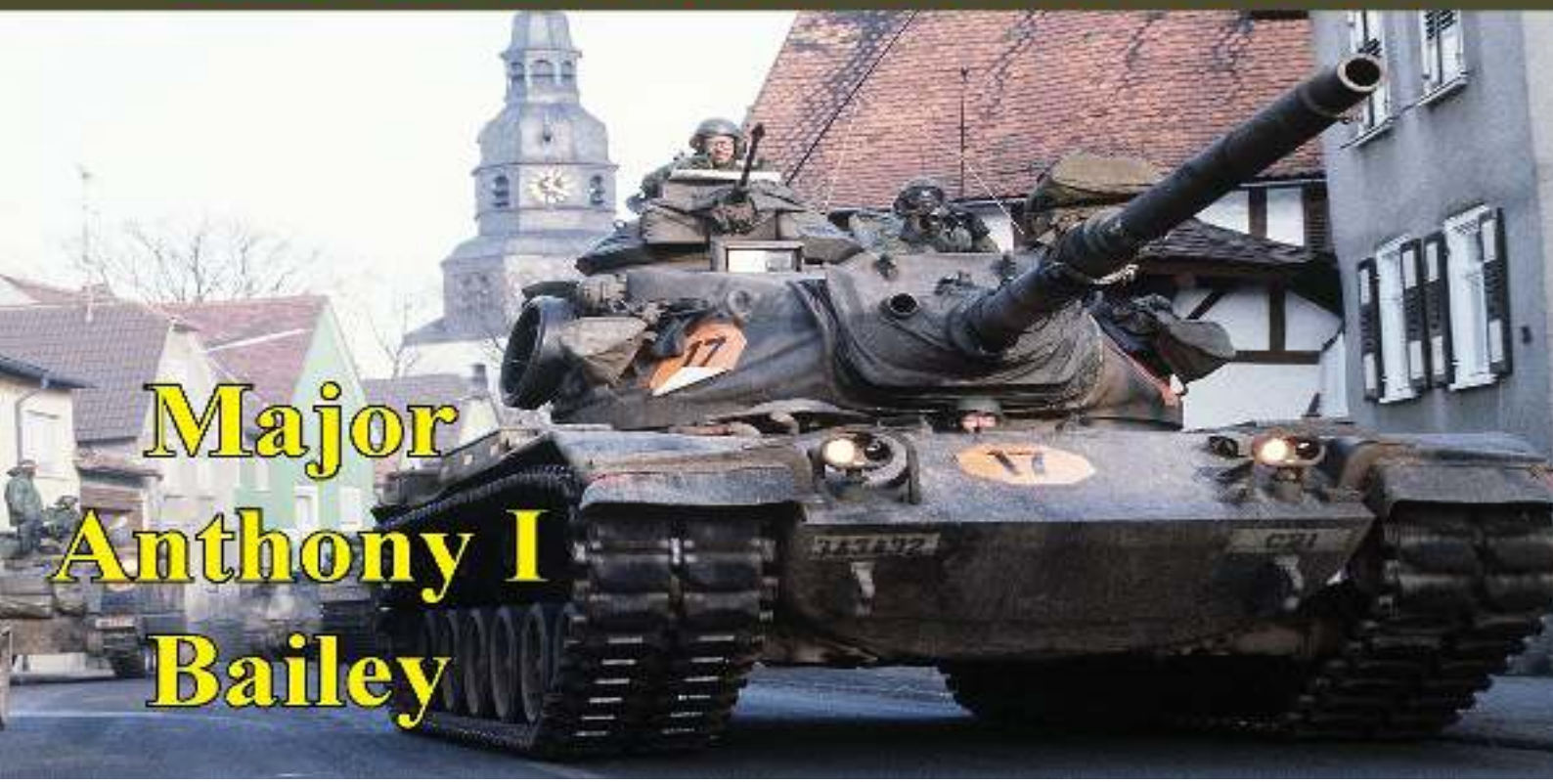
REASONS TO IMPROVE: THE EVOLUTION OF THE US TANK FROM 1945-1991



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Publisher's Note

Although in most cases we have retained the Author's original spelling and grammar to authentically reproduce the work of the Author and the origina
intent of such material, some additional notes and clarifications have been added for the modern reader's benefit.

We have also made every effort to include all maps and illustrations of the original edition the limitations of formatting do not allow of including larger ma
we will upload as many of these maps as possible.

Reasons to Improve: The Evolution of the U.S. Tank from 1945-1991

by

Major Anthony I Bailey United States Army

Contents

Abstract

The American primary tank in the Second World War was inferior to its German counterpart for a
but the final months of the war. The U.S. tank evolved and demonstrated its superiority to the world
Operation DESERT STORM in 1991. This monograph examines the evolution of America's prima
tank in the years between 1945 and 1991 focusing on three periods: the Second World War, th
Korean War, and the 1973 Arab Israeli War. Each period examines the adversary, America's industri
capabilities, and the combat environment. Describing the adversary highlights there is a tangib
threat to U.S. armored forces. In the face of this threat, the United States remained capable of buildi
new more complicated and more expensive tanks, which demonstrates the industrial endowme
required to meet the demands of the threat. An examination of the combat environment reveals wh
the U.S. Army and its armor force seemed so fixated on Europe as the next war's first battlefield.

Ultimately, this paper serves to demonstrate that a tank series, such as the M1 Abrams family, is
required component in the U.S. Army's combined arms arsenal. As such, it is important that the agi
Abrams, having served the Army in Operation Desert Storm and the Global War on Terror, continue
evolve in preparation for the next war.

Introduction

The U.S. Army's first armored encounter against Germany during the Second World War in Nort Africa was disastrous. During the winter of 1942, Allied forces landed in Algeria for Operatio TORCH.[1] The American 1st Armored Division maneuvered across the Algerian desert and east int Tunisia racing southwest to seize the vital Tunisian mountain passes which the Germans woul contest.[2] The 1st Armored Division, one of America's premier units, was fully equipped with the M Lee and M3/5 Stuart light tanks from the 1930s, and a few of the new M4 Sherman tanks. In Janua 1943, a Sherman tank platoon from Combat Command B operating near Kasserine Pass in Tunisi attacked Nazi armor to relieve a friendly unit under fire. The platoon rushed into contact, immediate exchanging fire with the enemy. The German tanks withdrew and the Sherman platoon pursued ther Unfortunately, the German Panzers were merely maneuvering to superior defensive positions. Th M4s charged directly into an ambush—annihilating the American five-tank platoon in minute German tanks and veteran crews outclassed the Americans in terms of gunnery, armor protection, ar tactics. Regrettably, for the Americans, their first lesson in armored combat against the enemy wa deadly.[3]

Almost fifty years later, American armored forces deployed for a different conflict in the desert. was a pitch-black night on February 26, 1991. The 1st Battalion, 37th Armored Regiment, as part 3rd Brigade, 1st Armored Division was in the Middle East to expel Saddam Hussein's forces fro Kuwait. The battalion maneuvered into the Iraqi desert, approximately twenty miles north from th Kuwaiti border, preparing to attack. An American tank platoon sergeant from Delta Compan complained that he could not see more than twenty feet in any direction.[4] The company command radioed to load sabot and hold fire.[5] The platoon of M1A1 tanks slowly advanced in line formatio across the undulating desert as part of the battalion attack on an Iraqi armored unit.[6] The targete Iraqi mechanized brigade was one of Saddam Hussein's highly trained units, the Tawakaln Mechanized Division. The brigade was located on the northern end of the division's defensive bel Aided by night vision devices, the American tank gunners identified Iraqi targets in their sights. Th 1/37 Armor Battalion commander ordered his Soldiers to open fire. The opening salvo destroye several Iraqi tanks and armored personnel carriers. As the American battalion made their way acros the desert, slowing near the crest of a ridgeline to adjust their formation, M1A1s lurched forward ov the ridgeline and into more Iraqi tanks and personnel carriers. The proximity of the Iraqis negated th Abrams superior range capabilities rendering the Americans vulnerable.[7] The Iraqis fought hard in short-range tank-on-tank engagement, scoring hits on American tanks, but none lethal.[8] By midnigh the Iraqi defenders along with most of their vehicles were devastated. American forces came out the battle with minimal damage and four disabled M1A1 tanks.[9] During the Second World War, ther were deficiencies in training, equipment, and experience, however, the U.S. Army's armore

performance in Operation DESERT STORM was exceptional.[10] proving the M1 Abrams and the crews excellent. These vignettes demonstrate how American armored capabilities evolved over fif years.

This successful U.S. armor evolution shows distinct improvement in mobility, firepower, ar armor protection. In November and December of 1942, the United States sent its armored force wi the new Sherman tank, to fight the Axis armies in Africa. The first encounters between American ar German armored forces substantiate American armor shortcomings, as reflected in battle losses, ar highlight German armor strengths.[11] Comparatively the German tanks possessed good mobilit armor protection, and firepower; the American tanks possessed only good mobility. Nearly fiv decades later, the United States sent its armored force to oust Saddam Hussein's military from Kuwa by confronting his veteran, Soviet-organized, Iraqi army in the Middle East. The encounters betwe American and Iraqi forces resulting in overwhelming American victories demonstrated the Unite States' armored strengths. In 1991, American tanks possessed excellent mobility, firepower, an armor protection revealing a fifty-year transformation from an inexperienced force into a superb trained and proficient one.[12]

Many events transpired between Operation TORCH in 1942 and Operation DESERT STORM 1991. They necessitated the transformation of the U.S. Army's tank. Three significant periods i particular affected that progression: the Second World War, the Korean War, and the 1973 Yom Kippur War. The years between 1941 and 1945 are significant in American tank development becaus they witnessed the improvement of Sherman tank models and, ultimately, introduced a new heavi tank in 1945, the M26 Pershing. The Pershing was comparable to German Panther and Tiger tanks armor and firepower. The Korean War experience did two things. First, it ushered in the era of limite war when President Harry Truman refused to allow General Douglas MacArthur's request to expar the Korean War into China.[13] Second, the Korean War energized American research and developmer budgets improving the atrophied, post Second World War ground forces.[14] The relevance becam clear when the Korean War compelled a conventional military response over that of an atomic on The U.S. military, and its armored force, was not prepared for a conventional fight. The thi significant event, the Arab-Israeli wars, provided the world with a model of the fight predicted occur in Europe. The Arab-Israeli wars included weapons like American-donated tanks to Israel ar Soviet-donated tanks and training to Arab countries such as Egypt, Syria, and Jordan. The 1973 Yom Kippur War included the effective use of anti-tank guided missiles that posed a clear threat to ar armored forces on the battlefield. These events form three distinct backdrops from which to shape a answer to the following question: What caused the evolution of the Army's primary tank from th Sherman used in the Second World War to the M1 series Abrams tank that superbly performed i Operation DESERT STORM?

The hypothesis of this monograph is the evolution of the Army's primary tank of the Second Worl War into today's main battle tank resulted from assessments of the adversary, American industria capacity, and the combat environment. The adversary refers to the overall enemy of the period, b focuses on armored combat formations considering a tank was determined the best anti-ta weapon.{15} Discussions throughout the monograph center on enemy tanks and anti-tank systems. Th discussion on American industrial capacity is intentionally limited to the nation's ability t manufacture military items, such as tanks. The combat environment refers to the physic environment including terrain, weather, and urban areas affecting the adversary's capabilities an altering the way forces interact in the attempt to defeat one another.{16}

Defining other commonly used words make the subsequent case studies easier to understand. Th words: tank, armor, firepower, mobility, and armored protection appear throughout the monograph The U.S. Army provided a simple definition of the terms "tank" and "armor" in 1949 and it remain accurate today:

> "A full track[ed], armored, fighting vehicle, mounting a major weapon and machine guns, capable of maneuvering bo individually and in formation against the enemy. The generic term _armor' embraces not only the tank and reconnaissance un of the armored cavalry, but also the armored infantry, armored artillery, armored engineers and the service support units require to form an integrated and a balanced fighting force, the nucleus of which is tanks."{17}

Lessons from the Second World War resulted in a desire to base conventional forces on offensiv capabilities from armored formations. The tank provided those capabilities in terms of firepowe armored protection, and mobility.

The term firepower refers to the measure of a tank's main gun destructive capacity. Mobility refe to the measure of movement, both on and off road, and agility afforded a tank from its engine an transmission. An agile tank with longer range is preferred. Armored protection refers to the measu of protection provided to the tank and it's crew; more is better. However a heavily armored tank tend to be slow. A slow tank does not provide the mobility, speed, and shock that armored forces must t bring to bear against an enemy. For instance, a light tank with a small gun will be very fast, but cann destroy a heavier armored threat. The dilemma for tank designers remains producing a tank that be combines firepower, mobility, and armored protection through a practical process. The followin three case studies evaluate the key events from the Second World War to Operation DESERT STORM appraising the adversary, American industry and the combat environment to answer the researc question about causes of the evolution of U.S. tanks and results in implications of further tan evolution beyond current operations in support of the Global War on Terrorism.

German tank superiority forced the United States to evolve tank design during the Second Wor War. Germany had been at war since 1939 and its armies included armored forces centered on th tank. Although employed during the early stages of the war, Germany replaced its light tanks provide the armored forces more combat power.{18} Germany developed powerful tanks such as th Panther and Tiger models before the United States entered the war. These tanks, particularly th Panther tank, possessed a good balance of firepower, mobility, and armor protection in comparison the American primary tank, the M4 Sherman.

Although disadvantaged in armored capabilities, the United States enjoyed a robust industri capacity that enabled a triumph over Axis forces.{19} It was no accident that America possessed suc capacity during the war. The United States increased industrial capabilities prior to its entrance in the war as military production increased assisting other armies fighting Germany.{20} The comb environment through which the United States had to fight was almost worldwide since the Axis thre spread across the globe. President Roosevelt understood the demands of joining a fight that wou have American armed forces engaged in combat around the world. Battle experience taught the Arm what to develop in tanks and armored forces and America's robust industry produced the new developed tanks.

Adversary

German armored firepower during the Second World War was superior to the United States in one-on-one tank comparison. A 1948 report to the Director of the Second Command Class at Fo Leavenworth recorded common experiences of armored crewmen in combat against German forc throughout the Second World War. The report's author, Colonel H.L. Hillyard, highlights some c those events from 1942 through 1944. One observation described 88-mm. guns destroying or disabli the lead five tanks of G Company, 67th Armored Regiment in Tunisia in December 1942. Th Germans were approximately 2000 yards away.{21} In July 1943, a Tiger tank near Gela, Sicily quick destroyed four tanks and hit a fifth from G Company, 67th Armored Regiment.{22} During anoth engagement in France 1944, a German tank fired seven rounds from a distance of 1500 yards a destroyed five American tanks of the 66th Armored Regiment.{23} Throughout most of the wa German tanks and anti-tank guns regularly engaged U.S. tanks faster and from greater distanc putting American tankers at a disadvantage. The Germans reaped the benefits of their weapo system's technical advantages such as muzzle caliber and round velocity.{24}

In terms of tank main guns, the larger the caliber, the more destructive the round's potential. Th German Army experimented with that concept throughout the war years. The best German tanks, th Panther and Tiger, had 75-mm. and 88-mm. main guns.{25} The German Army entered the Secon

World War with the *Panzerkampfwagen I* tank. This weapon system possessed machine guns as i primary weapon and that tank evolved throughout the war.{26} The *Panzerkampfwagen II* mounted 20-mm. main gun.{27} Follow-on models incrementally increased the main gun size from 37-mm. 50-mm. before manufacturing the 75-mm. and 88 mm. guns.{28} Additionally, the Germa experimented with 128-mm. main guns mounted on enormous tanks but he most efficient main gu appeared on the Tiger and Panther tanks.{29}

High velocity ammunition provided advantages in potential armor penetration. If two tank roun of the same caliber are fired at an armored target, the round with a higher velocity will penetrate mo armor than the round with lower velocity. In armored combat, high caliber guns that fire high-velocit ammunition are better than equivalent-sized guns of lower velocity. German 75-mm. guns could sho high velocity ammunition at approximately 2600 feet per second as compared to the Allied equivale ammunition that traversed just over 2000 feet per second.{30} German 88-mm. guns could sho ammunition approximately 2650 feet per second.{31} Both the German 75-mm. and 88-mm. guns cou fire ammunition at higher velocity than American tank rounds, allowing longer range and arm penetration. That ability provided the Germans an advantage over the United States in tank firepower

The disadvantage to the United States meant Sherman tanks, with lower velocity ammunition a reduced effective range, required maneuvering well into German tank ranges before the Sherma could threaten enemy tanks. At times, it required American tank commanders maneuvering with five hundred meters to penetrate enough armor to destroy enemy tanks.{32} The German adversary the form of Panther and Tiger tanks retained a significant advantage over the U.S. Sherman tan because of its armored protection. Myriad German advantages fed into the U.S. Army desire develop a better tank to better contend with German forces.

Industry

The United States moved to full industrial mobilization during the Second World War. {33} There a many indicators supporting this fact. Increased military production is one such indicator. Anoth indicator is the massive effort made to enlarge the physical size of the American industrial base, a effort that was also potentially costly. Yet another, and more subtle indicator, was pre-war industria growth that America conducted to assist her yet undeclared British and Soviet allies. Although there no significant debate challenging America's industrial growth during the Second World War, th following illustrates the extent of America's wartime mobilization. Acknowledging the extent American military production potential exemplifies that the United States possessed the industri capacity to simultaneously produce arms and equipment for an ongoing war and retain the productio latitude to build improved tanks for later in the war.

The United States increased military production almost two years prior to entering the war

December 1941.[34] Industrial capacity in the United States increased as early as 1940 to produ equipment and supplies primarily for Great Britain. This two-year advantage in the mobilizatio process allowed the U.S. Government to mobilize from a peacetime to wartime setting faster than otherwise could.[35]

"In short, he [President Roosevelt] proposed that America become =the arsenal of democracy' The job placed befo Congress was to provide the country with a law that would meet the situation in spirit and in fact. It required an epoch maki decision on policy and the setting up of machinery to provide the needed help in ships, planes, tanks, guns, food, and oth supplies."[36]

Subsequently, the U.S. Congress made Lend Lease into law on March 11, 1941.[37] Other recipien of the Lend Lease equipment included the Soviet Union, France, Italy, and China.[38] Despite th disadvantages in training and experience, the United States entered the Second World War with it industrial capacity already gearing for total military production allowing America to mass-produc the weapons and tanks needed to destroy the Axis armies.

The gross national product from 1941 through 1944 expanded from eleven to forty-five percent.[This figure reflects the expansion within the American industrial base to accommodate the demand required to support the war effort.[40] The creation of the War Production Board reflected the U.S Government's desire to expand its ability to mass-produce war equipment. The Board identifie problem areas, such as labor, throughout the years it met and used its authority to mitigate th problems before they became catastrophic.[41] In March 1942, the board identified the dwindlin numbers of skilled laborers that were lost to the growing military. The War Production Boar implemented a plan to train less skilled workers to assume the duties of the skilled labor party.[42] Th growth of the American industrial capacity, as evidenced by the expanded gross national product, an industrial oversight, as evidenced by the War Production Board, led to the armored force success i evolving tanks as the need arose.

The U.S. Government built 1600 new industrial plants and expanded others costing nineteen billio dollars.[43] The increase of America's industrial capabilities demonstrated the nation's resolve fo winning the war. This expansion of the industrial complex enabled the mass production of Sherma tanks in addition to thousands of other vehicles, airplanes, equipment, and ammunition. Although i one on one comparison to German heavy tanks, the Sherman was inferior, American industr produced almost 60,000 Sherman tanks throughout the war.[44] Rarely would the Sherman face th Panther or Tiger in a one on one situation. That is not to say that industry alone guarantees a natio victory, but it certainly helps. Expanded industrial capacity placed the United States in a position o advantage over Germany throughout the war. That advantage allowed the Army to produce critic munitions and material while retaining capacity to evolve tanks.

Combat Environment

The combat environment demanded a tank that could handle the physical stresses of a variety theaters around the world. Tanks were expected to function in climates that were hot, cold, wet, ar dry. It was feasible to deploy and fight in one theater one month, only to redeploy to a different theat with its own unique environmental challenges several weeks or months later. The combat environme is also more than just the physical surroundings; it also includes interaction with the adversary. Th following examination of the combat environment highlights the challenges that American tar designers must embrace while striving to evolve the tank.

American tanks fought German armor in Africa and across Europe in varying terrain that demande mechanical reliability. {45} However, building a reliable tank for a number of extreme environment conditions can be very difficult. The physical environment of each of the geographic area whe American tanks fought provided unique challenges. Algeria and Tunisia included desert environmen that exposed tanks and men to hot, rocky, and extremely dry conditions that wreaked havoc on the armored vehicles. Harsh environments make it difficult to maintain tanks that require pur uncontaminated petroleum, oils, and lubricants to function. The M4A3 Medium Tank technic manual called for constant inspections while the tank is in operation. It specified mechanical chec before, during, and after operation to prevent any damage that may result in the tank breakin down.{46}

Other areas of operation included different environmental conditions. Moisture and salt from th Mediterranean Sea characterize the Italian environment; exposure to this is extremely damaging tanks. Italy‘s terrain offered a variety of high mountain roads and passes as well as lowland swamp and canals often considered unsuitable for tank combat maneuvers.{47} American tank crews learne how to maneuver their tanks through “unsuitable” terrain but not without putting stress on the tank mechanical abilities.{48}

The European environment proved much more temperate, but harsh winters burdened tanks an especially their crews. The same petroleum, oils, and lubricants that fail when contaminated with du and dirt performed very differently at near freezing temperatures. Despite the potential extremes the physical environment, the enemy added additional complexities that further specify the comb environment.

The primary German threat in the combat environment included ground-based, direct-fi systems.{49}.Germany started the war with the ability to fight in combined arms fashion consisting air and land combat systems. As the war progressed, Germany lost their ability to wage war from th air; the Allies gained air superiority and the *Luftwaffe* became a defensive arm. The German div bombers that bombed Polish units in 1939 were much less threatening to American tanks during 1944 and 1945 because Allied air coverage disrupted what was left of those formations.{50} Masse

artillery fires provided by American artillery units surpassed German artillery capabilities. Early
the war, Germany's combined arms approach allowed their formations to use direct and indirect fir
from both air and ground platforms. Later in the war, the German threat was primarily ground base
and from direct fire weapon systems. It made sense for American tank designers to focus on attainir
greater firepower and armored protection because therein laid the immediate threat.

American tank designers, with an understanding of the combat environment through after-actio
reports, continually improved the Sherman tank throughout the war. In fact, the Sherman tank we
through nineteen variations, which accounted for improvements in size, shape, armor, main gu
internal configuration, as well as in its engine.{51} Although each variant of the Sherman tank improve
upon the other, the tank ultimately never possessed the proper combination of firepower and armore
protection to oppose individual Panther or Tiger tanks. It took an entirely new tank to stand, toe to to
against German tanks.

The M26 Pershing

That new tank, the M26 Pershing, arrived in 1945 in Germany where it hunted German Panther ar
Tiger tanks.{52} The Pershing possessed a 90-mm. main gun capable of shooting high velocity arm
piercing ammunition. The Pershing held seventy main gun rounds, five hundred fifty .50-caliber heav
machine gun rounds, and five thousand .30-caliber light machine gun rounds.{53} The main gu
ammunition traveled 2800 feet per second, meaning that a Pershing tank firing a sabot rour
penetrated approximately five inches of armor at 500 meters, four and a half inches of armor at 100
meters, and just under four inches of armor at 2000 meters. {54}The M26 weighed only forty-six ton
was lighter than its German counterparts, and boasted frontal armor greater than four inches thic
almost twice that of a Sherman tank. A 500 horsepower Ford V-8 engine powered the Pershing up t
thirty miles per hour.{55} However, the engine, similar to that used in the thirty-five ton Sherman tan
left the Pershing underpowered. In terms of firepower, the M26 Pershing was America's answer to th
German heavy tanks.

Summary

The Second World War provided the U.S. Army the impetus to improve its primary tank because o
the lethality of German armor. American industrial power supported the country and its Allies, an
preserved the ability to develop the tank. The Sherman tank continuously improved throughout th
war but it was never able to compete with the best armor Germany produced. The American Arme
Branch and the Ordnance Department worked together to develop a new tank resulting in the M2
Pershing.{56} The Pershing possessed the firepower capable of destroying German armor at reasonab
ranges and included armor protection that equaled that of the Tiger tank. However, what the M2
gained in firepower and armored protection, it sacrificed in engine power. Despite these shortfalls, th

Pershing was good enough to see the surrender of Germany and the end of the Second World War.[57]

The Korean War

The Korean War highlighted the strengths and deficiencies of the M26 and created an opportuni to improve the tank. The United States possessing a monopoly in atomic weapons reduced i industrial war production. Not only did the war-making industries shrink, but so too did the milita forces. The actual strength of the 1950 Army was 40,000 men less than the authorized strengt Finances and plans early in 1950 urged further reductions of 20,000 men.[58] The reduction in forc affected the 8th Army in Japan because the priority of replacements went first to Europe.[59] Ear American defeats in the Korean War, such as that of Task Force Smith, caused President Truman t recognize the obligation to bolster military strength.[60] Although initially lacking, American arm performance in Korea demonstrated the M26s strengths in firepower and weaknesses in mechanic reliability. The United States planned to correct conventional military weakness using legislation re-mobilize industry and to reverse the post Second World War downsizing in an effort to stem th North Korean invaders.[61]

Adversary

In the late 1940s the Soviet Union trained, armed, and equipped the North Korean People‘s Arm with modern weaponry including the T34/85 medium tank. The North Korean Army grew strong than the American-backed South Korean Army, which was a light infantry force. In an effort to uni the Korean peninsula under Communist rule, the North Korean Army invaded South Korea in Jun 1950. Massive amounts of artillery and the T34/85 tank led the invasion.[62]

Armed with a 76-mm. main gun, the T34/76 of the Second World War evolved into the T34/8 through internal upgrades to the fire control system and an improved 85-mm. gun.[63] The T34/85 secondary armament included two 7.62-mm. machine guns, one in the hull and the other coaxial mounted next to the main gun.[64] The tank weighed just over thirty-one tons and possessed slope frontal armor near three and one half inches thick.[65] A 512 horsepower V-12 diesel engine powere the tank enabling speeds over thirty miles per hour.[66] Comparatively the T34/85 neared the Germa Panther tank’s capabilities in terms of firepower, armor protection, and mobility.

The T34/85 proved more than a match for the South Korean Army, which possessed no tanks ar only ineffective bazooka anti-tank weapons. The T34/85 also proved adept in countering the Unite State Army‘s M24 light tanks that deployed from Japan.[67] The T34/85 in North Korean hands prove devastating in the Korean War until the United States could adequately respond. That respons included close air support from Japan, 3.5in bazookas and the Pershing family of tanks, most of whi had to be refurbished and deployed from the United States. Just as the Pershing proved lethal again German Panther and Tiger tanks, in Korea, they were just as were lethal against the T34/85.

Despite sufficient firepower, the Pershing had mechanical issues that made it difficult to maintai operational readiness within armored units. In fact, there was an ongoing M26 upgrade progra addressing the underpowered engine and transmission.{68} The M26 had an inefficient drive train ar power plant given the weight of the vehicle, which the upgrades resolved.{69} The new engine increase the horsepower by approximately forty percent and was smaller thus providing an upgrade of th transmission.{70} The upgrade program also installed improvements on the 90-mm. gun adding a bor evacuator as well as modernizing the fire control system, making it more efficient.{71} The improvements altered the M26 enough that it was ultimately re-designated the M46 Patton tank. Th M46, like the M26, was effective in combat against the T34/85. The Korean War experienc highlighted the strength of firepower in the M26 and its weakness in mobility that served to speed th evolution of America‘s tank.

Industry

In 1950, the U.S. industrial manufacturers were not prepared for war. Machine tool capacity 1950 was approximately one third of the Second World War capacity.{72} The reduction in th capacity decreased the wartime industrial capacity of the United States in the years between 1945 ar 1950.{73} The reduced wartime industrial capacity allowed the military to atrophy into a deplete organization incapable of responding to emergencies other than those that required the use of atom or hydrogen bombs. Professionals, strategists, and the national leadership recognized the degradatio of national security capabilities by the Korean War and enacted legislation increasing military budge and war industry production.{74}

The National Security Council Report number 68 identified the necessity to —make ourselv strong,” through the development of military and economic strength.{75} This report identified number of shortcomings within the nation‘s defense policies such as poor coordination between th military and civilian manufacturers.{76} More than simply improving the nation’s military ar economic power, the U.S. Government created governing agencies to supervise the strengthening industry and the military. Although the post Second World War era demonstrated a downsizing an weakening of the American military and industrial power, the national command authority identifie these shortcomings and established measures to mitigate them. What legislation could not do, th Korean War experience accomplished, showing the need to more rapidly evolve the flawed Pershin tank.

The Defense Production Act of 1950 aimed at developing and maintaining military and economi strength allowed the United States to “oppose aggression and promote peace” with minimal strain o civilian economy.{77} The Defense Production Act had three sections and each section had provisio to support industrial war production. The first section authorized the President to require businesses

fulfill national defense orders. The next section established regulatory mechanisms to fulfill the inte of the Defense Production Act. The last section authorized Presidential control of the civilia economy to make available any scarce or critical materials. The greatest benefit gained through th passage of this act occurred after the Korean War in that the Act required industry to maintain constant and enduring level of war production, in order to provide for strengthened military. This wa known as limited mobilization.{78}

The Office of Defense Mobilization managed the stated objectives of the Defense Production A of 1950.{79} That office possessed a number of powers to mobilize civilians, as well as variou industries and government agencies to meet any national security demands in a crisis.{80} In respon to the Korean War, President Truman requested the expansion of the armed forces and an expansion o defense spending. Truman also appointed a mobilization director charged with managing the bread of war production on behalf of the President.{81} The level of legislative foresight allowed milita production to meet the needs of the Korean War as well as to maintain the armed forces after the wa This program provided finances giving tank designers resources that allowed faster tank evolutio than that which occurred after the Second World War.{82}

The Combat Environment

Europe provided the basis on which tank designers deduced future combat conditions because th Soviet Union constantly strengthened itself and the militaries of Soviet Bloc countries after th Second World War. {83} American strategists derived certain goals in response to the Soviet Union an the National Security Council elaborated them in April 1950.{84} It became alarmingly clear that th ultimate security of the United States rested in the defense of Europe.{85} The resultant focus o Europe as the next major battleground in a future conflict played an enduring role in the developme of the American main battle tank. Designers produced a tank that could defeat the Soviet Union Europe to prevent an attack on American soil.

United States objectives and programs for national security, as addressed in National Securi Council 68 in April 1950, specified the fears of Soviet expansion westward through Europe by stating

> "Two complex sets of factors have now basically altered this historic distribution of power. First, the defeat of Germany an Japan and the decline of the British and French Empires have interacted with the development of the United States and t Soviet Union in such a way that power increasingly gravitated to these two centers. Second, the Soviet Union, unlike previo aspirants to hegemony, is animated by a new fanatic faith, antithetical to our own, and seeks to impose its absolute authority ov the rest of the world. Conflict has, therefore, become endemic and is waged, on the part of the Soviet Union, by violent or no violent methods in accordance with the dictates of expediency. With the development of increasingly terrifying weapons of mas destruction, every individual faces the ever-present possibility of annihilation should the conflict enter the phase of total war."{86

The document goes on to identify the goals of the Soviet Union to first overrun Europe, then defeat Britain through air attacks, and finally to attack the United States through a choice of atomic

conventional weapons.[87] Armed with this understanding of Soviet intentions and observing th strengthening of Soviet Bloc countries, it is easy to see why American politicians and strategists clun to the forecast of a European battlefield. That is why American tank designers focused on conceiving tank to win on European soil.

American analysts, aware of Soviet military organization from the Second World War, knew th Soviet Union was organized and equipped to use direct and indirect fires delivered from both groun and air platforms.[88] American tanks required a reasonable chance of survival under those thre conditions meaning that armored formations must withstand the effects of direct and indirect fi while remaining combat effective.[89] American intelligence on the composition of Soviet forces wa predicated on both clandestine and open source observation.[90] The observation primarily occurre through Soviet military parades and through proxy armies. The North Korean and Chinese armi were equipped with arms from the Soviet Union, including tanks. However, American strategis could predict to a reasonable degree of certainty the composition of the Soviet forces. Tank designe predicted that Soviet forces were more numerous and their tank capabilities at least equivalent to th United States.[91] Given the future European battlefield, future tanks were designed for that comb environment.

Designers evaluated environmental conditions against Soviet capabilities to produce a viable tan Knowing the physical environment of Europe, particularly central Germany, and the assume capabilities of the Soviet Union allowed tank designers a standard against which to make tan improvements. Tank designers developed tanks that could handle four seasons, both hot and co temperatures in wet and dry conditions throughout a year. Tanks had to be able to ford the rivers an streams found in the European countryside in the event of destroyed bridges. Other considerations f tank design included the necessity for cross-country maneuver and the desired ability to have lon cruising ranges before requiring refuel. The ability to operate long times between refuel enhance th tanks overall mobility which lends itself to exploitation in the offense. The M48 Patton tank result from such a design process but was hurried by experiences from the Soviet backed Korean War.

The M48 Patton

The M48 maintained the 90-mm. gun from its predecessors, and it incorporated a more powerf engine and transmission yielding better mobility and agility.[92] It retained the .50-caliber heav machine gun on top of the turret but included only one .30-caliber machine gun, coaxially mounte next to the main gun. The fifth crewman and the second .30-caliber, hull mounted in previous model was gone. The M48 carried sixty main gun rounds, five hundred .50-caliber rounds, and fifty-nin hundred .30-caliber rounds. The tank weighed forty-eight tons with over four inches of rounded front armor. A Continental twelve-cylinder engine powered the tank with 704 horsepower achieving a to

speed near thirty miles per hour.{93} The first M48 Patton tank rolled off Chrysler's Delaware Tan
Plant and was christened by Mrs. George S. Patton Jr. in 1952.{94} The M48 Patton tank replaced bo
the M26 and M46 as the U.S. main battle tank through the early years of the Cold War.{95} The Arm
recognized the M48 as superior to its predecessors. The Army also recognized that the M48 wa
rushed into service because of the Korean War experience and tank evolution continued.

The M60 Patton

The M60 Patton tank is the product of a more methodical evolution process that was not rushed b
immediate combat requirements like the M48 during the Korean War. The M60, maintaining the M4
turret and hull assembly mounted a new high velocity 105-mm. main gun and possessed a Gener
Motors twelve-cylinder air-cooled engine.{96} The 750 horsepower power plant rendered a top spe
near thirty miles per hour.{97} Secondary weapon systems on the fifty-five ton tank included a .5
caliber heavy machine gun and a 7.62-mm. coaxially mounted light machine gun.{98} The new Patto
carried fifty-seven main gun rounds, nine-hundred .50-caliber rounds, and six thousand light machi
gun rounds.{99} The M60 also incorporated night vision equipment and a nuclear, biological an
chemical protective system.{100} Subsequent models, the M60A1 and A2 weighed almost sixty tons an
included a larger turret, additional main gun ammunition, and a main gun stabilizer.{101} The M60A
was capable of firing missiles as well as standard ammunition.{102}

Summary

The Soviet threat to Western European countries and the United States after the Second World Wa
permeated the American system. That Soviet threat was both conventional and atomic in natur
Specifics of the conventional threat were often unclear, but occasionally some specifics could b
determined. For instance, tank designers agreed that the Soviet Union in the 1950s could deploy
modern mechanized army that both fought in combined arms fashion and was lethal from both groun
and air.{103} The threat provided by this capable military force gave reason for another evolution of th
tank. Tank evolution also required money and a vigorous industrial capacity to produce the new tank
The demobilization of American post-war industry greatly reduced the ability of the United States
maintain and manufacture new tanks. The Communist invasion of South Korea highlighted th
problem and corrected it through legislation.{104} The Soviet threat, primarily observed in Europ
spread across the globe and into Korea. The industrial growth following the Korean War sped th
evolution of the M26/46 tanks into the M48 Patton. Years of peace would witness continued tan
evolution resulting in the M60, M60A1 and M60A2 tanks.

The United States‘ assessment of captured material and tanks from the Yom Kippur War resulte in yet another iteration of American tank evolution.{105} The assessment identified a distinct ar evolved threat on the armored battlefield in the form of both anti-tank guided missiles and a ne Soviet main battle tank. The United States required the strength of industry in order to neutralize th threat. In contrast to the military industrial inactivity at the beginning of the Korean War, America military industry in the 1970‘s was very active. The unimpeded access to captured and destroye Soviet equipment after the Yom Kippur War in 1973 provided numerous benefits for the militar community in the struggle to contain the Soviet Union throughout the world. The combat environme witnessed in Israel and the Sinai Desert provided specific information tank designers needed for th continued evolution of the main battle tank.

Adversary

The battlefield introduction of anti-tank guided missiles and the T62 main battle tank altered th way Western armies planned to fight the Soviet Union in Europe.{106} There were several anti-tar weapons used on the Israeli battlefield including rocket-propelled grenades, and a family of anti-tar guided missiles. Both had advantages and disadvantages, but the families of anti-tank guided missil concerned the American armored community because of its long-range lethality combined with i relative low cost and ease of use.{107} The Soviet Union provided modern T62 tanks to Arab force their use in battle allowed the United States a very close look at the tank‘s capabilities. The anti-tar guided missiles and the T62 tank were prevalent in the Soviet Bloc armies that the North Atlant Treaty Organization forces would presumably meet, particularly in Eastern Europe. Understandin these weapon systems provided an advantage to American tank designers.

Soviet Sagger and Swatter missiles introduced long-range anti-tank munitions to the battlefield.{1 The U.S. armored community became aware of the characteristics of Soviet short-range rocke propelled grenades when they encountered them in Vietnam. However, because the war in Vietnar involved relatively little armored maneuver warfare, the United States did not encounter the lon range anti-tank weapons used against Israeli armor in 1973. As intelligence from the Yom Kippur Wa became available, the Army‘s Training and Doctrine Command released bulletins exhibiting a deep understanding of enemy equipment. Training and Doctrine Command released a bulletin on anti-tar guided missiles in 1975 focusing on the Soviet Sagger and Swatter missiles. The Sagger missile w thirty-four inches long, weighed almost 25lbs and was effective between 500-3000 meters. A wi guided missile, the Sagger traveled approximately 120 meters per second, and came armed with a hig explosive anti-tank warhead capable of penetrating sixteen inches of armor.{109} The Swatter anti-tar guided missile resembled a mounted version of the Sagger for placement on a variety of ground ar

air platforms. Additionally, the Swatter was not capable of dismounted use. Properly employed, bo
missiles were deadly for tanks.

Anti-tank guided missiles provided inexpensive anti-armor capability to any army the Sovie
supported. On the other hand, building and maintaining an armor-centric army was very expensiv
Smart employment of the variety of anti-tank weapons available in the 1970s threatened armor
forces. The implication was that second and third world countries could afford to build an arm
capable of defeating armored formations on the cheap. It was much more difficult to identify an ant
tank Sagger team ambush than to identify platoon of enemy tanks since tanks were bigger and easi
to detect. An infantry company, equipped with rocket-propelled grenades and Sagger missiles cou
now seize terrain and successfully defend it against armored formations. The realization that anti-ta
missiles provided a substantial threat to American tanks forced the U.S. armor community to adapt
new enemy.{110}

The T62, wielding the fastest main gun round in the world, was the mainstay of the Soviet armor
force in the 1970s after it replaced the T54/55 series tank.{111} Nations with enough money, or th
support of the Soviet Union, could purchase T62 as well. The U.S. Army Training and Doctrin
Command continued its study of Soviet weapon capabilities and produced, Bulletin Number 10, titl
The Soviet Main Battle Tank: Capabilities and Limitations in February 1979. The purpose of th
bulletin was to familiarize every soldier with the Soviet tank series centered on the T62. The bullet
introduced the T62 as the Soviet‘s principal battle tank, mounting an accurate and highly lethal ma
gun, generally comparable to an American M60 series tank.{112} The primary strengths of the T62 we
its 115-mm. main gun and mobility.{113} The Soviet hypervelocity, armor piercing, fin-stabilize
discarding sabot ammunition traveled over one mile per second and penetrated thirty-thr
centimeters of armor. It had a fifty percent probability of first round hit on a stationary target at 150
meters with a seventy-one percent probability of killing the target.{114} The T62 tank proved reliab
and deadly on the battlefield.

Industry

American industry was much more prepared for war in the 1970s than it was in the 1950s.{115} Th
Korean War found American military industrial readiness severely lacking; the policy of limite
mobilization was incorporated after the Korean War to correct this fault. Limited mobilizatio
required the U.S. Government to employ a limited industrial capability for military material, even
times of peace.{116} This kind of mobilization, lacking before the Korean War, allowed continuin
military production and provided for industrial oversight. The Industrial Advisory Council ha
primary responsibility for identifying problems with industrial output during this time. This syste
worked throughout the 1950s and 1960s, and played an important role in meeting industrial deman

of the Vietnam War and allowed a regular pace of tank evolution and production.{117}

The Industrial Advisory Council forecasted turbulence with continued industrial mobilization a the Vietnam War wound down.{118} The Council found that there was no regular oversight for milita production in the 1960s and as industrial demands decreased, the military industrial base lost essenti skilled labor.{119} One issue affecting industrial efficiency stemmed from a lack of formal mobilizatio by the U.S. Government.{120} While this was consistent with the idea of limited mobilization, allowed many civilian companies to ignore unpopular military production orders. Those compani could do so because they treated military production orders as competitive bids against mo profitable civilian production bids, and in many instances, the desire to profit exceeded the desire support national defense requirements.{121} The Industrial Advisory Council had the authority propose corrections to identified issues within the military production process. Those correctio benefitted the entire system and allowed efficient production, like that required for evolution of th M48 into the M60 tank.

The Industrial Advisory Council proposed changes within industry focused on improved efficienc The Industrial Advisory Council ultimately outlined and recommended a planning system manage through the tenets of consistency, relevancy, thoroughness, and credibility.{122} Problems consistency stemmed from the difference of planning periods required by the different armed for services and recommended a common timeline for everyone.{123} Relevancy was a factor because th Department of Defense planned for too many non-essential items that curtailed planning for iten critical for national defense. Credibility improved when programs incorporated incentives for efficie industrial planning. Responsiveness in production, like credibility in planning, improved when th Council included rewards for speedy production.{124} Actions taken by organizations like the Industri Advisory Council served to coordinate and streamline industrial planning and production, which turn saved money and allowed critical military production even in times of limited economic growt The ultimate result for the United States was adequate access to military production capacity resultin in modern equipment, and vehicles, particularly the M60A1 and A2 series tank.

The Combat Environment

The 1973 Yom Kippur War provided a combat environment that closely resembled what the Unite States would endure against the Soviet Union in Europe.{125} A U.S. Training and Doctrine Comman Bulletin published the following assessment in 1975:

“While the Arab-Israeli War of October 1973 (The Yom Kippur War) reaffirmed the offensiv potential of the tank, it has also dramatized the lethality of modern anti-tank weapons-particularly th high velocity tank cannon and the long-range antitank guided missile (ATGM). The effect of thes modern antitank weapons in this war was devastating. Not since the Battle of Kursk between th

German and Russians in World War II has there been a comparable loss of tanks in such a short perio of time. If the rate of loss were extrapolated to the European battlefields over a period of 60-90 day the resulting losses would reach levels for which the U.S. Army is totally unprepared."{126}

That assessment served as an alert to the armor community. The combat environment changed wi the Yom Kippur War through the new weapons employed on the battlefield. Although the terrai differed from that of Europe, the Middle Eastern battlefield allowed the United States an opportuni to evaluate both friendly and enemy weapon systems in combat.

The Israeli Army equipped itself with a variety of Western equipment and the U.S. Governmer provided the majority of its arms.{127} The Israelis, fighting on two fronts, used tanks in the northe Golan Heights and the southern front in the Sinai Desert. In the north, the tanks included primari British Centurion tanks, and in smaller numbers, the upgraded M4 Sherman tank. Some Sherma tanks had 76-mm. guns and others used retrofitted 105-mm. guns.{128} The Israeli armored forces in th Sinai were comprised primarily of American M48 and M60 tanks with some British Centurion tanl and fewer Sherman tanks.{129} The M48 and M60 series tanks included Israeli mounted 105-mm. ma guns.

The Arab forces reflected the Soviet Army's organization, just as Israeli forces closely resemble that of the United States.{130} Syria attacked in northern Israel with armored forces including Sovi T54/55s as well as the T62 tank.{131} Against Israel's southern defense zone, the Egyptians attacke with T54/55s and T62s. The T54/55 wielded a 100-mm. main gun and the T62's main gun measure 115-mm.{132} After the war, studies on the effects of tank fire provided tremendous clarity about th nature of the modern Soviet combat environment.{133} There was significant information derived fro combat in Israel that applied to a potential war in Europe. Understanding that nature caused multip events such as the publication of service wide bulletins, the incorporation of new tactics, techniqu and procedures, changed doctrine, and provided focus for tank evolution.

One such tactic, technique, and procedure recommended by the U.S. Army's Training and Doctrin Command incorporated the "Sagger watch" in armored movement.{134} The Sagger watch was whe one element conducts overwatch looking for the signature of a Sagger missile launch. Once identifie the overwatching element shoots to suppress the Sagger team and alerts the unit. The target element, once alerted, conducts evasive maneuvering to dodge the missile. The Sagger anti-tar guided missile{135} resulted in not only new tactics, techniques, and procedures, but also supporte another evolution of the U.S. tank.

The M60A3

The M60A3 series tank was America's answer to the Soviet T62 and the anti-tank guided missi threat. It possessed a 105-mm. main gun capable of shooting both super-high velocity and hig

explosive anti-tank ammunition.{136} The M60A3 carried sixty-three main gun rounds, nine hundr .50-caliber rounds, and six thousand 7.62-mm. light machine gun rounds. The new Patton had a cre of four and weighed fifty-eight tons with slightly increased armor protection. A twelve-cylinder dies engine powered the tank providing it 750 hp and a top speed near thirty miles per hour. The eleve foot tall behemoth had a three hundred mile road range before it needed to refuel. Benefits technology added state of the art night vision and a nuclear, biological, and chemical protecti system.{137} The M60A3 Patton tank, a direct descendant of the M26 Pershing, achieved a formidab combination of firepower, armor protection, and mobility. However, American tank evolutio continued throughout the late 1970s and an entirely new tank arrived at the end of the decade.{138}

The M1 Abrams

The XM1 tank rolled off the assembly line in 1979 and the vehicle was tested and approved f general production as the M1 Abrams in 1981.{139} The Abrams was a new tank in that its chassis ar turret was entirely different from the M60 series. The Abrams carried an improved 105-mm. main gu capable of firing super-high velocity, depleted uranium sabot rounds that produced increased armo penetration. An enhanced fire control system included a new ballistic computer to aid the gunner. Th M1‘s secondary armament included a .50-caliber tank commander‘s weapon, a 7.62-mm. loader machine gun, and a coaxially mounted 7.62 mm. light machine gun. The M1 held fifty-five main gu rounds, one thousand .50-caliber rounds, and over ten thousand 7.62-mm. rounds. The Abram weighed sixty tons and enhanced armor provided additional crew protection. An AGT-1500 turbin engine powered the tank allowing speeds above forty-five miles per hour.{140} The Abrams tan achieved superior results in terms of firepower, armor protection, and mobility at the cost of high fu consumption rates; the tank needed almost three hundred gallons of fuel thrice daily.{141} Eve evolution of the American main battle tank was a step closer to achieving designer’s goals maximizing the balance of firepower, armor protection, and mobility, and the M1 proved n exception.

Summary

Three factors played a significant role in the evolution of the U.S. main battle tank: a credib threat, industrial potential, and a changing combat environment. The Soviet Union spent most of th Cold War supplying its allies with training and equipment. Often times, the best way to colle information on Soviet weapon systems was through their observed employment in foreign armies o foreign battlefields. The Yom Kippur War provided such an opportunity and from it America analysts confirmed the new and more lethal capabilities of the Soviet armored forces. The early 197 demonstrated a credible Soviet conventional threat to the United States.

An analysis of industry during this period revealed potential challenges like a weakening econom

coinciding with the waning war in Vietnam. The unpopularity of the Vietnam War impacted civilia manufacturers who preferred to distance themselves from military production towards the end of th conflict in favor of civilian customers who brought greater profits. No American president elevate the nation‘s industrial base to a level of emergency or crisis and as a result, the industrial comple continued to operate with profit as its main goal, not national security.{142} However, the nation military production was sufficient to sustain the Vietnam War, as well as to rebuild the Arm afterwards and included evolutions of the tank in the 1970s.

The combat environment changed in concert with the changing Soviet threat. American analys took advantage of the explicit knowledge gained from studying the results of the Yom Kippur War an extrapolated its potential to European battlefields. The result of the 1970s environment was anoth iteration of American tank development as the M60 tank series culminated in the M60A3. The M Abrams tank family arrived in the 1980s demonstrating improvements over the M60A3.{143}