudieri, and Joe Williams, “Maintaining and Modernizing the Force in Periods of Reduced Resources” (case study, Historical Services Division, U.S. Army Heritage and Education Center, 2012).

around the law. Within the Cavalry, armored units trained as independent units in contrast to the Infantry's concept of infantry-tank cooperation.[2]

For a short period, the U.S. attempted to unite tank development and modernization within the Mechanized Force, a combat force to develop concepts and guide the organization and employment of armored vehicles. This experimental force, based at Camp Meade, sought to mimic developments in Great Britain where individuals like J .F. C. Fuller and B. H. Liddell Hart were theorizing the role of the tank, especially the idea of using fast, heavily armed mechanized columns to achieve decisive effect. Like the British, the French under the guidance of General Edmond Buat also spent the 1920s experimenting with mobility and firepower until abandoning these efforts for the perceived safety of the Maginot Line. Observing French and British armor developments, the German army decided by the early 1930s that armored tanks would be the decisive offensive weapon. As the European powers started embracing armor, Americans remained skeptical, evident when then-Major George S. Patton Jr. degraded Fuller and Liddell Hart: "Surely the remarks of Col. J. F. C. Fuller (British Army) who during the course of four years' war replete with opportunities attained only the rank of Lieutenant-Colonel, or the opinions of such a hack-writer as Captain Lyle [*sic*] Hart seem puerile when compared with the forceful statements of the elite of the military world."[3]

With negative opinions like Patton's and the refusal of either the Infantry or the Cavalry to divert manpower and money to the Mechanized Force, the Army disbanded the Mechanized Force in 1931. Instead, throughout the mid-1930s, the Army directed the Infantry, Cavalry, and other branches to independently adopt mechanization and motorization as far as possible with limited budgets. Seven years later, the War Department reversed this decision and made mechanization the responsibility of the Infantry and Cavalry, but this reversal ensured that modernization and doctrine remained divided. In the Infantry, doctrine focused on developing and using tanks as a weapon to support Infantry combat and close support, but the Infantry eventually pooled tank resources into a Provisional Tank Brigade composed of one full regiment and two separate battalions of light tanks and one company of medium tanks. On the other hand, the Cavalry, replacing the horse with the tank, saw the tank as adopting traditional Cavalry missions: reconnaissance, pursuit, envelopment, and exploitation of the breakthrough.[4]

In the spring of 1940, the maneuvers in Georgia and Louisiana brought existing armored units and equipment to the field. The exercise demonstrated both the promises and challenges of mechanization, but did not significantly alter either Infantry or Cavalry

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[2] Robert S. Cameron, *Mobility, Shock, and Firepower: The Emergence of the U.S. Army's Armor Branch, 1917-1945* (Washington, DC: Center of Military History, 2008), 9-21; Historical Section, Army Ground Forces, "The Armored Force Command and Center, Study No. 27" (Washington, DC, 1946), 1

[3] Brian Bond and Martin Alexander, "Liddell Hart and De Gaulle: The Doctrines of Limited Liability and Mobile Defense" in *Makers of Modern Strategy: From Machiavelli to the Nuclear Age*, edited by Peter Paret (Princeton: Princeton University Press, 1986), 598-623; Cameron, 39.

[4] Historical Section, Army Ground Forces, "The Armored Force Command and Center, Study No. 27," 1-4.

doctrine. The maneuvers did, however, spur debate over the future of mechanization, and the officers involved reached several unanimous conclusions: the development of armored units could no longer be delayed; it was no longer feasible to have developments in both the Infantry and the Cavalry; and existing light tanks should be used, but the development of medium tanks should be stressed. These recommendations, coming as the situation in Europe deteriorated, were quickly assessed by the War Department and resulted in the formation of the Armored Force.[5]

The Armored Force was founded on 10 July 1940 with the direction to "service test" armored warfare because no separate branch was authorized by Congress. The new organization drew on and developed existing equipment and doctrine. MG Adna R. Chaffee was designated the first Chief of the Armored Force and was responsible for building up the force until his death in August 1941. The foundation of the Armored Force included the 7th Mechanized Cavalry, six battalions of Infantry tank units that composed the Provisional Tank Brigade, 500 officers, and more than 9,000 enlisted men. From these incoming units, the Armored Force established the I Armored Corps, composed of the 1st and 2nd Armored Divisions; the 70th General Headquarters (GHQ) Reserve Tank Battalion at Fort Meade; the Armored Force Board, to test new equipment; and the Armored Force School and Replacement Center, to train, recruit, and specialize technicians. The Armored Force was headquartered at Fort Knox, Kentucky, due to its proximity to industrial centers.[6]

Doctrine: FM 100-5

The Army entered World War II with the 1941 FM 100-5 *Operations* that was heavily influenced by impressions of German blitzkrieg and lessons from the Louisiana Maneuvers. The FM stressed combined arms warfare and was generally successful in guiding such operations on fortified positions or in jungles, but less apt for operations in heavily wooded areas or the bocage. FM 100-5 was revised in 1944 to add amphibious operations. Chief of Army Ground Forces LTG Lesley McNair significantly influenced both versions and reflected his desire to reduce the structure of the division by creating "pools" of special units. The biggest failure of that concept was the tank destroyer, a favorite of McNair. Initially tank destroyer doctrine stressed fighting enemy tanks while tanks went after enemy infantry, but that resulted in outgunned tanks and too many tank destroyers. Eventually the field realized tanks were the best weapon against enemy tanks, and the right equipment and organizations resulted. Tank destroyers never did accomplish very much, and were a wasted development, though FM 100-5 did not reflect that. The doctrine also tended to expect too much from artillery and airpower.[7]

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[5] Historical Section, Army Ground Forces, "The Armored Force Command and Center, Study No. 27," 7-8; for discussion of the spring 1940 maneuvers, see LTC William M. Grimes, "The Spring 1940 Maneuvers," *The Cavalry Journal* 49 no. 2 (March-April 1940): 98-114.

[6] Cameron, 253-255.

[7] Christopher Gabel, *Seek, Strike, and Destroy: U.S. Army Tank Destroyer Doctrine in World War II* (Fort Leavenworth: Combat Studies Institute, 1985).

The Army relied on a decentralized approach to adaptation throughout WWII. Army branches developed weapons systems separately, and units in the field adapted faster than doctrine could keep up. One exception was for close air support. After the problems with air-ground cooperation in North Africa, a new FM 100-20, *Command and Employment of Air Power*, appeared in July 1943. It provided the basis for successful Allied close air support for the rest of the war. The Army Air Force was much quicker to create new doctrine than its ground counterparts, but weapons systems generally developed from processes within branches more than from any central direction. System upgrades were driven by lessons learned in the field that were rarely incorporated into doctrine. As historian Michael Doubler wrote, "The preference for problem solving at the lowest levels precluded the development of army-wide solutions, and adaptations in the field using limited resources were generally modest and had mixed success in achieving objectives and preventing casualties."[8]

From the M2 to the M4: Tank Modernization during WWII

Materials shortfalls plagued the Armored Force in preparations for war. Throughout its first year, the Armored Force lacked combat vehicles in numbers sufficient to equip new units and support training. Although authorized 100 light and 32 medium tanks, the replacement center reported only 27 light tanks by July 1941. The first armored organizations were built around some 400 obsolete tanks and an assortment of armored personnel carriers, a significantly inadequate number when each armored division required 3,243 vehicles, including 1,140 combat vehicles. Yet, production lines for tanks and halftracks took time to establish, particularly since the design of these vehicles, as the case of the M4 demonstrates, was continually evolving.[9]

The tanks available in 1940 and 1941 included the M2A series and M3 (Stuart) light-tank designs. The M2A1, M2A2, and M2A3 possessed similar armor, weighed about ten tons, and carried one .50-caliber and two .30-caliber machine guns. The M2A2 and M2A3 versions possessed two limited traverse turrets, each mounting either a .50-caliber or a .30-caliber machine gun in addition to a bow-mounted .30-caliber machine gun. The appearance of the twin turrets led crews to nickname this configuration the Mae West. The principal differences in the M2A2 and M2A3 lay in the latter's slightly thicker frontal armor and upgraded transmission. All three versions of the M2 represented an improvement in tank design, particularly in their more robust suspensions and engines that permitted speeds in excess of thirty miles per hour. However, they were still intended largely for training purposes.[10]

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[8] Michael Doubler, *Closing with the Enemy: How GIs Fought the War in Europe, 1944-45* (Lawrence: University of Kansas Press, 1994), 138; Walter Kretchik, *U.S. Army Doctrine: From the American Revolution to the War on Terror* (Lawrence: University of Kansas Press, 2011), 148-156.

[9] Cameron, 264; Historical Section, Army Ground Forces, "The Armored Force Command and Center, Study No. 27," 12.

[10] Cameron, 134.

The newer M2A4 light tank was designed for combat. It increased armament to a 37-mm gun mounted in a single turret. In addition, it had four machine guns mounted in the hull front coaxially with the main gun and two hull sponsons. Armor increased to one inch, and overall weight rose to nearly twelve tons, but the M2A4 retained the automotive reliability and general mobility of the M2A2 and M2A3 models. The new vehicle also benefited from a periscope device that improved visibility, especially when operating with the hatches closed. Development of the M2A4 coincided with the onset of war in Europe and efforts to improve the modernization of the Army and additional funds soon became available not only for tank development but also for tank production. The American Car and Foundry Company received a contract to produce 329 M2A4s. This contract marked the first significant production order placed since World War I. Deliveries of the M2A4 started in April 1940 and finished by March 1941.[11]

Medium tanks, on the other hand, remained in short supply in the early 1940s. The preference given to light tanks since the 1920s, the doctrinal emphasis on mobility, and the difficulties associated with building a heavier vehicle, slowed medium-tank development in the 1930s. In 1939, the Army assembled eighteen M2 medium tanks at Rock Island Arsenal. This vehicle possessed one-inch armor and weighed seventeen tons. It was scheduled for replacement by the heavier and better-protected M2A1, which weighed 18.5 tons. The M2A1 five-man crew operated six .50-caliber machine guns in addition to the turret-mounted main armament of a 37-mm gun. Despite the medium tank's heavier weight and better armor, it offered only slight improvements. The M2A1 medium tank, for example, carried the same main armament as the M2A4 light tank. The 37-mm gun carried by both vehicles did not offer any particular advantage to the medium tank. The weapon possessed an effective range of 1,000 yards, the same distance at which a similar gun could theoretically destroy the tank. To engage targets, it had to close into ranges that made it vulnerable. This situation did not encourage mass production, and reports of European tank battles in 1939 and 1940 led the Ordnance Department to seek a tank more powerful than the M2A1 and to cancel production plans.[12]

With the M2A1 production limited, a stopgap effort was developed to produce the M3 Lee medium tank. (The Lee, like the M3 light tank Stuart and the future M4 Sherman, received its moniker from British tankers who named American tanks after Civil War generals.) The M3's principal armament included a turret-mounted 37-mm antitank gun and a 75-mm gun mounted in the hull. The latter constituted a secondary weapon for supporting fire. It possessed a low muzzle velocity and short range; its slow, limited traverse made engagement of moving targets nearly impossible. Nevertheless, crews often tried to use the 75-mm as an antitank weapon due to the poor armor penetration of the 37-mm gun, which the Germans mockingly called "the army's little knocker." Additionally, the vehicle's radio remained unreliable, and the frequency often shifted after firing the 75-mm gun or when the tank was hit by enemy fire.[13]

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[11] Cameron, 134-135.

[12] Cameron, 135-136

[13] John J. Adams, *General Jacob Devers: World War II's Forgotten Four Star General* (Bloomington: Indiana University Press, 2015), 60; Cameron, 391.

The M3 started rolling off production lines in June 1941, but the majority of the initial production run went to British armored divisions through Lend-Lease. Because of this distribution, the M3 saw its first action in the North African desert. In fact, the War Department assigned a higher priority to meeting British demands for medium tanks than it did those of the American Armored Force. The supply of American tanks to Allied nations only grew in 1941 when the Soviet Union became eligible for Lend-Lease. In combat, the British fought with the M3, but found it incapable of truly challenging German tanks. They specifically disliked the M3's gun arrangement and excessive height. With these deficiencies, the M3 was doomed to a short production life of only 15 months; around 4,924 were built and saw combat service.[14]

The distribution of tanks abroad, however, undermined American armored divisions. As fighting in North Africa intensified in mid-1941, Secretary of War Henry L. Stimson started directing monthly quotas of tanks to the British, sending 1,460 light and medium tanks to the British in July out of 2,770 total available. The next month the Armored Force requested that the deliveries for Lend-Lease stop until American divisions obtained at least 50 percent of their authorized numbers. This request had little effect. According to War Department records, between October 1941 and June 1942, the U.S. produced 3,746 light tanks and sent 2,130 of them to the Allies. For medium tanks, production was 6,805 but 4,119 of them went abroad. By November 1942, an Armored Force report complained, "During the past several months the British have received approximately 90 percent of their allocation of estimated production; and the United States only 60 percent of their allocation."[15]

Along with developments in tanks, the Army concurrently invested time and energy into tank destroyers, a favorite weapon system of McNair. He was determined to see "if and how we can crush a modern tank offensive." His advocacy for antitank weapons started when he was the commandant of the Command and General Staff School at Fort Leavenworth, Kansas, and he remained dismissive of reports showing the French army's inability to halt the German offensive with antitank guns. Instead, he believed "if the gun outmatches the tank, then not only is the gun superior to the tank in antitank defense, but employing armored units against other armored units positively should be avoided whenever possible. The gun, supported properly by foot troops, should defeat hostile armored units by fire and free the friendly armored units for action against objectives which are vulnerable to them."[16]

With McNair's backing, the War Department established a separate tank destroyer command at Camp Hood, Texas, in March 1942. The doctrine developed by the tank destroyer command for tank destroyer units was "seek, strike, and destroy."

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[14] Cameron, 264, 391; Steve Zaloga and Peter Sarson, *Sherman Medium Tank, 1942-1945* (London: Osprey Publishing, 1993), 7.

[15] Eric W. Freiwald, "Building and Training of the 4th Armored Division: 1941-1944," (PhD diss., Temple University, 2001), 144-145.

[16] David E. Johnson, *Fast Tanks and Heavy Bombers: Innovation in the U.S. Army, 1917-1945* (Ithaca: Cornell University Press, 2013), 150.

During offensive operations, they protected friendly forces from enemy armored counterattacks “and thus allow full exploitation of their success.” During defensive combat, a portion of the tank destroyers were deployed in depth to protect against enemy armored attack. The majority, however, were held in a mobile reserve to react to the main enemy. The need for extreme mobility and an effective antitank gun were implicit in tank destroyer doctrine, and the doctrine determined equipment design. Tank destroyers were thus lightly armored and equipped with relatively high-velocity guns.[17]

McNair’s obsession with the tank destroyers did not go unchallenged. COL K. B. Edmunds, assistant commandant under McNair at the Command and General Staff College, favored a tank-vs-tank approach and had stated his opinion to McNair in July 1940. Like Edmunds, MG Jacob L. Devers, who assumed command over the Armored Force in 1941 following Chafee’s death, strongly disagreed with McNair and asserted that tanks, “supported by Air and Infantry,” would “always win” because they combined mobility with firepower; the armored force needed heavy tanks “with larger calibered weapons [to] support and protect the advance of the smaller calibered but more mobile weapons.” Moreover, he attempted to convince McNair that the U.S. Army’s tank destroyers, with their open turrets and essentially defensive missions, had limited utility on a highly lethal battlefield. The tank, with its heavier armor, could survive, and he thus preferred to mount higher-velocity guns on tanks. McNair remained unconvinced and as the commanding general of the Army Ground Forces, which included both Armored Force and the Tank Destroyer Command, his decision regarding the best way to defeat tanks initially prevailed.[18]

At the same time he was arguing with McNair over the utility of the tank destroyers, Devers was also attempting to accelerate the development of a new medium tank. Shortly after taking command of the Armored Force at Fort Knox, Devers observed the testing of the M3, but was disappointed in its firepower. He was especially critical of the Ordnance Department, which retained control over modernization and testing, for shortening the barrel of the 75-mm canon to prevent it from being caught in trees. While the British used the M3s against German Panzer IIIs, it proved no challenge to the Panzer IV with its long-barreled 75-mm gun. Recognizing this shortfall, Devers embarked on a rapid testing and development program to design a 35-ton tank, heavy enough to face the Germans but light enough to travel over European bridges, with a 75-mm gun. The gun, however, was a challenge, as the Ordnance Department had not yet developed the capability to manufacture a turret with 360-degree traverse large enough to house a 75-mm gun and would not have a prototype available until early 1942.[19]

As the Ordnance Department worked to improve the turret gun, Devers was also seeking a reliable engine to power the tank that would become the M4 Sherman. This was especially important as feedback from the British about the M3 strongly criticized its Wright engine. More than 10 percent of them had to be replaced before less than 100

[17] Johnson, 151.
[18] Johnson, 151-152.
[19] Adams, 65.

hours of operation. While Devers longed for an 800 horsepower engine strong enough to propel a 50-ton tank, American industry was not yet capable of this feat, forcing him and his staff to undertake a rapid review of available options to get the M4 into production. Diesel engines were ruled out early because of their weight. A lighter engine would allow thicker armor. Moreover, American metallurgy had developed a steel safe enough for 70-octane fuel. In his haste to find an engine, Devers identified a Guibersone air-cooled engine and acquired $7 million to build an engine plant, but the engines proved susceptible to vapor lock, an issue that also plagued diesel engines, and the new plant was quickly shutdown.[20]

Eventually, Devers settled on Ford's 400 horsepower engine, another decision based on battlefield experience. Reading reports about the German Tiger tank, a tank that inspired great fear, Devers discovered that the Tiger's mechanical unreliability meant that its crews often abandoned them in the field because of breakdowns. With this insight, he wanted the Ford engine, and almost all features of the Sherman, to be easily replaceable and fixable on the battlefield. The fighting in North Africa also resulted in other modifications to the M4. Experience in the desert with the first versions of the M4 demonstrated that the bolts holding the armored plate often popped out when struck, a danger that could potentially kill crewmen. Devers demanded a solution, and a gathering of expert welders organized by Chrysler took 48 hours to develop electric arc welding which allowed for attaching the armor plates without using bolts.[21]

The first M4 Shermans, specifically the M4A1, started rolling off production lines in February 1942. With the 1st Armored Division already deployed and training in England, the first M4A1s went to the 2nd Armored Division, but the unit did not have a long time to familiarize itself with the tank. That summer, GEN George Marshall directed the division's 400 M4A1 tanks to North Africa for use by the British 8th Army where the Sherman tank would see its combat debut at the Battle of El Alamein. Marshall directed these tanks to the British because it was easier just to send the tanks to Africa than to prepare and deploy the entire 2nd Armored Division to Egypt. The M4s left the U.S. in late July and arrived in late September. Both the 1st and 2nd Armored Divisions would slowly accept and integrate the M4s into their divisions as they became available.[22]

The chaotic and erratic distribution of the M4s to the American Armored Divisions was also evident in the experience of the 4th Armored Division. When the division moved in February 1941 to Camp Bowie in Brownwood, Texas, it had very little of its authorized equipment: no medium tanks and twenty of 273 light tanks (one per company). The 4th received its first medium tanks, fifty M3s, in October 1941 and did not reach its full complement of 232 medium tanks until August 1942. Based on production schedules, the 4th Armored Division was to receive its first M4A1s in the summer of 1942, but they never arrived. Instead, the division received hands-on training with the Sherman while at the Desert Training Center (DTC) in California from November 1942

[20] Adams, 66-68; James Scott Wheeler, *Jacob L. Devers: A General's Life* (Lexington: University Press Kentucky, 2015), 166.

[21] Adams, 68-69.

[22] Zaloga and Sarson, 20.

to June 1943. However, Shermans remained in short supply and both the 4th and 5th Armored Divisions painted the letter “M” on M3 light tanks to substitute for the scarce M4s. The tankers of the 4th Armored Division regarded the M4A1s as a significant improvement over the M3, especially the extra armor on the front glacis and the 360-degree turret with the 75-mm gun.[23]

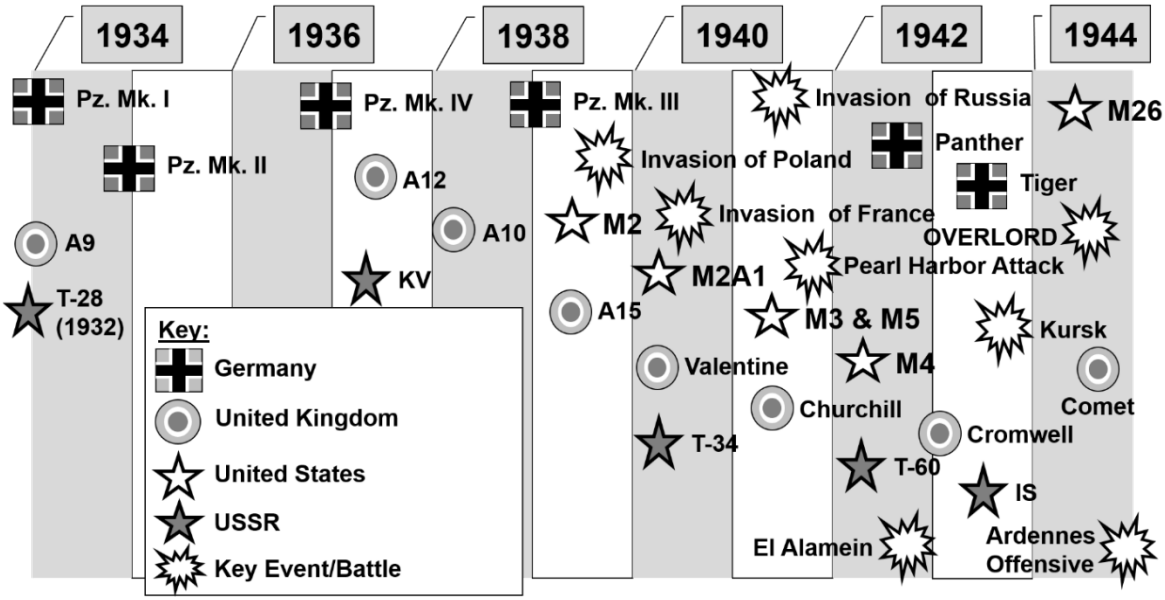
When the division returned to Camp Bowie in June 1943, it left behind all its equipment and was to receive a full complement of new M4A1 Shermans when it arrived back in Texas. The division started receiving Shermans in July, including the newest model, the M4A3. By September 1943, when the division underwent a reorganization, it had 54 M4A3s and 178 M4A1s. The M4A3 was the first version of the Sherman equipped with the new Ford V8 engine, giving it 450-horsepower and a speed of 21 to 36 mph. This version soon became the preferred version of the Sherman, and the Army Ground Forces recommended supplying the M4A3s to units in the field or those designated for overseas movement. While a logical decision, it proved impracticable, even in 1943 at the peak of Sherman production, because production was shut down for five months when manufacturing was shifted from a Ford factory to Fisher Body and Chrysler. Because of this, when the 4th Armored Division prepared for deployment to England in December 1943, it still only had 54 M4A3s.[24]

The development and distribution of the M4 to armored units was an accelerated and uneven process driven by the necessities of war and the personalities of commanders. Throughout the 1920s and 1930s, tank modernization lagged due to budget shortfalls and uncertainty over the role and place of the tank within the Army. Only because of the looming threat of war was tank modernization accelerated, though design and production initially centered on light tanks based on the tentative doctrines while medium tanks were produced in fewer numbers. The drive towards developing and establishing the M4 Sherman as the main battle tank of the Army during the war only occurred once Devers assumed command of the Armored Force. With his artillery background and prudent analysis of battlefield reports, he pushed and accelerated the modernization and development of the M4. Nevertheless, even as the M4 entered into production, the low number of tanks and the needs of American allies ensured that distribution to American armored divisions was chaotic and uneven. While many armored units obtained sufficient numbers of M4s by 1944, all units relied on an assortment of medium and light tanks on the battlefield.

[23] Freiwald, 148-150.
[24] Freiwald, 150-154.

Tank Developments in World War II[25]

Figure 1- Tank Developments in World War II



Training: Learning Armor and Tanks from the M2 to the M4

In November 1940, the first classes started arriving at the Armored Force School in Fort Knox, but without a cadre of training officers, an ad hoc training program developed whereby the 1st and 2nd Armored Divisions instructed the incoming Soldiers and provided the nuclei for the Replacement and Training Center, as well as for the 3rd and 4th Armored Divisions. Like the 1st and 2nd Divisions, the 3rd and 4th were then cannibalized to form new divisions. For example, in early 1942, the 4th Armored Division supplied 1,100 personnel to the 5th Armored Division and months later provided 2,900 officers and Soldiers for the 8th and 9th Armored Divisions. In the first class of 1941, some 200 officers and 2,000 enlisted men received instruction, and the first three months of 1941 emphasized five objectives in training:

1. Training of the regiment, brigade, and division in preparation for spring maneuvers.
2. Training in the functioning of headquarters of all echelons.
3. Coordinated action of all components.
4. Coordinated action with other troops with particular attention to supporting combat aviation.
5. Training selectees.

For the second quarter of 1941, this training was supplemented by directives emphasizing combat firing, service practice, combat intelligence, camouflage, field

[25] SPR, PQC, Oct 2020.

maintenance, supply, and evacuation. Other course areas included tanks, wheeled vehicles, motorcycles, communications, tactics, gunnery, field engineering, and clerical. Due to a lack of building space, the Armored Force School operated in two shifts.[26]

For training, the new Armored Force relied on improvisation to create a new doctrine for the new armored divisions before the arrival of the first recruits. Officers in the 1st and 2nd Armored Divisions relied on numerous sources to establish basic principles, including extracts from existing field manuals, training memorandums, and senior leader briefings. This mix, however, reflected divergent ideas that were not universally accepted. For example, the Infantry leadership of the 2nd Armored Division refused to apply extracts from a Mechanized Cavalry field manual without extensive changes. To aid development, the War Department issued Training Circular No. 4, which defined the armored division as "a self-sustaining unit of specially equipped elements of the combined arms and services. It has great offensive power and mobility but only a limited and temporary capacity for the defense." Thus, according to the War Department, the division's primary purpose lay in attacking the enemy's rear areas or open flanks. In these operations, tanks would provide the central offensive force while aircraft would support its forward movement and motorized infantry or cavalry would consolidate its successes.[27]

By January 1941, a tentative field manual, FM 100-5 (Tentative), for the armored division had emerged and stressed the offensive nature of the formation. Principal missions included seizing critical objectives, enveloping enemy forces, exploiting breakthroughs, and pursing the enemy. With these missions, an armored division's efforts centered on the enemy rear where it would work to spread destruction, create confusion, and demoralize enemy forces. This emphasis derived from analysis of German combat operations and from Mechanized Cavalry officers who believed that the mechanized arm could do more than simply assist the advance of friendly forces. To facilitate and train for rapid, coordinated action by armored units, the Armored Force developed a "play" system with standard procedures. Units learned a series of tactical movements and firing patterns that helped to train new Armored Force personnel unfamiliar with mechanized combat units. This concept was supported by Marshall: "I have held the view for some time that if we trained our tactical units more as football teams, with plays which can be called by signals rather than detailed and voluminous orders, that we can expedite entry into action tremendously."[28]

Field exercises also made up an important aspect of unit training, but they underscored the training challenge facing the Armored Force. When attacking, tanks failed to coordinate their efforts and instead raced toward their objectives, treating phase lines as finish lines. Armored units also proved incapable of mounting effective counterattacks against hostile mechanized forces. Reconnaissance tended to focus on

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[26] Cameron, 261; Freiwald, 187; Historical Section, Army Ground Forces, "The Armored Force Command and Center, Study No. 27," 50-51.

[27] Cameron, 270.

[28] Cameron, 270-271; Field Manual (FM) 100–5 (Tentative), "The Armored Division," 24 Jan 41, Alvan C. Gillem Jr. Papers, Box 4, USAHEC Archives.

near objectives rather than the distant reconnoitering needed for rapid, long-distance movements by the armored divisions. Armored training also stressed envelopment by large tank masses. Single and double envelopments were especially encouraged in tactical exercises and demonstrations. In fact, at this time, basic tactical principles for armored operations called for the establishment of a base of fire while a second force performed a flanking maneuver to destroy the enemy or cause its retreat. Although a simple concept, it was especially suitable for teaching new personnel and ensured uniformity of doctrine with the other combat arms.[29]

In the summer of 1941, as the 1st and 2nd Armored Divisions started preparing for a series of training maneuvers in Tennessee, Louisiana, and the Carolinas, new armored divisions were just starting to train. The 4th Armored Division, initially located at Camp Pine (now Fort Drum), New York, accepted new recruits directly from receptions centers because the Army lacked the space to put all new recruits through a standard Basic Training. By receiving men without any training, a majority of the men trained together from induction to deployment. The initial training period lasted 13 weeks and included four phases. The first phase included drilling, map reading, firing and repairing weapons, and vehicle driving and maintenance, a format that integrated basic and technical training from the outset. The second phase focused on small unit training from the crew to the company and concentrated on specific subjects for each branch: tankers, artillerymen, and reconnaissance units worked on driving, maintenance, and firing; infantry stressed marksmanship; and engineers practiced building, repairing, and reinforcing bridges. However, the lack of equipment made tank training especially difficult and some units practiced tank maneuvers by moving men around on foot in crew-sized groups on the parade grounds or used jeeps as replacements. The third phase centered on combined training in hypothetical combat situations along with some war-gaming to teach tactics and communications. The fourth phase focused on battalion level exercises, but alack of vehicles and other equipment left the 4th holding marches, overnight bivouacs, and platoon level exercises. By the end of September 1941, the division had completed basic training, but without combined arms training.[30]

While the 4th Armored Division improvised through its initial training, the 1st and 2nd took part in three large training maneuvers supervised by McNair. They involved over 740,000 Soldiers from the Regular Army and National Guard. The magnitude of these maneuvers mandated extraordinary preparations, including leasing vast tracts of land and securing trespassing rights. For the first time the Army would use large-scale training areas free from the constraints of private property restrictions that had kept prior maneuvers road bound. To further enhance realism, the army commanders were free to conduct operations as they desired without mandatory interruptions.

After the 1st and 2nd Armored Divisions made their debuts at the Tennessee maneuvers, where both divisions received high praise, they participated in the Louisiana phase of the maneuvers, which had the Second Army facing off against the Third Army.

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[29] Cameron, 276-277; Brief Summaries on Armored Regiments, 4 April 1941. Gillem Papers, Box 3, USAHEC Archives.

[30] Freiwald, 165-180.

The Second Army controlled the I Armored Corps, which was made up of the 1st and 2nd Armored Divisions. The Third Army met this armored attack with three newly formed GHQ antitank groups. One of the major insights from this exercise was that the performance of the GHQ antitank units seemed to offer a solution to the problem of stopping tanks; however, the rules of the maneuvers favored antitank guns and reinforced McNair's biases. Two months later, in the final phase of the GHQ maneuvers in the Carolinas, the IV Corps, which included the I Armored Corps, fought the First Army. The First Army commanded the three GHQ antitank groups from the Louisiana exercises and three more created for the third phase. The main question tested at the Carolina maneuvers centered on the struggle between tanks and antitank units and included 865 tanks and armored cars, against 764 mobile antitank guns and 3,557 other pieces of artillery. The strengthened antitank units confronting the I Armored Corps stymied the striking echelons of the armored divisions. Infantry and tanks were supposed to demonstrate greater coordination, but that was not very apparent. Whenever tank regiments attacked without infantry and artillery support, they suffered heavy losses from the antitank guns based on the umpires' rulings.[31]

Shortly after the conclusion of the Carolina maneuvers, Imperial Japan launched a surprise attack on the U.S. at Pearl Harbor and accelerated America's entry into the war. With the U.S. entering the war, the Armored Force quickly expanded and altered its training. In fact, the speed at which the U.S. entered the war resulted in the 1st Armored Division being sent to Fort Dix shortly after the Carolina maneuvers. From there, the division went to Northern Ireland and Northern England for training in the summer and autumn of 1942 before deploying to the North African Theater in November 1942. Once in Africa, the 1st started receiving new equipment in theater, and the Soldiers had little time to familiarize themselves with the new tanks. The division's early deployment also insured it would miss out on much of the innovation and reorganization going on back in the U.S. Although learning under fire, their experiences would influence other training and modernization efforts.[32]

The constant activation of new units kept Armored Force training focused on basic training, small-unit training, and physical conditioning throughout 1942. Small unit training emphasized tactics to correct deficiencies identified during maneuvers. Yet, the new divisions were still expected to achieve a base level of combat readiness within three months of formation. Adherence to this timeline proved difficult, especially after the Armored Force began to channel selective servicemen directly into armored organizations without prior basic training. Like the experience with the 4th Armored Division, this provided a steady flow of new Soldiers, but it also meant that new formations included inexperienced personnel unfamiliar with military life or armored operations.[33]

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[31] Adams, 78-79; Cameron, 277, 326, 343-344; Christopher R. Gabel, *The U.S. Army GHQ Maneuvers of 1941* (Washington, DC: Center of Military History, 1992); Johnson, 150.

[32] LTC Steve E. Dietrich, "In-Theater Armored Force Modernization," *The Military Review* (October 1993): 36; George F. Howe, *The Battle History of the 1st Armored Division* (Washington, DC: Combat Forces Press, 1954), 7.

[33] Cameron, 365.

The process of creating new formations also started changing in the spring of 1942. Rather than cannibalizing units to start new divisions, the 8th Armored Division was activated at Fort Knox to specifically serve as a training unit. It relieved existing formations of training responsibilities and left them free to focus on combat readiness. After completing its own training, the 8th Armored Division prepared cadres for the 9th through 14th Armored Divisions between June 1942 and January 1943. Afterward, the 8th Armored Division transitioned to a combat organization, and cadre preparation became the responsibility of the 20th Armored Division in March 1943, which trained new units and replacements until Army Ground Forces directed it to train as a combat division in July 1943.[34]

Instruction also became more systematic with specialized instructors teaching selected topics. One example involved a “golf course” program to simultaneously train newly formed companies. It included eighteen different tactical problems that addressed the various skills associated with armored company operations. The golf course permitted eighteen tank companies, or two armored regiments, to train simultaneously. Upon completion of each problem, the companies rotated. The success of this method led to its adoption throughout the Armored Force.[35]

New training also emphasized greater realism by including simulated combat sounds and the creation of environments that more closely resembled a battlefield with its related physical and psychological stresses. Early in 1942, the 2nd Armored Division began to apply training techniques adapted from British commando training that emphasized close-combat skills for the individual Soldier. The Armored Force School then adopted this training approach. By January 1943, the school began training for urban combat and attacks on fortified positions. The following month armored battalion training cycles ended with a period of operations under simulated battlefield conditions. For armored divisions the training program lengthened to thirty-eight weeks in which the final eleven consisted of training exercises involving the entire formation. Afterward, it participated in corps maneuvers.[36]

When the first M4A1 Shermans started coming off the production line in 1942, Devers designed a training and drill memorandum for the new tank. All crews went through a fundamental training regime that included learning formations, radio communication, mounting, dismounting, escaping, dismounted fighting, mounted fighting, and basic maintenance. This all occurred in a 26-week training period with 8 different sessions that went from basic training to tactical training to advanced training, though those who had already completed basic training would have a shortened training period of 13-weeks. This 13-week period for the Sherman typically included formation and specificity training such as battalion and regimental tactics as well as quartermaster, medical, machine gunner, and engineering training. Once through this

[34] Historical Section, Army Ground Forces, “The Armored Force Command and Center, Study No. 27,” 51.

[35] Cameron, 367.

[36] Cameron, 367.

training period, divisions would be prepared for advanced maneuvers and deployment.[37]

The 4th Armored Division would undertake this training with the M4 as well as with the M5 light tank and the M6 tank destroyer during their stay at the DTC from November 1942 to June 1943. During the first four weeks at the DTC, the 4th reviewed crew training and gunnery with the new equipment; the second week involved units learning how to operate the tanks; the third week consisted of preliminary gunnery practice, or dry shooting; and the fourth week started live firing drills that would carry over into three additional weeks that reinforced battalion and combat firing exercises. These typically involved a heavy-tank force (tank battalion, infantry company, artillery battery, and engineer company) attacking a position fortified with antitank guns and minefields.[38]

In January 1943, the 4th started training tankers to fire the main gun of the M4 and then held live fire tank-vs-tank training that involved firing the .30 caliber machine gun at opposing tanks. Once hit, tanks were to cease-fire and raise a yellow flag. These exercises started with tank-vs-tank duels, shifted to platoon-vs-platoon fights, and ended with company-vs-company interactions. These live fire training exercises allowed unit commanders to evaluate subordinates and commanders to better grasp tactics and unit control while tankers experienced being under fire: the sights, sounds, and smells of a tank in battle. Following this month of training, the 4th participated in maneuvers with the IV Corps then under MG Walton H. Walker. The three weeks of maneuvers were to replicate combat realism as closely as possible and included the construction and destruction of obstacles, the use of pyrotechnic explosions, tear gas, smoke pots, and lime bombs.[39]

Following these months of field exercises, the 4th spent March conducting combat command firing exercises and April on a specific training aimed at preparing to fight the Japanese. This exercise had the 4th Armored Division travel north and seize and hold the TWA Airport and the Boulder Dam outside of Boulder, Nevada. The last major event at the DTC for the division involved a series of tests to determine the best-trained platoons in the division: light tank, medium tank, artillery, assault gun, reconnaissance, and 81-mm mortar. The exercise included attacking a target through firing and moving so that umpires could grade the rapidity and effectiveness of the fire delivered. During the last month, the division spent two weeks on individual and small unit training in tactics, gunnery, and marksmanship before preparing to return to Texas. The 4th Armored Division experienced some of the last large-scale training maneuvers in preparation for battle. Soon after they completed their training, the requirement to send more service support units overseas forced the Army Ground Forces to start shrinking and eliminating maneuver areas and maneuver training.[40]

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[37] Training Memorandum 33 for the Medium Tank Crew (M4 Series), 30 September 1942, Thomas J. Camp Papers, Box 4, USAHEC Archives.

[38] Freiwald, 215-218.

[39] Freiwald, 219-229.

[40] Freiwald, 230-237.

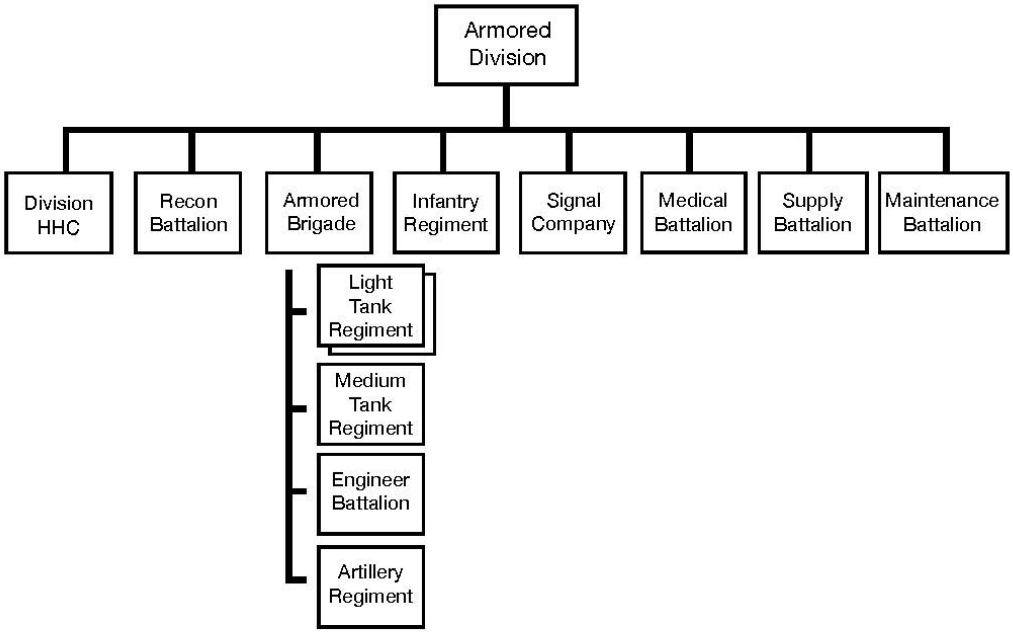
Following these large-scale training maneuvers, the 4th Armored Division returned to Texas and worked on gunnery, small unit tactics, and incorporating lessoned learned from North Africa, Sicily, and Italy, including night fighting training, small unit tactics, attacking to disable German tanks, and courses centered on infiltration and urban combat in a Nazi village. In September, the 4th participated in the Individual Training Program tests prepared by the Army Ground Forces to certify the division for overseas deployment. However, the 4th, like the majority of Armored Divisions, underwent a divisional reorganization (see below) in September 1943 that hindered it during the evaluation, as 300 artillerymen suddenly became infantrymen and tankers were tested on specialty skills with other newly modernized systems like mortars, bazookas, and antitank guns. While not performing admirably, and tested by officers inexperienced with armor, all of the 4th Armored Division battalions eventually passed.[41]

Following more combined arms training in November, the 4th spent December 1943 preparing for overseas movement. The division left the U.S. on 29 December and arrived twelve days later in England, where the unit continually trained until arriving in France on 11 July 1944. That training, however, proved challenging. Commanders competed for the limited training areas in England; only two tank divisions had adequate time on firing ranges and in multi-echelon maneuvers; and some divisions did not fire weapons on new tanks until they arrived in France. Additionally, as new tanks arrived in theater, they arrived with more than 500 items of equipment such as machineguns, radios, tools, and gun sights coated in rust preventative compounds. To process and prepare the thousands of M4s required about 50 working hours each by ordnance personnel, including the unpacking, cleaning, installing, and testing of all accessories.[42]

[41] Freiwald, 238-257.
[42] Dietrich, 38.

Organization: The Structure of the Armored Division, 1940-1944

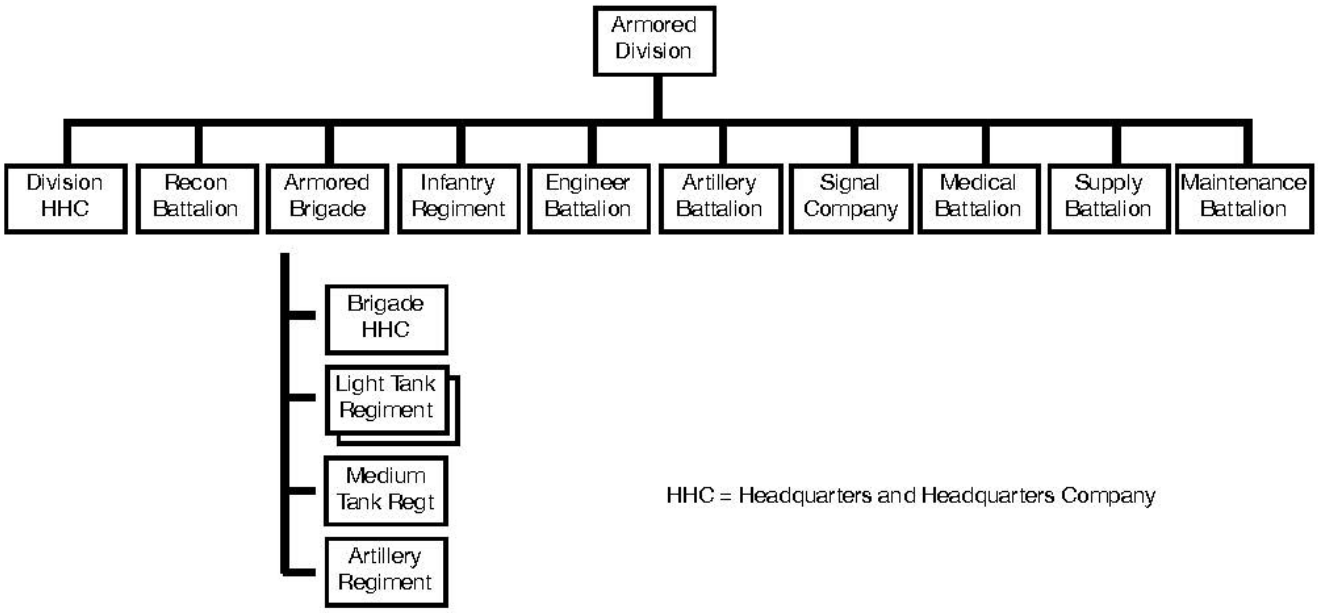
Figure 2- Armored Division, July 1940



In November 1940, three months after its founding, the Armored Force reorganized the armored division. The division's offensive force lay in its armored brigade, which included two light and one medium tank regiments. The light regiments bore the brunt of offensive operations, according to the War Department's draft *Armored Force Field Manual*: "Due to its organization and equipment, [it] is the most mobile, self-contained combat element of the armored division. . . . Its main role, as part of the armored brigade, is to furnish the striking power necessary for the conduct of highly mobile ground warfare against strategical or tactical objectives deep in the hostile rear." The medium-tank regiment reinforced the light regiments as necessary, but the medium units could not be employed independently because they lacked reconnaissance and support elements.[43]

[43] Cameron, 283.

Figure 3--Armored Division, November 1940



The medium tanks did, however, possess heavier armor and firepower. They were intended to provide additional firepower to light-tank units confronting enemy mechanization or antitank weapons. They also performed the role of artillery when required. The other divisional components supported the armored brigade. The reconnaissance battalion operated in advance of the armored division, scouting enemy positions and road conditions. Engineers assisted the tank advance either by eliminating obstacles or through mobility assistance, particularly bridge construction. Artillery provided smokescreens and general fire support, while the infantry disrupted enemy defenses prior to a tank attack and secured captured objectives afterward.[44]

As training, doctrine, and technology were undergoing development during the Armored Forces first months, Chaffee proposed the creation of the II Armored Corps to incorporate the 3rd and 4th Armored Divisions in October 1940. These divisions were scheduled for activation in 1941. War Department guidance emphasized the importance of employing armored formations as a “decisive mass.” Therefore, Chaffee sought to create a permanent organization to function in the same manner as a German Panzer Corps. He intended corps assets to include military police, signal, artillery, medical, ordnance, quartermaster, antiaircraft, antitank, engineer, and air units. All of these units were to be organized and trained by the Armored Force.[45]

[44] Cameron, 283-284.
[45] Cameron, 286.

In the War Department, these discussion about a corps organization led to debate over whether the Armored Force should become a permanent, legally constituted branch of the Army, but the idea found only limited support. For Chaffee, the legal status was a secondary concern to the Armored Force's effectiveness. He did not want the chief of the Armored Force to be reduced to an adviser like the traditional branch chiefs. Instead, he wanted the Armored Force to become a separate field force that controlled multiple armored divisions grouped into corps. In this arrangement, the chief of the Armored Force would possess his own staff and preside over the doctrinal, organizational, training, and materiel development of armored formations. In effect, the Armored Force chief would merge the functions of a combat arms branch chief and senior field commander. This command structure served to build "an armored army capable of being employed in whole or in part as the Germans have organized and used it."[46]

Chaffee's views were not widely accepted within the War Department, and he thus focused his energy on overcoming opposition to the armored corps and developing a sound organization for this formation. The demonstrated success of the German Panzer Corps justified this emphasis, but he did not believe such a formation could be improvised on short notice. On paper, the I Armored Corps included a corps headquarters and the 1st and 2nd Armored Divisions, but it possessed none of the signal and support assets considered necessary for the control of mobile formations and its headquarters personnel also served as the Armored Force staff. Nevertheless, the Armored Force leadership failed to secure the support of the War Department to develop the I Armored Corps into an effective tactical command. Deputy Chief of Staff MG William Bryden considered armored corps unnecessary and opposed plans to create them. He thus eliminated the II Armored Corps from the Army's 1942 expansion plans.[47]

Initially, Marshall reinforced his deputy's stand by deferring indefinitely the activation of any additional armored corps and placing organization and training of the 3rd and 4th Armored Divisions under General Headquarters. However, Chaffee personally intervened with Marshall to revoke these instructions. Instead, the War Department directed the creation of an Armored Force staff, which retained responsibility for organizing and training the 3rd and 4th Armored Divisions. However, these formations were to be established as separate divisions. Activation of a second armored corps was not authorized.[48]

Although the future of the armored corps was uncertain, the armored division remained central to the Armored Force and the Army, but the organization of the division remained a work in progress throughout 1942. In late 1941, Devers, seeking to facilitate the integration of tactical functions, experimented with reorganizing the divisional structure with the 4th Armored Division. The division transformed its brigade headquarters into two command agencies known as combat commands. The backbone

[46] Cameron, 287.
[47] Cameron, 288.
[48] Cameron, 288.

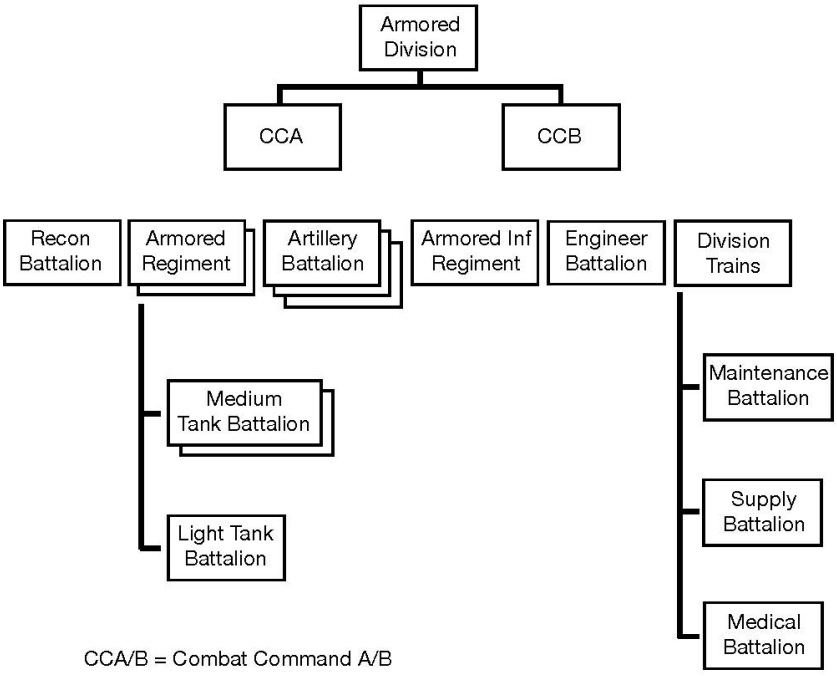
of each combat command included a tank regiment supplemented with infantry, artillery, engineer, and reconnaissance elements. The division commander, who maintained a small reserve force, could assign additional signal, service, and reconnaissance units. The other armored divisions soon began to follow the pattern established by the 4th Armored Division and fashioned their own combat commands. The precise configuration of each combat command varied, but each generally included a combined-arms mix organized around a tank regiment.[49]

Within this structure, the combat commands acted as subordinate headquarters. From the assets assigned to them, they fashioned smaller combined-arms task forces. Typically, each task force included a tank battalion reinforced with combat and service elements. The division commander assigned missions to each combat command. They then determined the composition, objective, and operational boundaries of their task forces. Successful accomplishment of the combat command's objective rested on the collective efforts of the independently operating task forces. Task force commanders were thus expected to exercise initiative and determine how best to employ the units assigned to them.[50]

Seeing great potential in this structure, Devers issued a new table of organization in March 1942. The Armored Division now included a division headquarters; two combat commands; two armored regiments; an armored infantry regiment; three artillery battalions; and reconnaissance, engineers, and support services. Its structure reflected Devers's guidance regarding increased combined-arms teams, which eventually became central to Armored Force doctrine.[51]

[49] Cameron, 372-375.
[50] Cameron, 375.
[51] Cameron, 373-375.

Figure 4- Armored Division, 1942



This emerging command structure pushed decision-making responsibility down to task force commanders. These task force commanders needed to possess an understanding of combined arms operations and to manage continuous task force reconfiguration to exploit tactical opportunities and to utilize the formation's tactical flexibility. However, in 1942, most armored officers had not yet reached this level of professional development. At both the combat command and task force levels, too many leaders preferred functional separation in lieu of combined-arms teams. A common organizational recommendation separated tanks and their supporting infantry and artillery into different combat commands, a practice abandoned by the Germans in 1940.[52]

Although experimenting with the divisional command structure continued, much was unresolved, and a push to further reduce the size of the division came from the Army Ground Forces in late 1942. Marshall initiated this effort in October when he demanded a 15 percent reduction in personnel and 20 percent in vehicles because the size of the divisions stressed shipping facilities. Part of his justification rested on the interpretation that the divisional tables reflected what divisional commanders asked for rather than what they needed. To accomplish this objective, Marshall placed McNair in charge of a Reduction Board to review all units under his control. In regards to armored

[52] Cameron, 375-376.

divisions, McNair desired leaner formations that were more easily controlled by a corps headquarters and the elimination of components that could be temporarily attached from higher commands as needed.[53]

Devers initially opposed McNair's reduction efforts, and he succeeded in delaying any downsizing of the armored division until after the campaign in North Africa, seeking to use this experience to influence any changes. While conceding to the delay, the debate continued behind the scenes over the reorganization. Both McNair and Devers wanted to increase the ratio of infantry to tanks, but disagreed over what this should look like. McNair preferred following the Germans by reducing the armored division's tank strength and providing it more riflemen. Devers wanted to expand the motorized divisions, designed to be grouped with armored divisions in armored corps. However, the demise of the armored corps also eliminated support for the motorized division.[54]

Once combat operations ended in North Africa, McNair remained determined to downsize the armored division, and Devers organized a separate board of officers convened in the North African Theater of Operations to address the armored division's organization. These officers identified several flaws that would influence their recommendations. During the fighting, the Germans' successful employment of antitank guns and mines led Army leaders to recognize that tanks would frequently have to be escorted by foot troops sent ahead to locate and destroy antitank defenses. It was also recognized that the armored division required more infantry in proportion to tanks and would usually operate in closer proximity to infantry divisions than had been supposed.[55]

Although delayed for several months, new tables on the structure of the armored division were published in September 1943. In this new organization, the regimental echelon in the armored division was abolished, and the battalion became the basic unit. The division received organically three battalions of tanks, three of armored infantry, and three of armored field artillery. Infantry strength in proportion to tanks was thereby doubled. At the same time separate tank battalions, separate armored infantry battalions, and separate armored field artillery battalions were set up in non-divisional pools. These battalions were made identical with the corresponding battalions organic in the armored division. The chain of command in the restructured divisions led from the division headquarters to the combat commands to battalions parceled out among task forces. Three Combat Commands existed: A, B, and R. The last had a skeleton staff intended to control only those forces not assigned to Combat Command A or B. In effect, the armored division now included a collection of battalions that could be attached to combat commands to suit changing tactical situations.[56]

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[53] Cameron, 376; John B. Wilson, *Maneuver and Firepower: The Evolution of Divisions and Separate Brigades* (Washington, DC: Center of Military History, 1998), 180.

[54] Cameron, 376-377.

[55] Cameron, 382-383.

[56] Cameron, 383-384.

Figure 5-Armored Division, 1943

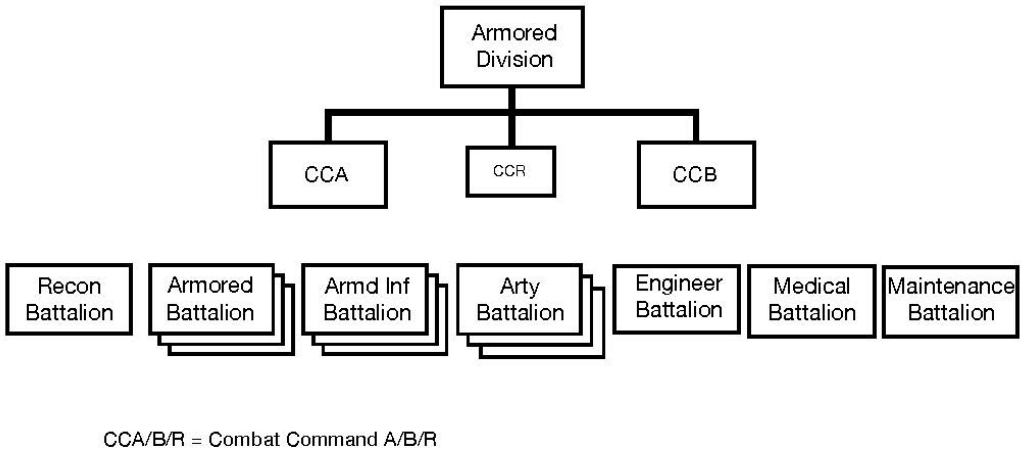
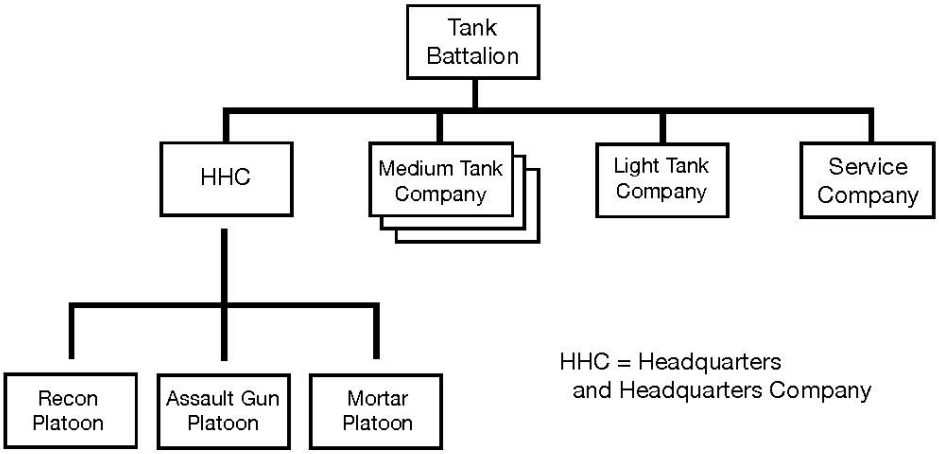


Figure 6- Armored Tank Battalion, 1943



The majority of units underwent this reorganization in late 1943 or early 1944, but the 1st Armored Division, the division whose combat experience most influenced the

change in division structure, did not undergo reorganization until July 1944 because the unit was in constant combat. After pulling out of the line on 12 July for rest and rehabilitation after reaching the Arno River, the unit was officially reorganized on 20 July and then completed range and small unit training, which included using new equipment, including the M4A3 tank and self-propelled 105mm howitzers mounted on medium tank chassis. Three days after the reorganization, the 1st Armored Division was attached to the IV Corps and much of the division returned to the frontlines between 30 July and 13 August in preparation for the assault against the Gothic Line. This combat-experienced division was expected to incorporate the new modernization much faster than newly organized units, with just a very short drop in readiness. It is unclear whether that assumption was correct or not. Although the reorganization created a more flexible division and provided more infantry, the 1st, like the V Army as a whole, struggled to make progress in the mountains of central Italy, with the defeat of the Gothic Line not coming until the winter of 1944.[57]

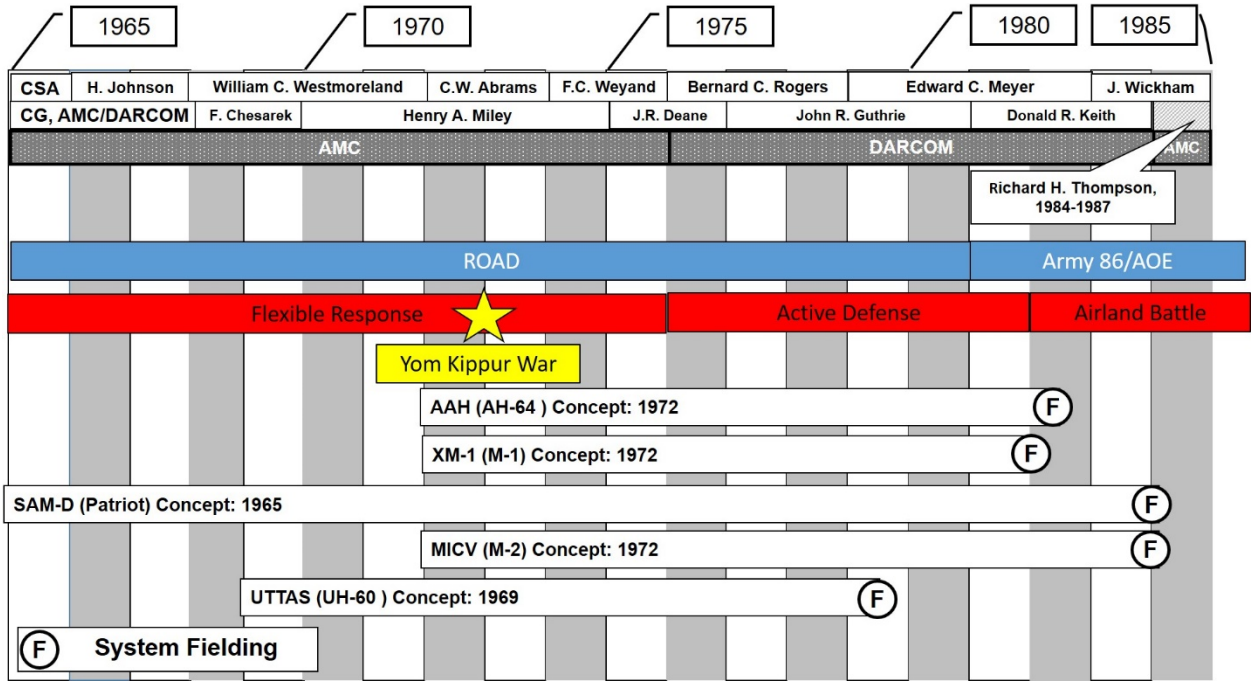
[57] Curry N. Vaughn, "Mud, Mountains, and Armor: The 1st Armored Division from Rome to the Alps," Armor School 1949, 71-75.

Modernization for the 1980s

The modernization processes of the 1980s were different from those of 40 years before, but did have some similarities. Army leaders still had the same three levers to control budget dollars: organizational structure, modernization, and readiness. The Army leadership during the 1970s dealt with shrinking budgets, diminishing end strength, and societal malaise in the wake of an unpopular war…as had their predecessors during the 1930s. And like their predecessors in the 1940s, Army leaders such as GEN William Depuy, GEN Donn A. Starry, and others worked to build an entirely new Army for the 1980s—but this time it was an All Volunteer Force built on the corpse of an organization ruined by Vietnam. They reorganized training, redesigned the Army's weapons systems, and reconceptualized the doctrine to take advantage of the powerful new Army they had created. Unlike their predecessors, this new generation of Army leaders did not have to develop and field new equipment under the pressure of total war, but they did face a very real and defined major enemy threat which made managing the three levers challenging. They also did eventually see their efforts validated in combat.

The Army's "Big 5" is often cited as the exemplar of successful Army modernization, and a template for future modernization plans. The "Big 5," however—the M1 Abrams, M 2/3 Bradley, AH-64 Apache, UH-60 Blackhawk, and PATRIOT—was not actually a synchronized effort at modernization. Modernization occurs deliberately, and achieving readiness requires careful planning, coordination, and adaptation at many levels. Their development and fielding spanned the mid-1960s to mid-1980s. Specifically, concept dates ranged from 1965 to 1972 and fielding dates from 1979 to 1984 (see Fig. 1). While four of the Big 5 took eight to eleven years from concept to fielding, the PATRIOT Air Defense Missile System was the most stubborn, taking nearly twenty years (1965-1984) and bookending the Big 5 as the first in concept and the last in fielding.

Figure 7-Big 5 Development



1980s Army Doctrine

The initial weapons system development preceded that of Airland Battle doctrine. Flaws in Active Defense doctrine made Airland Battle necessary, but the Big 5 made it possible.

The Big 5 weapons systems were developed independently from Army doctrine. Their concepts were perfected in the lean times after Vietnam, but came to fruition under the defense buildup of the Jimmy Carter and Ronald Reagan presidential administrations. When DePuy became the first commander of Training and Doctrine Command (TRADOC) in 1973, he began work on a new warfighting doctrine that would be termed Active Defense. Thus, the 1976 FM 100-5, *Operations*, built heavily on perceived lessons of the lethality of the 1973 Arab-Israeli War, and emphasized fighting with an elastic defense and winning the first battle with adept application of fires. The manual caused so much consternation within the Army, that when Starry took over TRADOC, he led the development of the new, offense-oriented AirLand Battle doctrine that first appeared in the 1982 version of FM 100-5. Starry and the new doctrine also contributed to the organizational shift from the 1960s Reorganization Objective Army Division (oriented to President John F. Kennedy's Flexible Response) to Division 86, which contained new heavy divisions.

However, all those doctrinal changes were disconnected from the development of the weapons systems that would execute them. The Big 5 would eventually be incorporated into the new concepts and enable them, but they were not developed as an integrated system, nor were they shaped by doctrinal requirements. Their existence

proved fortuitous, and again the Army relied on agile adaptation to fit them into the force.

Reorganization Objectives, Army Divisions (ROAD)

After a brief flirtation with a "pentomic" division structure consisting of five "battle groups" designed to make the division more survivable on a nuclear battlefield, the Army returned to the familiar triangular arrangement in the form of the Reorganization Objectives, Army Divisions, or ROAD formation. The ROAD concept built on the World War II armored division combat commands: the three highly flexible brigade headquarters had no organic subordinate battalions, but would coordinate the actions of maneuver battalions and other support units. Combat maneuver battalions were nearly identical tactically, and administratively self-sufficient. The brigade was intended to function solely as a tactical headquarters, controlling two to five maneuver battalions. The different types of ROAD divisions used varied battalion mixes, with each type having about 15,000 soldiers (see Table 1).

Table 1 - ROAD Divisions Force Structure: Combat Battalions[58]

Infantry	**Armor**	**Mechanized**
8 infantry	6 armor	7 mechanized
2 armor	5 mechanized	3 armor
3 artillery (105 mm)(T) 3x6	3 artillery (105 mm)(SP) 3x6	3 artillery (105 mm)(SP) 3x6
1 artillery (155mm/8") (T)	1 artillery (155mm/8")(SP)	1 artillery (155mm/8")(SP)
1 Rocket (Honest John)	1 Rocket (Honest John)	1 Rocket (Honest John)
Strength: 15,000	**Strength: 15,000**	**Strength: 15,000**

Division 86

The threat posed by Eastern Bloc armored and mechanized forces served as the focal point for Army reformation efforts (i.e., doctrine, force structure, modernization) following the Vietnam War. Senior Army leaders recognized that the Army required reconfiguration from its Vietnam-era ROAD structure to an armor-heavy design that accommodated modernized weapons systems undergoing development and testing. Army Training and Doctrine Command (TRADOC) conducted several studies, and in 1979, Army Chief of Staff of the Army GEN Edward C. Meyer approved a new concept known as Division 86.

The Division 86 reforms established a 16,800 troop armored division containing six armor and four mechanized infantry battalions and a 17,000 Soldier mechanized infantry division that included an even split of five tank and five infantry battalions. The conversion of the Army in the field from the ROAD organizations of the 1960s ("H" series Modification Table of Organization and Equipment [MTOE]), to the Army 86 (interim and final "J" series) was altered in 1983 by the Army of Excellence designs. The

[58] Richard W. Kedzior, *Evolution and Endurance: The US Army Division in the Twentieth Century* (Santa Monica, CA: Rand, 2000), 39-30.

new “J” series (MTOE) for Division 86 made many changes, but all at battalion level or below. The number of tanks and tank companies increased, and cavalry units were reorganized with new missions. [59]

Fire support included three 155mm self-propelled howitzer battalions, an 8-inch battalion, and a battery of nine multiple-launch rocket systems (MLRS) (see Table 2). Converting the entire force to the Division 86 structure would require 836,000 personnel positions, but in the early 1980s the force size was limited to 780,000. By 1983, a series of global events illustrated the requirement for lighter, more rapidly deployable forces and the Division 86 program became incorporated in the Army of Excellence (AOE) concept. [60]

[59] Karl E. Cocke, *Department of the Army Historical Summary: Fiscal Year 1985* (Washington: Government Printing Office, 1995), 61.

[60] John B. Wilson, *Maneuver and Firepower: The Evolution of Divisions and Separate Brigades* (Washington: Government Printing Office, 1995), 386.

Table 2 - Division 86 Force Structure: Combat Battalions[61]

Division 86 Armored Division	Division 86 Mechanized Division
6 armor	5 armor
4 mechanized	5 mechanized
3 artillery (155mm) (SP) 3x8 guns	3 artillery (155mm) (SP) 3x8 guns
1 artillery (8"/MLRS)	1 artillery (8"/MLRS)
1 air cavalry brigade	1 air cavalry brigade
Strength: 19,900	**Strength: 20,200**

In 1979, the Soviet invasion of Afghanistan and the Iranian Hostage Crisis drove the Army to re-look the force structure again. Army Chief of Staff GEN Edward C. Meyer directed studies on "light" forces—smaller and with less equipment than an armored division—capable of swiftly responding to a range of global crises. Subsequent events, including the British invasion of the Falkland Islands in 1982 and Operation URGENT FURY in Grenada the following year, reinforced the need for forces capable of conducting a broad range of missions anywhere that U.S. national interests were threatened.

Army of Excellence

GEN John A. Wickham Jr., who succeeded Meyer as CSA in 1983, continued force structure studies into more rapidly deployable divisions. The concept of the AOE was a balance of the heavy (armored and mechanized) divisions serving as a deterrent to the Soviet forces based in Eastern Europe and smaller, more agile "light" divisions designed to deploy and protect U.S. national interests around the globe. These new "light" divisions were limited to 10,000 troops and were required to deploy the entire division to anywhere in the world within four days using Air Force (USAF) strategic lift (limited to 550 C-141 sorties). In order to create the light infantry division, Wickham restructured the heavy divisions and used Reserve Component (RC) brigades to "roundout" designated Regular Army divisions. [62]

The Army divisions were already converting to the Division 86 design when the reorganization began in 1983. Some of the ROAD-structured Army heavy divisions that had not yet shifted to Division 86 then began to convert to the AOE design. Because the transitions depended upon the delivery of new equipment, it was often haphazard in the early years. The Army prioritized the most critical forward force: U.S. Army, Europe (USAREUR). The TOEs for the heavy division were completed and approved by the Department of the Army in 1986 and were implemented in October of that year.[63]

[61] John L. Romjue, *The Army of Excellence: The Development of the 1980s Army* (Washington: Center of Military History, 1997), 10.

[62] Wilson, 393.

[63] Romjue, 89-90.

Table 3 - AOE Force Structure: Combat Battalions[64]

AOE Armored Division	AOE Mechanized Division	AOE Light Division
5 armor	4 armor	N/A
4 mechanized	5 mechanized	9 infantry
3 artillery (155mm) (SP) 3x8 guns	3 artillery (155mm) (SP) 3x8 guns	3 artillery (105)(T) 3x6 guns
1 artillery (8"/MLRS)	1 artillery (8"/MLRS)	N/A
1 air cavalry brigade	1 air cavalry brigade	1 air cavalry brigade
Strength: 16,900	Strength: 17,200	Strength: 10,000

The only Regular Army infantry division that received an exception to the AOE conversion process was the Korean-based 2nd Infantry Division (2ID). The "Indianhead" Division's unique mission warranted a hybrid force structure. This design included two armor and two mechanized infantry battalions alongside two infantry, air assault battalions. The division finished converting to the AOE design in 1990. In August 1990, the AOE received its first test when the redesigned 82nd Airborne Division arrived in Saudi Arabia following the Iraqi invasion of Kuwait. [65]

Fielding the Big 5

The fielding of the Big 5 in the 1980s provides both a model and a cautionary tale for future modernization. Then, as now, modernization was inextricably linked to readiness. There is more to force modernization than simply buying new equipment. The fielding of the Big 5 was a complicated procedure that included several different, related processes. The Army planned for divisions to be in a transitional status for many years, with units having a mixture of new and old technology within their organizations. Rather than thinking of the Big 5 as upgrades in weapon systems, it is perhaps better and more productive to think of the Big 5 in terms of a different "Big 5"—of five missions required for modernization. Those missions include reorganization, re-manning, reequipping and redistribution, retraining, and readiness.

[64] Romjue, 45-46, 49, 90.
[65] Wilson, 401.

Reorganize

The new AOE organizational designs introduced comprehensive changes throughout the Army's Tables of Organization and Equipment (TOEs). At the same time, rapid development of the interim and final tables of the AOE was a pressing necessity. TOEs were often developed late by TRADOC. The AOE heavy division base TOEs had not yet been published by the spring of 1984, even though implementation was due to start in the fall. This affected the development of other documentation as well. For example, USAREUR received the M1 Tank Basis of Issue Plan (BOIP) eighteen months before fielding, but the MTOE was not finalized until three weeks out. Late development of this documentation and short-fuse schedule changes had negative effects on Soldier utilization, housing decisions, and family support.[66]

In 1984, Army Vice Chief of Staff GEN Max Thurman introduced a plan to provide more timely documents to the field. The new document would be called the "living TOE," or LTOE, which started with a base TOE for an organization in its least modernized form. Combat developers then added mission-significant equipment to form incremental change packages (ICP). The ICPs then formed the intermediate LTOEs, until the objective TOEs were approved. "L" replaced the "J" of new TOE editions and the "H" of old ones. The Army contracted with the Allen Corporation of America for commercial preparation of sixty-five draft company-size LTOEs. After these were approved by TRADOC, the contract was extended to cover subsequent AOE “L” TOEs. The contract included "Commanders' TOE Handbooks," which provided commanders an "audit trail" of the force modernization changes from base level to fully modernized. Objective TOEs were published in 1984 for the light infantry division and for the heavy divisions, separate heavy brigade, and M1 tank brigade, and unit conversions began the same year. Development of the remaining LTOEs for the rest of the Army was completed in 1988. [67]

The magnitude of the effort necessary to field the Big 5 required a large modernization infrastructure. Divisions and installations required a robust force modernization staff to coordinate the process. The units being modernized required external support, and New Equipment Training Teams (NETT) were necessary to assist with the transition. The division and corps G-3s built large Force Modernization Offices to coordinate the myriad activities required, and TRADOC and Army Material Command (AMC) fielded the NETTs which deployed to installations to field the new equipment.[68]

As the fielding progressed, it became important to move quickly to the interim or objective unit design. Starry initially faced some opposition to altering the units moving to the Division 86 structure. He believed that units, including test units, must transition to the new organization before beginning new equipment training in order to maximize the capabilities of the new organizations and weapons system. He insisted that the M1 test units be organized “with four tanks in a platoon, three platoons in a company, four

[66] Donald G. Hall and James V. Wells, “Force Structure – ALO,” USAWC Military Studies Program (Carlisle, PA: US Army War College, 1984), 40.

[67] Romjue, 106-107.

[68] Hall and Wells, 40.

companies in a battalion, and a battalion base with a configuration designed to support that line organization and to implement new concepts and accept some new equipment we have or soon will have in our tank battalion."[69]

Modernization, especially involving the reorganization of units, inevitably causes personnel friction. The rush to field new systems without synchronizing manpower requirements obscured the added personnel requirements, especially in support units. A GAO report in 1985 determined that the Army still lacked an overall plan for correcting the problems related to manpower, personnel, and training (MPT) that had existed as early as 1980. Management of the M1 fielding was not integrated with management of the personnel functions. The problem was so prevalent that the first M1 trained tankers sent as replacements for those initially trained in Europe were provided despite the absence of the appropriate personnel authorizations. Each of these assignments required offline actions to force the system to get the right personnel in place. Other personnel problems surfaced as well: [70]

- M1 Maintenance: Training programs for maintenance personnel were not developed before the tank was fielded.
- Black Hawk Maintenance: Personnel requirements were underestimated. The Army needed to launch new recruitment initiatives to obtain the needed personnel after the system was fielded.
- Multiple Launch Rocket System (MLRS): Launcher/loader crew skill requirements were not properly analyzed. The required skill levels or and the consequences for lowering them were not clearly understood.[71]
- TACFIRE: The new field artillery fire control system encountered shortages of both operators and repairmen when it was fielded. A ten month delay in fielding of the TACFIRE system resulted in seventeen systems trained NCOs being malassigned in USAREUR and reduced their in-theater retainability after TACFIRE finally arrived. [72]
- M1: Tank schedule slippage required that forty-five NCOs be deferred. [73]
- Signal systems: Certain fixed signal communications equipment was installed without personnel authorizations for operators, and VINSON secure voice

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[69] Message, GEN Starry, CG, TRADOC, to GEN Meyer, CSA, et al, 25 SEP 1979, Subject: Organization of Test Unit For OT-III XM1.

[70] Hall and Wells, 1; GAO, *Report To The Secretary Of The Army The Army Can Better Integrate Manpower, Personnel, And Training Into The Weapon Systems Acquisition Process*, GAO/NSIAD-85-154, (Washington, D.C: United States General Accounting Office, Sep. 1985), 1-2; John L. McGillen, "Force Modernization: Systems or Hardware?" Student Research Project (Carlisle, PA: US Army War College, 1983), 7.

[71] GAO, *Report To The Secretary Of The Army The Army Can Better Integrate Manpower, Personnel, And Training Into The Weapon Systems Acquisition Process*, GAO/NSIAD-85-154, (Washington, D.C: United States General Accounting Office, Sep. 1985), App. I, 1-2, 5-6.

[72] McGillen, 7; Hall and Wells, 39.

[73] Hall and Wells, 39.

equipment was initially fielded without authorizations for maintenance personnel.

- Firefinder Radar: Initial requirements (FY82) to train 120 operators were developed within the life cycle management model when the actual training need was for 216.[74]

[74] McGillen, 7.

Re-Manning

All Army units experienced the same general manpower hardships associated with modernization, but the effects in USAREUR were greatly exacerbated due to troop stationing and end strength restrictions in the 1980s. The USAREUR specific environment, with its dispersed troop stationing throughout many communities, in densely populated areas, with the accompanying security requirements consumed approximately 1.5 percent of the command's present for duty strength. Permanent change of station (PCS) constraints were especially costly for accompanied personnel. For instance, Soldiers/families could not be ordered from Frankfurt to Stuttgart to meet an urgent requirement due to funding restrictions and morale implications, as could be done at CONUS posts These limitations also precluded moving a service member (and family) during the last 12 months of their tour, a constraint that did not exist in CONUS because no PCS funds were involved and there was no limiting factor of a Date of Effective Return from Overseas (DEROS).[75]

The changes due to Division 86 and AOE structures reduced the number of support personnel both within maneuver units and in support units to the point that Table of Distribution and Allowances (TDA) augmentation was recommended to ensure normal missions and responsibilities could be resourced. One example was the planned elimination of cooks from the structure to accommodate "Unit Pack" feeding. When the Army realized the tray pack still required cooks, it was difficult to determine where and how to re-insert the cooks.[76]

Because of its mission, USAREUR was required to maintain a high state of combat readiness at all times, and did not have the option of shutting down many units simultaneously. This forced a certain amount of redundancy between old and new equipment during the fielding process. Increases in personnel to support this redundancy came out of hide, because strength ceilings reduced the ability to surge to meet additional demand. New systems fielding plans sometimes do not identify all ancillary equipment, and shortfalls often must be made up creatively. The Pershing II fielding, for example, required some items to be removed from POMCUS to make up shortfalls.[77]

[75] Hall and Wells, 21, 30, 42.
[76] Hall and Wells, 33, 40.
[77] Hall and Wells, 40-41.

Re-Equip and Redistribute

The most visible symbol of the new modernization was the M1 Main Battle Tank. It would revolutionize tactics and drive the development of the next version of Army doctrine: Airland Battle. It could maneuver on the battlefield about three times faster than the M-60, and would expand commanders' decision-making time. It gave commanders the capability to mass forces rapidly at the critical point. As part of the M1 development, the Army chose to field the initial version with the 105 mm main gun in order to get them in the field, but continued testing on other howitzer main guns to determine that appropriate substitute. Eventually, a German-designed 120 mm smoothbore cannon was selected as the main gun. The new M1E1 (later M1A1) then replaced the M1. This process will be explained in more detail later.

In order to fully outfit the units, each battalion needed to be isolated for at least 90 days in order to conduct new equipment fielding and training. In Germany, units moved by battalion from their home stations to Vilseck Training Area to receive the new equipment. New equipment fielding brought often overwhelming requirements, such as:

- Processing old equipment for turn-in while processing new equipment for issue.
- Increasing new supply and maintenance functions and workloads necessary to support the new system--often larger requirements than the old system.
- Conversion or re-training of personnel to meet the MOS or equipment specific demands of the new system.[78]

Additionally, at unit level, new equipment transition required a tremendous increase in the number of man hours worked to ready displaced equipment, associated material, and supplies for turn in before the new equipment arrived. When the new equipment, materiel and supplies were received, personnel had to accomplish the necessary maintenance and operational training before the unit could be readied for possible combat operations.[79]

A focus on just the maneuver unit, however, camouflaged the larger mission in the support units. The armor or infantry unit, for instance, went through the preparation/turn-in/issue/preparation cycle only once, for a period of about 12 weeks. The support units, however, faced the same cycle repetitively with both old and new equipment moving through their facility (and from different units) until all supported units had completed the transition. This included adjustment of Authorized Stockage Lists (ASL) to fit the new support requirements. A support unit might therefore spend a year or more supporting modernization.[80]

The reductions in personnel and additional workload caused by modernization also increased the load on the staff at all levels. New weapons systems required new training facilities, adjusting General Defense Plans to take advantage of new capabilities, integrating new doctrine (or assisting in the development of new doctrine),

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[79] Hall and Wells, 31.
[80] Hall and Wells, 32.

obtaining personnel replacements, and receiving updated publications, in addition to many other missions.[81]

The redistribution of old equipment involved bringing it up to “-10/-20” standards—fully mission capable—and then either turning it in or cross-leveling it to another unit (shifting equipment to another unit based on priorities). Units often “rolled down” old equipment to units with even older equipment. For instance, M60A3s were rolled down to units that still had M60A1s.Higher priority units that received upgraded systems passed their replaced equipment to lower priority organizations. When the M1A1 replaced the M1, the first units that had received the new tanks passed their M1 tanks to units still equipped with the M60A3. Pre-positioned Material Configured to Unit Sets (POMCUS) contained four heavy divisions’ worth of equipment, and this equipment also needed to be modernized as well.

Although the “Big Five” serve as the symbols of Army modernization efforts in the 1980s, the force underwent a more holistic transformation. The Army fielded more than twenty-five other support or related systems or upgrades at the same time (see Fig. 3). Modernization includes many other “sunk” or hidden costs besides the major weapons systems. These can include numerous support systems, special tools, repair parts, and special equipment such as Unit Conduct of Fire Trainer (UCOFT), ranges, Simplified Test Equipment/M1 (STE/M1), Thermal System Test Set (TSTS), Direct Support Electrical System Test Set (DSESTS), etc.

[81] Hall and Wells, 33.

Figure 8-Major New Tactical Systems Affecting the Division

Armor
- *M1 Abrams* Main Battle Tank

Cavalry
- *M3* Cavalry Fighting Vehicle

Infantry
- *M2* Infantry Fighting Vehicle
- *M961* Improved TOW Vehicle

Artillery
- *M270* Multiple Launch Rocket System
- *AN/GSG-10* Tactical Fire Direction System
- *AN/GYK-29* Battery Computer System
- *YMQM-25 Aquila* Remotely-Piloted Vehicle

Aviation
- *AH64* Advanced Attack Helicopter
- *AH1S Cobra* (fully modern.)
- *UH60 Blackhawk* Utility Helicopter
- *CH47D Chinook*
- *OH58D Kiowa (AHIP)*

Engineer
- *M9* Armored Combat Earthmover (ACE)

Air Defense
- *M247 SGT York* Division Air Defense Gun
- *MIM48* Improved Chapparal Air Defense Missile
- FIM92 *Stinger* Manportable Air Defense System

Signal
- *AN/TTC-1* Automatic Telephone Central

Intelligence
- *EH-1H/EH-60 Quickfix* ECM Aircraft *Trailblazer* and *Teampack* Intercept and Direction Finding Systems
- *ASAS* (All Source Analysis System)

Common Items
- *TSEC/KY-57,58 Vinson* Speech Security Equipment
- *M977* Heavy Expanded Mobility Tactical Truck (HEMMT)
- *M939* Series 5-ton Trucks

Source: John D. Borgman and Alexander F. Wojcicki, "The Challenge of Force Modernization" *Armor,* September-October 1983 (Fort Knox: US Army Armor Center, 1983), 32.

New fires, transportation, and communication systems, among others, went from drawing boards and designers to motor pools and end users, thanks in large part to increased defense budgets. In one five-year period between 1979 and 1984, the Army's budget increased by more than $27 billion, from $34.1 billion to $61.5 billion.[82]

To avoid piecemealing new equipment to units and making it harder to maintain readiness, the Army used a concept called Total Package Unit Material Fielding (TPUMF), later shortened to TPF, designed to ensure that the unit received a complete package of the equipment, tools, Authorized Stockage Lists (ASL), Prescribed Load

[82] Conrad C. Crane, Michael E. Lynch, Jessica J. Sheets, Shane P. Reilly, Evan Adams, and Sophia Nee, *Passing the Colors: Leadership Transitions of the Army Chiefs of Staff* (Carlisle: Army Heritage and Education Center, 2019), 27.

Lists (PLL), the Direct Support Electrical System Test Sets (DSESTS), and other critical sets, kits, and outfits. In practice these components were sometimes lacking, and this affected unit readiness almost immediately.

The Multiple Launch Rocket System (MLRS) provided a single, self-propelled, indirect fire system capable of placing a heavy volume of conventional munitions on a large area. Other new field artillery innovations incorporated new fire-finder systems including the AN/TPQ-36 (artillery locator) and the AN/TPQ-37 (mortar fire locator).[83]

The Army also modernized its truck fleet, shifting from the Vietnam-era vehicles to new tactical truck models. These included the M923 (5-ton cargo) and M931 (tractor). Other initial vehicles included the Commercial Utility Cargo Vehicle (CUCV), the Heavy Expanded Mobility Tactical Truck (HEMMT), and the versatile, High-Mobility Multi-Wheeled Vehicle (HMMWV). Additional resources were also used to introduce new communication systems.[84]

These advancements ranged from the joint, strategic-level to tactical units in the field. The Joint Surveillance and Target Attack Radar System (J-STARS)—an airborne battlefield tracking system—evolved during the 1980s and underwent full-scale development in FY87. The joint Air Force (USAF) and Army product became operational in 1991. Tactical units also received new communications equipment. The Single-Channel Ground Air Radio System (SINGCARS), under development during most of the 1980s, was fielded in 1988. SINGCARS permitted users to pre-load multiple frequencies into the radio and communicate across a secure network. [85]

[83]Mary Ellen Condon-Rall, *Department of the Army Historical Summary: Fiscal Year* 1983 (Washington: Government Printing Office, 1990), 161, 170.

[84] Condon-Rall, 165.

[85] William Joe Webb, *Department of the Army Historical Summary: Fiscal Year 1988* (Washington: Government Printing Office, 1993), 63.

Equipping Case Study: Operation Desert Shield

In 1990, the M1 series Abrams tank had entered its 11th production year, and the fleet included five different models:

- **M1** - The original M1 that appeared in 1980 had a 105 mm main gun, gas particulate filter unit, and special armor.
- **IPM1** - The improved performance M1 (IPM1), introduced in 1984, provided increased armor protection.
- **M1A1** - The M1A1 offered significant improvements, including the new 120 mm smoothbore cannon that provided pinpoint accuracy at longer ranges, enhanced armor, and a hybrid nuclear, biological, and chemical overpressure system that pumped in clear air while a microclimatic system provided cool air.
- **M1A1HA** - In 1988, the M1A1 Heavy Armor (HA) increased armor protection more than 70%, almost guaranteeing crew survival against any known enemy round.
- **M1A1 Common** - The M1A1 Common was an M1A1 HA modified for use by the Marine Corps.

As Army units prepared for deployment to Saudi Arabia for Operation DESERT SHIELD in 1990, Army leaders determined that the M1A1HA was the only version superior to Iraqi tanks. However, by 1990, the earliest M1A1s were rapidly becoming obsolete and because tanks in the field had not always been retrofitted with the latest modifications, differences existed between the same model-year tanks. Army Chief of Staff GEN Carl E. Vuono ordered that all units be issued the M1A1HA or receive additional armor plating. Many of the changes required modifications to tools, diagnostic equipment, spares, and repair parts issued to units. Given the urgency of pending combat operations, the Army decided to modernize and exchange tanks in-theater. To achieve this objective, AMC began moving 865 tanks stored in Pre-positioning of Material Configured to Unit Sets (POMCUS) in Europe to Saudi Arabia in October 1990.[86]

AMC established operations at the port of Ad Damman, Saudi Arabia. COL David O. Bird (Chief, European Fielding Team, Armored Systems Modernization) built an extended fielding team of 622 people that included former New Equipment Transition (NET) team members that had trained Europe based units on the M1A1 tank, members of Material Fielding Teams at Fort Carson, the Tank-Automotive Command (TACOM), and the M1 Abrams Program Manager's office. The POMCUS tanks, because they were manufactured over a span of six years, had not all been fitted with the same modifications. Moreover, many of them had been used during REFORGER exercises or had been exchanged by units for M1A1HA tanks. All of these tanks thus required significant maintenance and repair work that differed from tank to tank.[87]

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[86] LTC Steve E. Dietrich, "In-Theater Armored Force Modernization" *The Military Review* (October 1993): 40-41.

[87] Dietrich, 41-42.

To organize the process, the team inspected the tanks, separated them by year, and determined which modifications were necessary for each one. Next, the depot personnel applied up to five modifications for each tank, including new armored plates, new engines and heat shields, a check valve in the fire extinguisher, hundreds of new and updated optical systems, and painting for desert operations. The mechanics then made sure the vehicles were operational before assisting manufacturer's representatives inspected the completed vehicles. Finally, TACOM quality assurance inspectors did a final check. Following this process, the vehicle was turned over to the Materiel Fielding Team to prepare for issuance to the gaining unit. The initial production goal of eight tanks per day was raised to twelve, but the average was about 20 tanks per day. Between November 1990 and the start of ground operations on 24 February 1991, 1,200 M1A1 and M1A1HA tanks were modified, repaired, and issued through the M1A1 rollover program.[88]

While praised by commanders, the M1A1 rollover program was perplexing and highly improvised. It required meticulous and exhaustive control measures, taxed the flexibility and endurance of all team members, took three months to conceive and plan, and four months to execute in-theater. Like previous experiences in the 20th century, the Army went to war with tank units that were not prepared or equipped to dominate the battlefield. Although the Army had sought to learn from previous experiences and developed procedures to rapidly modernize in theater, the Gulf War rollover demonstrates that no matter how well prepared or conceived, modernization and the associated upgrading of weapons systems is a timely, complicated, labor intensive process.

[88] Dietrich, 41-44.

Retraining

This is the part of the transition that rightfully received the most focus. When fielding the M1 and the rest of the Big 5, units planned on at least 90 days of training on the new equipment. The M1 required not only individual training on how to use, maintain, and fight the weapon system, but newly organized units needed time to develop and practice new tactics.

The new weapons systems offered significant advantages over those they replaced. The M1 especially offered speed and stability firing that was well ahead of its predecessor M60A3. The Commandant of the US Army Armor School warned:

> Commanders must train crews to operate at higher speeds. This does not mean we can now become careless with their soldiers safety training, and simply means we must plan training more thoroughly and innovate ways to train our crews to operate the M1 at their full potential . . . units must be trained to take advantage of these capabilities or the M1 will perform only marginally better than M60 series tank. . . . Commanders must be thoroughly trained in the M1 and its capabilities and ensure their crews are trained employ the M1 to its full potential.[89]

The training process involved the use of new training aids, ranges, and simulators such as the unit conduct of fire trainer (UCOFT). Modernization also did not synchronize the need for training aids well. For instance, development of the Black Hawk Flight Simulator was poorly managed (e.g., changes in the Black Hawk's design specifications were not considered), which slowed down their production. This resulted in only one flight simulator being available after one third of the planned number of helicopters had been delivered. This adversely affected training.[90]

Re-training also includes support personnel and mechanics, and possibly even creating new MOSs. In the case of the PATRIOT, the Army Air Defense Artillery School established a certification program for each complement of Soldiers and equipment following the 16 weeks of collective training required of all newly activated PATRIOT battalions. The unit then deployed to its station, where AMC fielded the entire set of equipment. By the end of 1986, the Army had fielded seven battalions in USAREUR and three battalions in FORSCOM.[91]

Uneven modernization across the force caused a mobility differential in units that included both modernized and legacy equipment. The reorganization of units and fielding of new equipment took time, and commanders of transitioning organizations employed a mix of high and low-technology equipment. M1 tanks, M113 personnel

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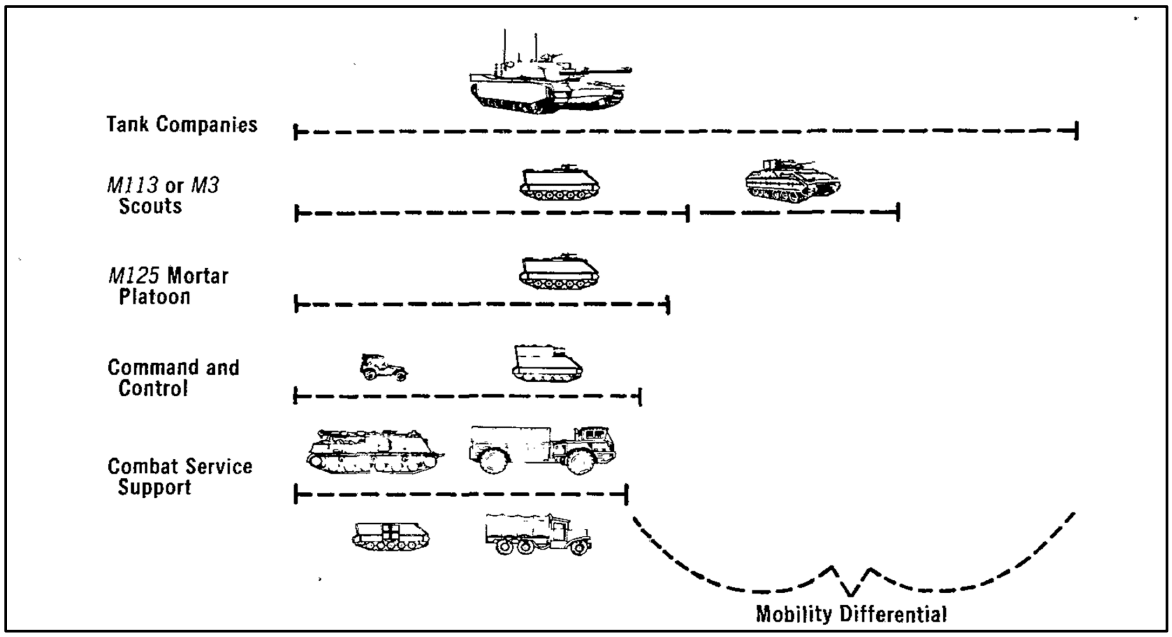
[89] MG Louis C. Wagner, Jr., “Commanders Hatch: M1 Unit Commanders Face Challenges,” *Armor,* September- October, 1982, 5- 6.

[90] GAO, *Report To The Secretary Of The Army The Army Can Better Integrate Manpower, Personnel, And Training Into The Weapon Systems Acquisition Process*, GAO/NSIAD-85-154, (Washington, DC: United States General Accounting Office, Sep. 1985), 1-2.

[91] Gregory A. Rountree, “PATRIOT Fielding: Successful as a Function of Integrated Logistics Support (ILS),” USAWC Military Studies Program (Carlisle, PA: US Army War College, 1990), 2-5.

carriers, Vulcan air defense systems, and M109-series artillery all had different mobility characteristics. Figure 4 shows aspects of the M1 mobility differential that needed to be considered, and required significant operational adjustments by units.

Figure 9-Mobility Differential[92]



The commander of 2-5 CAV, the first battalion to field the M1 laid out some of the problems the M1 created:

> From the logistical side of the house, however, we have some bugs to work out. It uses a lot of fuel, and its cross-country and highway speed stretches our tail a long way. . . . Turning to the combined arms aspect of combat operations, we come up with another need. The mechanized infantry's M113 armored personnel carriers cannot keep up with the M1. We have to come up with something to get the infantry and cavalry out there. For example, during the long road marches, we used our scout platoon more for traffic control than anything else, and we had to send them out as much as 2 hours ahead of time just to keep the tanks from running over them. We know that the armor-protected rearm, resupply, and refuel vehicles are being developed, but the question is, “When are we going to get them?”[93]

The M1’s greater speed and firing stability also required longer and deeper ranges, as well as adjusted tactics. A Master Gunner from the 2-5 CAV, the first unit to field the M1, reported:

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[92] Lawrence M. Jackson II, "Force Modernization: Doctrine, Organization, and Equipment" *Military Review*, December 1982 (Fort Leavenworth: Army University Press, 1982), 10.

[93] Royce R. Taylor, “The Best Tank Ever Built,” *Armor*, Jan-Feb 1982, 34.

[93] Hall and Wells, 40.

> The fire control has to be one of the most outstanding things about the tank. Firing in the stabilized mode is great. When we went down range last week on a daylight run, the number of first round hits we scored would sure ruin the other fellows day -in fact he wouldn't have a day at all. . . . It's a lot better tank than the M-60. It has a lot of modern features that the M-60 doesn't have that make the tanker's work a lot easier maintenance-wise. And I love the way it shoots.[94]

Training facility development to support the new weapons systems presented another problem. Military Construction, Army (MCA) projects were nearly impossible to synchronize with force modernization changes, resulting in suboptimal stationing for some units. The definition of training system support requirements came so late in an already long fielding weapons systems development cycle that construction of new ranges lagged behind. For example, existing tank ranges developed based on the capabilities of the M48 and M60 tanks were completely inadequate for the M1. There were initially no tank ranges in CONUS or USAREUR suitable for the M1, as its greater speed allowed it to overrun many of the targets on existing ranges before being able to engage them. The M2/3 Bradley presented an even more difficult problem, as it mounted crew served weapons requiring gunnery tables similar to tank gunnery tables. This adds a new crew qualification requirement to units that had none previously, and doubled or tripled the range usage.[95]

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[94] Taylor, 33.

[95] Condon-Rall, 165. Donald B. Skipper, “Armor Gunnery Ranges,” *Armor*, September- October, 1982, 42- 43.

Readiness and Capability

The Army's modernization efforts have never proceeded at a smooth pace, even during deliberate fielding processes such as the Big 5. The modernization process forces units to distinguish between *readiness*, the state of the unit's authorized equipment, personnel, and training, and *capability,* the unit's potential to execute its mission using assigned equipment and personnel. Maintaining readiness and capability while modernizing presented a special challenge for units in Europe facing the Warsaw Pact. In the 1980s, units in Germany and Korea stood on the frontlines of the Cold War, facing a very real and clearly defined enemy. [96]

The constant ebb and flow of materials as various units reorganized and re-outfitted themselves caused havoc with the readiness reporting system. The conversion to the AOE structure required moving many slots from support units to combat units, and the resulting loss of capability in the support units required reduction in their Authorized Level of Organization (ALO). This caused an imbalance between readiness and capability. For instance, in a snapshot taken in 1984, most VII Corps maneuver units, combat support elements, headquarters, and support units were at ALO 1 and therefore both ready and capable. Over 50 percent of 21st Support Command reporting units, however, were below their ALO 2. So while the units reported adequate readiness based on their assigned ALO, that same ALO also limited their capability. Thus overall USAREUR readiness differed from USAREUR capability.[97]

Moreover, early versions of AR 220-1, *Unit Status Reporting,* did not account for the difference between readiness and capability. With no distinction between readiness and capability, the unit status report (USR) was assumed to reflect the full capability of a unit to carry out its mission. In order to measure and communicate the increased capabilities resulting from all the changes, the Army developed the Measuring Improved Capability of Army Forces (MICAF) report. The initial study concluded that the Army's twenty-four divisions increased their war-fighting capability by 18 percent from fiscal year 1980 to fiscal year 1984.[98]

The MICAF, which remained in effect through the end of the decade, temporarily fixed the readiness/capability imbalance, but deeper problems remained as the difference between readiness and capability blurred further. The GAO discovered a problem with readiness reporting in 1991 based on the previous three years of data. The M1 Abrams operational readiness data from 1986-1989 indicated that the fleet-wide readiness rates exceeded the Army's mission-capable goal of 90 percent in 10 of the 12 quarters reported. The readiness reporting procedures however, used exceptions that allowed non-mission capable (NMC) tanks to be reported as fully mission capable (FMC), which skewed the data:

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[96] John D. Borgman and Alexander F. Wojcicki, "The Challenge of Force Modernization," *Armor, Sept-Oct. 1983, 30.*

[97] Hall and Wells, 29.

[98] William Donnelly, *Army Readiness Reporting Systems, 1945-2003* (Washington: Center of Military History, 2018), 118-123.

- *Daily Snapshot:* Tank readiness was determined once a day. As long as a tank was FMC at the time operational readiness is determined, it was considered mission capable the whole day.
- *Grace Period 1*: The unit was not required to classify the tank NMC if the problem could be repaired within 24 hours. Most maintenance problems were corrected by removing and replacing modular components. As a result, only four maintenance actions required more than 24 hours to complete.
- *Grace Period 2*: A unit could classify the tank as mission capable even though the problem was not corrected within 24 hours. For example, a semiannual maintenance included removing and disassembling the engine and transmission to replace the seals. This maintenance took about 5 days; but tanks undergoing this procedure were considered mission capable while their engines and transmissions were disassembled because the tank could be put back into operation within 24 hours.
- *Controlled Exchange*: A unit with two tanks non-mission capable for different reasons could use “controlled exchange” to take parts from one tank to make the other one mission capable.
- *Operational Readiness Float (ORF*): A tank requiring extensive repairs could be traded for another tank in good condition: the support battalion maintained “float” tanks, which were not included in the readiness rates. If a unit had a tank requiring extensive repairs outside the unit’s motor pool, the unit could trade the defective tank for one of the division’s float tanks. The tank undergoing repair then became one of the division’s float tanks and was not counted against unit readiness rates, but the support battalion was still required to repair them and maintain them.[99]

The MICAF was a temporary fix until most of the Big 5 systems were fully fielded, and reduced the distinctions between readiness and capability. Those distinctions returned after the Army began to adjust missions and field new equipment during the wars in Afghanistan and Iraq. A RAND study of the Army's readiness reporting system in 2013 determined:

- The reporting system does not communicate the extent of a unit’s “drift” from their design and appears to exacerbate a lack of appreciation within the Army for just how much units may have changed with respect to readiness and capabilities.

[99] GAO Report to the Chairman, Committee on Armed Services, US House of Representatives, Abrams Tank: Operating Costs More Than Expected GAO/NSIAD-91-114 (Washington: US General Accounting Office), 7-8.

- The audience for readiness reporting may have an inaccurate understanding of what Army units are ready to do and capable of doing, for three reasons:
    - Overuse of the term “full-spectrum operations (FSO)” – a vague term that lacks metrics.
    - The readiness system does not require great precision.
    - Lack of appreciation within the Army for the difference between particular bands of capabilities.
- The reporting system is not adapted optimally for the Army Force Generation (ARFORGEN) cycle.[100]

In summary, while modernization increases capabilities, it might also temporarily degrade readiness, a factor that must be dealt with in reporting systems. If there are problems with that process before modernization hits its full stride, they will be exacerbated without adjustments.

[100] Christopher G. Pernin, Dwayne M. Butler, Louay Constant, Lily Geyer, Duncan Long, Dan Madden, John E. Peters, James D. Powers, Michael Shurkin, Readiness Reporting for an Adaptive Army (Santa Monica, CA: RAND Corp., 2013), xiv.

Key Insights

- **Modernization cannot truly begin to any great degree without Congressional funding, though it can continue when budgets decline.** The 1920s and 1930s saw little development in armor technology, doctrine, or training, but the Infantry and Cavalry were operating under tight budgets and diverting their funding to higher order concerns. Tanks and combat cars did receive some funding, but not nearly enough to sustain large-scale research and development. Only with the increased funding of the late 1930s and the flood of money in the early 1940s did armor technology, doctrine, and training accelerate. A similar process happened during the 1980s. However, even after the Carter-Reagan defense buildup came to an end, modernization continued with many system upgrades of platforms already fielded.

- **Modernization requires investment in headquarters and installation infrastructure.** Weapon systems created in the 1980s were so far advanced over their predecessors that existing infrastructure was inadequate to support them. Planning for this kind of support needs to be synchronized with weapon system development. The planning and execution of the fielding process is complex and labor intensive. The constant pressure to reduce headquarters over the last several years has eliminated much of the overhead that would be necessary to provide slots for force modernization staffs. The creation of a mass Army for World War II also created significant demands for new headquarters and facilities, because of the scale of change as well as the quality.

- **Modernization includes significant support requirements for major systems.** Similarly to the M1 Abrams rollover before the start of the Gulf War, the arrival of M4s in-theater during World War II required a major effort to prepare them for the battlefield. M4s arrived with more than 500 items of equipment such as machineguns, radios, tools, and gun sights coated in rust preventative compounds. To process and prepare the thousands of M4s required about 50 working hours by ordnance personnel, including the unpacking, cleaning, installing, and testing of all accessories. M1s and other new systems also required a great deal of test equipment that complicated fielding. Deployment plans often did not give enough consideration to the demands on maintainers and sustainers of major systems.

- **Key support requirements include multidisciplinary New Equipment Training Teams representing AMC, TRADOC, and other agencies to field complete systems.** The Big 5 modernizations used Total Package Fielding (TPF) to issue entire systems to include the weapons system, all sets, kits, outfits, special tools, repair parts, and manuals. Specialized multiagency teams were required to supervise the process. This included fielding completed in Saudi Arabia on the eve of Operation Desert Storm, which differed greatly from

the fielding of new equipment in theaters during World War II. Those systems were less sophisticated and required the gaining unit to provide the bulk of support.

- **Modernization inevitably causes personnel friction as units reorganize.** New equipment may require new MOSs as well as new structures. The rush to field new systems in the 1980s before synchronizing manpower requirements in all affected units obscured the added personnel needed, especially in support units. The support units often became overloaded as they processed in new equipment while processing out old equipment. Scheduled personnel rotations saw new or untrained personnel arriving while experienced personnel departed. This was a problem both in the 1940s and 1980s. The shift of personnel and cadres between divisions preparing for World War II did help provide a trained core for new divisions, but considerably delayed the deployment of the losing units.

- **Training, doctrine, and modernization usually develop at the same time and thus inform one another.** In WWII, tank crew training changed and evolved as their equipment changed, switching quickly from obsolete light M2s, to the M3s, to the M4 within one year, though some of the first armored units did not even have any tanks for training. As the tanks quickly modernized, doctrine also changed and was influenced by observations of European battlefields, especially regarding the use of tank destroyers and the actual role of the tank: a weapon for close combined arms combat or an independent fast striking weapon acting in organized tank corps. The Big 5 experience was somewhat different, as doctrine developed independently from modernization, but the new systems enabled it, and also required many changes to training programs because of increased capabilities. Some ideas, especially in doctrine, might initially be wrong, such as GEN DePuy's concept of Active Defense or LTG McNair's fixation on tank destroyers. The Army must be prepared to learn and adapt throughout the process, because wrong doctrine can lead to misdirected resources, i.e. personnel, equipment, and time.

- **There is never enough modernization to go around.** WWII armored units were sent to Africa and the Pacific with the tanks that were available, and in 1943, there were not many M4 Shermans. These units, like the 1st Armored Division, would have to receive and incorporate the M4 into their unit, and train Soldiers, all while in-theater. Additionally, many armored units were training with a mix of M3s and M4s because there were not enough tanks in 1943 to equip every armored division entirely with M4s. The same happened during the 1980s, as some units retained M60 model tanks while even those with M1s might have different versions.

- **These big bursts of modernization that occur every 40 years or so result in more than just a better force, they transform it**. The Big Five were part of a wholesale, post-Vietnam era, force transformation, not just modernization.

Reforms included headquarters restructuring and creation; development of new doctrine; a new training philosophy that focused on task completion, not time; creation of realistic, live-fire training centers to validate doctrine; and modernization across the entire DoD from J-STARS at the strategic level to platoon-level SINCGARS radios. President Reagan's focus on national defense provided the funding for the Army to develop and implement these new systems. The other factor that aided in this transformation was that the major threat never changed between 1973 and 1990, permitting Army leaders to have a singular focus on designing the new force. Similarly, the World War II experience resulted in a totally different Army, with new structures, systems and capabilities. What had begun as the 17th largest Army in the world became the best by 1945.

- **Modernization never really ends.** For the Army, the process is always occurring to some degree. It requires continued and consistent support of multiple CSAs with a common understanding of where it is headed. In 1990, the M1 Series Abrams tank had entered its 11th production year and there were five different models of the tank. Systems upgrades continue even today. New systems continued to be fielded in the 1950s and 1990s, but at a slower pace. The Army continues to invest in research and development and to seek improvement. The service is never stagnant.

- **Reports on the status of modernization must be able to distinguish between readiness and capability.**

  The Army had to come up with a whole new reporting system to accurately reflect the actual impact of the Big 5 modernization surge on the service. Readiness status did not always match unit capability because the pace of deployment sometimes resulted in a mix of systems, the increased capability of new systems was not adequately represented, out of date and shifting MTOEs, or loopholes in procedures that allowed misleading reports. For the newest wave of modernization, the Army will have to be able to measure and project an accurate account of its increased capabilities.

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