



**STRATEGY  
RESEARCH  
PROJECT**

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**WILL THE U.S. ARMY HAVE A TANK IN 2020?**

**BY**

**LIEUTENANT COLONEL DENNIS J. SZYDLOSKI  
United States Army**

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Lieutenant Colonel Dennis J. Szydloski

Colonel Robert C. Coon  
Project Advisor

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U.S. Army War College  
CARLISLE BARRACKS, PENNSYLVANIA 17013

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## ABSTRACT

AUTHOR: LTC Dennis J. Szydloski

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The viability of the tank as a key weapon system on future battlefields is arguable given the proliferation of precision guided munitions, the extreme weight and logistical requirements of current tanks, and doctrine which increasingly emphasizes rapid strategic deployability. This paper discusses the strengths, weaknesses, opportunities, and challenges of tanks today. It describes the tank capability the force will have in 2010 as part of Army XXI. Several relevant trends for after Army XXI are identified. Three possible scenarios for the tank in 2020 are identified: an evolutionary heavy tank, a revolutionary lighter tank, and a system of systems that does not require a tank at all. The author concludes that tanks will still be part of the force even after Army XXI. Combat systems of 2020 will include selectively improved current tanks, a new lighter tank-like system, and new systems as part of a revolutionary rapidly deployable force which will not include anything like the current tank.



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## INTRODUCTION

The requirement for our nation to maintain a capable armored force has scarcely been questioned for fifty years. The tank played a significant role in land combat from World War II to Desert Storm. The US Army is arguably equipped with the best tank in the world. Today, however, some question the viability of the tank on the future battlefield.

While the tank is criticized as senile, obsolete, redundant or irrelevant to future warfare,<sup>1</sup> the US Army is preparing to keep the Abrams family of tanks, albeit selectively modernized, as part of the digitized Army XXI. Most of the ground combat systems we will have on the battlefield 2010 will be upgraded versions of today's equipment.

What the US Army after the Army XXI force will need has not been established. It is not clear whether there will be a new system that will be recognized as a tank. Changing threat estimates, emerging concepts and new technologies raise the issue of whether investment in armored vehicle systems for the Army of 2020 is even necessary. It is conceivable that some new system and operational concept could displace the tank from the force structure.

These questions are important because resource decisions have to be made whether to continue upgrading part of the Abrams tank fleet to the M1A2 configuration, to invest in research and development of new tank technologies, to procure new tank systems or to dedicate limited funding to the development of a more revolutionary set of systems.

The Army historically has taken about fifteen years to develop and field new, major weapon systems after approving mission needs statements. The systems we will need in 2020 will require identification of formal requirements by around 2005. Strategic planners will have to make decisions before 2005 to build and field new systems or a radically new force by 2020.<sup>2</sup> The Army's strategic leaders will have to make tough choices to focus the Army's limited

funding for modernization on the systems that promise the biggest payoff in future scenarios. New systems will have to compete on their merits and value added to Army combat power across the possible spectrum of future conflict.

## **SCOPE**

Solutions to battlefield requirements properly include several dimensions: doctrine, organization, training, leader development, materiel, and quality soldiers. This paper will focus on the general requirements for a tank or a similar ground close combat fighting system capability of the future force. It will not address soldier quality, training, and leader development. Emerging doctrinal and organizational concepts are introduced in this paper only to provide a glimpse of the capability required of future materiel systems. The time focus of this paper is 2020. This year is representative of the time period of the generation of systems required after Army XXI. The year could arguably be as early as 2015 or well beyond 2020.

## **TANKS TODAY**

Although air and maritime operations are effective instruments of national power, land combat remains decisive in war. "Combat remains the coin of the war."<sup>3</sup> Close combat, although carried out less and less by Americans since Vietnam, remains a terrible crucible into which we may have to send soldiers. Until this mission is performed by unmanned systems, we have to be prepared to deploy soldiers to fight in close combat anywhere in the world. For this mission we need tanks.

The tank is a close combat system that combines lethality, tactical mobility, and survivability into one platform that enables ground forces to conduct offensive combined arms

operations. The tank does not exist just to kill tanks. There are plenty of systems that kill tanks quite effectively and even more capable systems are being developed. However, the tank does function as a great tank killer because it provides a high volume of fires, including kinetic energy projectiles that kill in a distinctly different manner than most other anti-tank weapons.

The tank allows the combined arms team to conduct offensive maneuver. The tank was developed to restore mobility and maneuver to the battlefield after it had become stagnant and dominated by attrition in W.W.I. The tank provided mobile protected firepower that permitted infantry forces to attack successfully positions which infantry could not penetrate even with massive artillery support.

In W.W.II, tanks facilitated the German blitzkrieg as well as deep offensive operations by Allied forces in France in 1944. This new method of warfare freed forces from the tyranny of the railhead by using armored systems to fight deep into the enemy's rear.<sup>4</sup> The tank was an essential element in facilitating this revolution in tactics and operations because it provided mobility in addition to protected firepower.

## **STRENGTHS**

The US has a proven and capable tank fleet of M1s, M1A1s, and M1A2s. The tank remains the most survivable platform on the battlefield in the close fight. The M1's heavy passive armor demonstrated unsurpassed protection during Operation Desert Storm.<sup>5</sup> Our tanks possess highly lethal gun and ammunition systems. No other system provides this high volume of kinetic energy (KE) lethality while under fire and while on the move. Today, the tank is the only close combat weapons system that can move through the enemy's killing zone and kill any target on the move facilitating the offensive maneuver of ground forces at the tactical level.

The tank still possesses great shock effect and has a tremendous psychological impact on an enemy. Its presence as part of the NATO peacekeeping units in Bosnia has proven a valuable tool despite not having had to fire a shot in anger.

## WEAKNESSES

Today's main battle tank has several characteristics that reduce its relevance to the future battlefield. Its weight, logistical supports requirements, limitations on strategic and operational mobility, and increasing vulnerability to a wide variety of anti-tank weapons threaten its viability.

The growth of US tank weight brings with it limited strategic mobility. Today's M1A2 tank weighs about 70 tons. As rapid strategic deployability becomes more imperative, the tank appears to become increasingly irrelevant to most future operations of the US armed forces. Tanks cannot get quickly from the continental US to the fight anywhere in the world in significant numbers, unless already forward deployed or drawn from prepositioned stocks.

The tank's weight also limits its operational mobility. The opportunity for operations in theaters with austere infrastructures will increase, while the transportation infrastructure in most countries around the world is only designed to handle heavy trucks. The expectation that the most likely future employment of ground forces will be in unconventional warfare or in terrain considered prohibitive to tanks is another reason to question whether a new tank will ever be produced or exist in anything like their current numbers in the US force. Tanks will not be able to maneuver in some theaters due to the terrain, weather, and infrastructure limitations. Certainly, bridging equipment to facilitate mobility can deploy into theater with the heavy force, but this equipment serves to increase the size and logistical tail of the force. Deployment of

seventy-ton tanks to these nations may damage the transportation network and the economy of developing nations whom we may be trying to assist.

The tank must be supported by a significant logistical tail. The M1 series of tanks requires significant fuel, ammunition, and maintenance support. While the tank was intended to free armies from static warfare and the constraints of the railhead, the tank is now tethered with a logistical umbilical and shackles the Army, reducing its agility above the tactical level. The requirement for massive amounts of fuel will likely only be reduced through total system weight reduction.

The dominance that firepower will exhibit reduces the relative benefit of maneuver for the foreseeable future.<sup>6</sup> Precision guided munitions (PGM) pose clear threats to the survivability of tanks, but they are not silver bullets. Smart mines and terminally guided sub-munitions from air and artillery delivered weapons have been developed that can attack tanks with great precision in very vulnerable spots. While the US has these now, many potential adversaries will have them at some point in the future. Highly accurate anti-tank guided missiles with ranges much greater than tank cannons are already widely available. These weapons are dangerous, but like other technological threats they can be countered.

Two significant weaknesses described above that must be addressed to keep tanks relevant to the Army of the future are reduction of vulnerability to PGMs and weight reduction. Weight reduction can directly improve deployability and reduce fuel consumption.

## **OPPORTUNITIES**

Technology provides opportunities to address these weaknesses and to improve tank performance. There are advanced technologies available today that are not yet incorporated on

the Abrams fleet or the M1A2. Investment in these tank specific technologies is required to further develop these opportunities.

A number of approaches are available to reduce the weight of future tanks. Automation, including automatic loaders, automatic target detection and acquisition systems, navigation systems, identification friend or foe (IFF) systems can decrease crew workload and allow tank crew reduction as well as improve performance. Alternatives that will reduce the protected volume of tanks, reducing the overall requirement for passive armor, include designs with turretless external guns, crew in the hull configurations, and more compact power plants. Lighter materials and composites can also be used to reduce weight.<sup>7</sup>

Vulnerability reduction through the addition of passive armor has reached the point of diminishing returns. Tanks may need additional passive armor to protect selected spots, such as the top of the turret, from penetration by new anti-tank munitions, but complete, all around protection with passive armor would result in unacceptable weight increases. New defensive approaches to vulnerability reduction include reactive armor, which explodes upon the impact of an anti-tank projectile, and active protection systems that can counter armor defeating munitions through jamming or interception.<sup>8</sup> Reactive armor is already used widely by Israel and the Russian Federation.<sup>9</sup> The Russian Federation has also fielded an active defensive system that the open press claims demonstrated effectiveness against US kinetic energy tank rounds.<sup>10</sup> Neither of these approaches has yet been exploited by Abrams tanks. Electric armor, which defeats projectiles by discharging large amounts of electricity when projectiles start to pass through it, is another approach that is being explored.<sup>11</sup> Decreasing vulnerability needs to be approached holistically if serious weight reduction is going to happen on future tanks. This approach includes consideration of increased mobility, overmatching lethality, signature reduction,

combined arms teamwork, as well as defensive and protective systems to reduce vulnerability and offset the risk of reductions in passive armor.

Technology is also available to make a new tank more lethal than today's tank. These elements include digital fire control improvements such as automatic target tracking, already in use on the Israeli Merkava III<sup>12</sup> and the Japanese Type 90 tank.<sup>13</sup> A number of alternative guns systems are in research and development. An advanced conventional gun system has been developed which has demonstrated increased performance over the 120mm cannon on the M1A2 and which allows for an upgrade from a 120mm to a 140mm conventional cannon.<sup>14</sup> Entirely new types of guns are being investigated as alternatives to this conventional cannon technology. Two alternatives that employ electrical power are electromagnetic guns, which use electromagnetic propulsion to accelerate KE penetrators, and electro-thermal guns, which use electricity to add energy to propellant gases of a more conventional cannon. Both these technologies offer higher energy levels for KE penetrators, but even with sustained research and development support they may not be ready for fielding in a new tank before 2020.<sup>15</sup>

Ammunition is another area where significant lethality performance improvements are possible. Smarter and guided tank rounds have been and are being developed.<sup>16</sup> These rounds offer the potential to increase the tank's effective engagement range and probability of hit. Studies of the Tank Extended Range Munitions (TERM) concept demonstrate that a longer range guided tank round offers significant increases in tank performance.<sup>17</sup> The Russians have fielded a number of radio or laser guided anti-tank missiles that can be fired from tank cannons to allow accurate fires out to five kilometers.<sup>18</sup>

Opportunities also exist to improve the propulsion systems of tanks in order to increase their mobility and to reduce their logistical support requirements. Increased efficiencies in the

performance of air-breathing, liquid-fueled engines alone will not produce major improvements in fuel economy for the current tank. However, new high efficiency propulsion systems are available that significantly reduce the volume required under armor on tanks. A diesel alternative to a turbine engine for the M1 series tank has already been demonstrated.<sup>19</sup> Concepts for revolutionary propulsion systems are also being investigated.<sup>20</sup> Electric propulsion has been touted as a possible technology for tank application. A tank propelled by electric motors will still need a primary power source, which could be driven by a fuel-efficient engine. While this electric approach promises fuel consumption reduction, electric vehicle propulsion technology has been demonstrated only on much lighter systems, like HMMWVs<sup>21</sup> and commercial buses. The keys to fuel consumption reductions lie in reducing the weight of the tank, providing an auxiliary power unit (APU) to allow reduced main propulsion system operation, improving the tank's power management, and greatly enhancing energy storage technology. Improving power systems on tanks is particularly important considering the increasing electricity demand of modernized tanks. APUs have been mounted on M1 series tanks and an under armor APU will be part of the M1A2 System Enhancement Program (SEP) program, which will apply selected high payoff improvements to the M1A2.

The Army also has an opportunity to get a bigger payoff for its investment in its armored force by making it more mentally agile. Integration of the tank into the heavy force combined arms team through digitization offers a payoff in overall increased capability by better exploiting the tank. Digitization brings better command and control and force agility. The M1A2 was the first armored vehicle in our force to allow a significant digital data link and information sharing between combat vehicles. Any future tank must be able to be integrated into the force and the command and control structure. The Army's digitization efforts and the fielding of a digitized

division by fiscal year (FY) 2000 and a digitized corps by FY 2004 will increase the warfighting capability of the heavy force.

## CHALLENGES

A number of factors pose a challenge to the approval of a requirement document for a new US main battle tank.

**The Threat.** The US is currently the preeminent military power in the world. No one wants to take us on conventionally.<sup>22</sup> During the Cold War, the threat of massive Soviet tank armies invading Germany provided much of the justification for our own heavy force and systems. Today, we no longer need a threat based force, but rather a capabilities based force.<sup>23</sup> While the number of tanks in armies around the world is still significant, our inability to identify a specific overwhelming threat to support larger heavy forces lends support to the rationale for a capabilities based force that can be employed in a wide variety of conflicts. Not all of these possible conflicts require tanks or armored forces.

Today, the armored threat posed by our potential adversaries has diminished significantly. Many countries still produce modern main battle tanks, albeit in more modest numbers than the Soviets did in the past. Many potential adversaries are focusing investment on systems to provide capabilities to fight us asymmetrically.<sup>24</sup>

The US defense budget and the Army budget are unlikely to increase in the foreseeable future.<sup>25</sup> Critical development and procurement programs will compete for funding. Despite the balanced budget expected for 1999, the potential for future deficits will keep a lid on the defense budget. Emergence of a peer competitor with a threatening military capability might provide the

rationale for increasing budgets, force structure and procurement, but such a development is unlikely before 2020.<sup>26</sup>

The projected Army share of defense budget will be only about 24% of the DOD budget for the foreseeable future.<sup>27</sup> Decision-makers will have to carefully weigh costs and value added to the nation's defense in resource decisions for future systems. The list of systems currently being developed is longer than the shorter list that will be affordable. Systems with the most relevance across the spectrum of possible conflicts will have the best position in competing for limited budget dollars. In the near term, some of the limited funding for armored systems modernization is planned for digitization of one corps by FY 2004 and M1A2 Systems Enhancement Program (SEP), which provides only selected high payoff improvements to the M1A2. The National Defense Panel (NDP) final report indicates that some question further investment in improvements in the existing tank fleet and instead support investment in leap ahead technologies and systems.<sup>28</sup>

The development of alternative anti-armor weapon systems raises the question of the continued need for a tank. A number of new and very capable anti-tank systems have been developed, some of which can outperform tanks in long-range tank killing. These systems include the Javelin, the Line of Sight Anti-Tank (LOSAT) missile, and the Extended Range Fiber Optic Guided Missile (EFOGM), and could provide maneuver forces a leap ahead in anti-armor firepower. The Javelin is a fire-and-forget precision munition that greatly increases the lethality of the dismounted infantryman and light forces.<sup>29</sup> Its accelerated fielding helped offset the loss of the Armored Gun System program. The LOSAT missile, a terribly lethal kinetic energy missile, which can be mounted and launched from a HMMWV or an armored vehicle chassis, is

another superb defensive system.<sup>30</sup> Its missile packs significantly more kinetic energy punch than any tank round. A LOSAT system can track, engage and kill multiple targets in seconds. The EFOGM is a 15 kilometer range anti-armor missile that can launch from beyond line-of-sight miles from its target and fly under machine control to the target area. It needs only minimal operator input before it hits the target with a devastating chemical energy warhead.<sup>31</sup> Efforts are already being made to extend the range of this type of fiber optic guided missile to 100 kilometers.<sup>32</sup> Despite their tremendous lethality, these missiles are defensive systems. They cannot lead an attacking formation into a close fight, firing on the move, and protecting their operators. They can complement but not replace the tank.

The proliferation of precision guided munitions also raises concerns that the tank is no longer viable. The presence on the battlefield of growing numbers of precision guided munitions (PGM) that can kill tanks will make them increasingly vulnerable but not obsolete. The US and other countries continue to invest in PGMs, delivered by both direct and indirect fire systems. With increasing accuracy and range, PGMs provide the capability to destroy tanks from well beyond the range of current tank guns. Some PGMs attack tanks at angles of attack that take advantage of areas relatively unprotected by passive armor. Even relatively unsophisticated forces will have the ability to make the battlefield more lethal to tanks through purchasing smarter weapons.

New warfighting concepts may be the biggest threat to the requirement for new tanks. The US Army TRADOC's Army After Next (AAN) initiative is investigating scenarios using rapidly deployable battle groups that have tremendous long range precision firepower.<sup>33</sup> These formations destroy large forces without having to engage in close combat. Without tanks, cannon artillery, or even significant infantry, these formations seek to mass the effects of

precision firepower to achieve decisive results, making close combat unnecessary. This revolutionary approach is only a concept now. Its achievability will be a function of fielding many new systems. However, this type of formation could only replace a portion of current maneuver forces. Even if this sort of concept is feasible and affordable, some conventional forces must be retained in the force structure to conduct operations that this organization could not. This formation will be incapable of conducting combat against enemy forces that do not rely on combat vehicles and aircraft or opponents that operate in environments in very restrictive terrain. If we could make close combat obsolete and ensure that we would not have to send soldiers into close combat to achieve decisive results, then the rationale for the tank would be severely weakened.

### **US TANKS IN 2010**

As the Army prepares for the 21<sup>st</sup> Century, the tank remains an essential element of our ground forces. The US currently has the best tank in the world.<sup>34</sup> The M1A2 System Enhancement Program (SEP) tank will be the most modernized tank in the Army in 2010.<sup>35</sup> Leap ahead technologies that would make a revolutionary impact on tank capabilities are not expected to be technically feasible before 2010.<sup>35</sup> In 2010, the Army will have a single digitized corps and about 1070 M1A2s. Most of these M1A2s will be rebuilt from M1 tanks. The remainder of the Army's tank fleet will consist of several thousand M1A1 and M1 tanks.<sup>37</sup> By 2010, part of the Abrams fleet may have outlived its economic usefulness, and the M1A2s will be approaching 15 years of service.

The Army XXI force seeks a significant increase in agility through the exploitation of information technology. It will accomplish this, in part, by adding appliqué information

technology enhancements to current and upgraded combat vehicles. This technology, along with new organizations, doctrine and training, will allow us to move information quicker, to share and exploit an accurate and common vision of the battlefield.<sup>38</sup> Digitization is expected to enable the force to fight more effectively.<sup>39</sup> Emerging insights into digital warfare gleaned from the Army's recent Advanced Warfighting Experiments indicate that much higher levels of performance can be obtained from our current hardware with appropriate investments in automation. The development of a digitized force is a necessary development in transitioning to the future. The experiences of this digitized force will be important to exploiting information technology to the maximum extent in a future generation of ground combat systems.

While digitization and M1A2 SEP tank promise to make the force more capable and more mentally agile, system upgrades will not significantly reduce the demand for a significant logistical tail. The US tank of 2010 will not be more strategically deployable than the Abrams of today. While an auxiliary power unit (APU) will reduce fuel consumption by permitting a small generator to maintain electrical power, the M1A2 SEP tank will still be a heavy, fuel guzzler. More electronic subsystems and the increasing maintenance requirements of an aging fleet may offset improvements in maintenance reliability. Because the tanks in the field in 2010 will not significantly reduce logistical requirements or improve deployability, they will be even less capable of performing their role in the Army After Next (AAN).

The Army will face a dilemma by 2010. The US will be maintaining an increasingly aged fleet of ground systems, including heavy tanks that need to be modernized. At the same time, new doctrinal concepts will demand a physically agile force with significantly higher levels of strategic mobility to provide decisive maneuver for the AAN force. We will have fleets of very

heavy systems and a future vision of battle that requires a whole new fleet of lighter, more deployable systems.

## **TRENDS IN THE STRATEGIC ENVIRONMENT**

The Army After Next program is investigating how the Army will fight after 2010. Some factors that need to be considered in projecting the utility of evolutionary and revolutionary systems in the 2020 timeframe are: the proliferation of advanced weapons technology, the increased use of asymmetrical warfare, the increased requirement to fight in urban terrain, the continued requirement to conduct military operations other than war, new organizational concepts, and the reduced forward presence of US forces.

Proliferation of weapons technology and sales of advanced weapons mean any relative advantage in weaponry the US possesses today cannot be assumed in the future. Firepower is becoming increasingly accurate, longer in range, and more lethal. These developments call for the prudent investment in the continued improvement of our current weapons.

**Asymmetrical Threats.** If potential adversaries consider military confrontation with the US, they will look for alternative means of fighting the US. Employment of WMD, ballistic missiles, unconventional war, and information warfare are possible alternatives. Armored forces and the tank may not be part of the force required to counter these sorts of threats. This trend argues for a reduction in the relative importance of heavy forces, which will nevertheless be maintained to provide deterrence.

**Operations in Urban Terrain.** As world population grows and becomes increasingly urbanized, the terrain on which wars will be fought will increasingly include urban terrain. This

environment increases the tank's vulnerability by placing it within range of more weapons while restricting the tank's mobility. The disastrous Russian actions in Grozny, Chechnya, in 1994 are instructive.<sup>40</sup> Regardless of the many contributing factors to this debacle, one lesson is that urban warfare can be very lethal and costly. It is unlikely that the US would support the Russian approach of unrestricted firepower as a response to a similar situation of urban fighting. However, if we have to engage in close combat in cities, tanks may well be part of the combined arms team that conducts that fight. Tank ammunition must be developed for anti-materiel and anti-personnel missions in urban terrain. Future tanks need to be relevant to fighting in urban environments and restricted terrain.

**Military Operations Other Than War.** Tanks can be useful in military operations other than war. Armored vehicles were deployed to Somalia in 1993 when the level of violence demanded increased protection and lethality for our forces there. Sheridans and Bradley Fighting Vehicles were deployed to Haiti in 1994 as part of Operation Restore Democracy. Heavy forces including tanks were deployed to Bosnia to ensure adequate combat power was present, should the former warring factions in Bosnia and Herzegovina return to armed confrontation. While tanks will not always be needed in these operations, even a limited number of tanks can play an important role in these types of contingencies by providing protection for soldiers and intimidating potential adversaries.

**New Organizational Concepts.** It is noteworthy that some concepts for future maneuver organizations anticipated exploiting the Armored Gun System (AGS). The AGS is a 25-ton, highly mobile, armor-protected, tracked combat vehicle with a 105mm tank gun with less than tank survivability.<sup>41</sup> The Army decided in 1995 that the AGS would not be fielded.<sup>42</sup> The AGS program was stopped to allow available funds to pay for higher priority programs. No system

with similar capabilities is currently being fielded. Organizational and operational concepts that do require a light tank-like system like the AGS argue for a system much lighter than the current tank.

Reduced Forward Presence. Reduced forward-deployed forces increase the requirement to rapidly deploy forces from the continental US, where the bulk of our forces will be based. Tanks that are too heavy to deploy rapidly will not play a role in decisive operations envisioned for the AAN. Realistically, large numbers of tanks will not compete for airlift except under the most extreme circumstances. Tank forces will deploy primarily by sea. Prepositioned equipment will also be increasingly important, as limited numbers of tanks will be forward deployed. Reduced forward presence increases the importance of a more deployable tank.

## **US ARMY GROUND SYSTEMS IN 2020**

While the Army will have a requirement for capabilities to conduct combat operations in 2020, the traditional role of the tank may or may not still have relevance on the 2020 battlefield. The Army After Next (AAN) program aims to identify Army capability requirements after 2010. The AAN may not identify a requirement for a tank. Future combat vehicle systems modeled in AAN simulations for the fiscal year 1998 wargame do not include a tank like system in its decisive maneuver formation.<sup>43</sup> The systems simulated in the AAN studies are notional. They may never exist. They push the edge of the feasibility envelope and stretch concepts to ensure we look aggressively for alternatives if not revolutionary means of fighting and winning future wars. The value of AAN studies in these areas is that they broaden the mind, provide new approaches, challenge planners and decision makers to be creative and consider solutions from outside conventional paradigms.

Even if the futuristic systems and concepts in the AAN studies are realized as envisioned in the 1998 wargame, a tank like system will be required to conduct operations that the notional mobile strike force cannot. Across the spectrum of conflict, there is still potential for close combat to take place. American soldiers will have to operate close to populations, whose goals may include inflicting American casualties. A tank or tank like system will be required to conduct decisive ground operations. The M1A2 will be about 25 years old by 2020 and may not be able to integrate available technologies. A system with characteristics called for in the Armor School's Future Combat System (FCS) concept will be required.

Recent briefings by the Armor School do not provide a weight constraint for the FCS.<sup>44</sup> This absence of a weight constraint is likely a measure taken to support research and development of promising technologies that have a significant weight penalty given the current state of the art. The Armor School previously expressed support for a tank that weighs close to 40 tons to allow two systems to be carried on a single C17 aircraft.<sup>45</sup>

There are at least three alternative futures for the tank in 2020. The first two are new tanks: an evolutionary heavy main battle tank system or a lighter revolutionary combat system. The third alternative is a very revolutionary system that eliminates the need for anything like a tank.

## **ALTERNATIVE SCENARIO - EVOLUTIONARY MAIN BATTLE TANK**

The Army could produce an evolutionary new heavy tank albeit with revolutionary technologies that would probably weigh well over 40 tons. A distinguishing characteristic of this system will be its retention of large amounts of heavy passive armor. The advantage of this option is that it provides the crew the most survivable system in high-risk close combat. This

tank could also incorporate leap ahead technologies to enhance its lethality and survivability and to reduce somewhat its logistical tail. This future heavy tank may include an electric propulsion system, an electric gun, and electric armor. The disadvantage of this option is that it will retain too much weight, thereby retaining burdensome logistical support and transportation requirements. Without significant advances in power storage technology, the all-electric option touted as a possible solution to tank requirements will be a very heavy system.<sup>46</sup>

This first option could weigh from 40 to 80 tons based on current technology projections. If technology controls the future of the Armor School's Future Combat System instead of operational concepts, then the choice of weapons system for the Future Combat System, which may be made as early as FY 2001, may be the controlling factor in the system design.<sup>47</sup> The armament system may be an electric gun, and failing significant advances in energy storage technology, it may cause the FCS to be too heavy to be useful. A tank that is too heavy in the future will be doomed to irrelevance.

### **ALTERNATIVE SCENARIO - REVOLUTIONARY LIGHTER TANK**

The second option is a more revolutionary armored fighting system in the 20 to 40 ton range. This system would involve a tradeoff of weight and system survivability derived from passive armor for increased deployability and reduced logistical support requirements. This is the sort of system that might replace the Armored Gun System in the light strike groups envisioned in Douglas MacGregor's Breaking the Phalanx.<sup>48</sup> This system would be light enough to compete for a role in rapidly deployable strike forces. This option reduces logistical requirements and increases the possibility of rapid deployment, especially strategic air deployment. This system could perform in the close combat role like a tank, but at greater risk.

While this system could be optimized for crew protection, there is a risk this system will not provide its crew the level of protection provided by the M1A2 tank. This potentially lower level of protection would require more modifications to current fighting tactics and techniques than the heavy option noted above. Synchronization, situational awareness, mobility advantage over an opposing force, overmatching firepower, and effective massing of effects of precision fires will all be required to help ensure this system's survivability.

This option will have to fully exploit the spectrum of possible means to reduce size and weight, such as reduced crew size, crew in the hull, autoloaders, new weapons technology, and an automated defensive suite. A fighting vehicle of 40 tons or less could provide a potential platform for a common chassis for a new tank, an infantry fighting vehicle, command and control vehicle, and other combat vehicles. These systems could share high cost components, electronics, and maintenance support, reducing logistical support requirements. Their shared mobility characteristics would also allow these systems to move together on the battlefield.

Weapon system choice will be a critical factor in the design of this system. Although a missile system would afford weight reduction, adoption of a missile system as a primary anti-tank armament is unlikely. Current missile launchers cannot fire on the move and provide the rapid fire in any direction provided by the current tank. This system would retain a cannon, which could fire conventional ammunition as well as guided projectiles or missiles.

### **ALTERNATIVE SCENARIO - NO TANK**

A third possibility for the Army of 2020 is no tank at all. Such a revolutionary approach would require a new way of fighting that does not require any mobile, protected, manned weapons platform that enables offensive maneuver under fire. The systems required for this

concept would not engage in close combat. This alternative could look like the battle force of and include systems of TRADOC's AAN force in the FY 1998 wargame.<sup>49</sup> The combat systems in this study were all less than 15 tons and easily air transportable. The systems in this scenario can benefit from current research and development for armored vehicle system systems, including the development of electric propulsion, lightweight materials, electromagnetic guns, and active protection systems. This option entails the greatest level of technological and operational risk. If a force could be developed that is so lethal that its precision fires preclude a requirement for close combat, a tank would be less relevant in the future.

The strike force envisioned in the AAN wargame might be superior to conventional forces in scenarios allowing long-range fighting on open terrain, where technical means provide near perfect knowledge of the battlefield. However, much of the terrain of future wars could be in close terrain or urban areas where sensors and weapons will not allow the same rate of successful target identification and engagement. A future enemy may not have or provide a conventional threat with ground and air systems that can be easily targeted. The enemy may not cooperate and provide targets for the high tech weapons of this new battle force. The enemy may blend in with a civilian population. This strike force would have a tough time fighting an unconventional enemy in urban terrain or jungles. This unit would be less flexible than traditional maneuver forces and less capable to conduct contingencies that require soldiers to interact closely with a population such as the recent interventions in Bosnia and Haiti. It is more likely that only a part of our future force structure would transition to provide a force capable of rapid strategically significant strike operations. Even if this alternative is feasible and affordable, the US will still need a more conventional capability after 2010.

The most likely result of these alternatives will be a balance of revolutionary lighter future combat systems and new formations that can conduct some strategic operations without any tanks. While a heavy system like today's M1A2 might make sense for armies that fight on or near their borders, the force projection Army of 2020 demands lighter systems.

At some point after 2020, a system of systems with distributed sensors, unmanned ground systems, swarms of lethal unmanned aerial vehicles (UAV), and very responsive and lethal, precision firepower may make close combat weapons systems obsolete and preclude the need for placing soldiers in close combat. Through 2020 unmanned air or ground systems operating in a close combat scenario near other friendly formations would pose a high risk of fratricide. We currently rely on human judgment to make the final decision to fire in the close fight. Spatial or temporal separation of these lethal elements and reliable IFF systems would be required to prevent fratricide.

## CONCLUSIONS

The viability of a future tank is in question due largely to the tank's excessive weight, burdensome logistical tail, and limited strategic and operational mobility rather than its vulnerability to new weapons or redundancy due to the multitude of other anti-tank capabilities. However, the tank is not yet obsolete. The M1A2 SEP tank will still be in the US Army inventory in 2020 even if a new system is fielded. Selective modernization of current systems that will be retained till 2020 should be pursued. A new tank will be feasible and should be developed. It will be significantly lighter and more deployable than the current tank. It will be the product of adding active protection systems, reducing the amount of passive armor, exploiting new technologies and designs to reduce weight in order to increase deployability,

sustainability, lethality and overall effectiveness. It will be important to identify which required capabilities cannot be compromised and which can be variables in the design. The full range of the close combat combined arms team's capabilities must compensate for any reduction in protection in the tank system itself. Tanks will be less relevant to rapid deployment forces of 2020 unless they become lighter.

The AAN investigations into new ways of fighting will lead to the introduction of formations designed to conduct decisive operations that will not have tanks. This capability will only replace part of the current force structure. The US Army will need both this revolutionary capability and a tank-like future combat system capable of rapid deployment and fighting the close fight. Research and development in supporting technologies for both these capabilities should be pursued. The heavy maneuver force will be smaller in 2020, if revolutionary new capabilities are fielded. The heavy force may pay part of the personnel bill to build this new force.

Budget limitations remain the biggest challenge to modernization. Even if the Department of Defense and the Army budgets remain flat, the competition for limited funds will keep the Army from procuring many systems. The high cost of replacing equipment in a large force quickly may be prohibitive given the limited defense budget of the future. Selectively modernized M1A2s will remain in the force after 2010 and provide some close fight capability in 2020, but these heavy tanks will not be able to get to the fight fast enough to contribute significantly unless they are already forward deployed or in prepositioned stocks near the fight. These legacy systems will be retained in selected units to perform supporting or follow on tasks for modernized forces, form part of a strategic reserve, or serve as the main force to deter a simultaneous threat from a less capable adversary.

## ENDNOTES

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- <sup>2</sup> Scott R. Gourley, "Vision 2020." *Army* (February): 41.
- <sup>3</sup> Douglas A. Macgregor, *Breaking the Phalanx: A New Design for Landpower in the 21st Century*, Westport, Connecticut: Praeger, 1997. 226.
- <sup>4</sup> Robert H. Scales, Jr., "Cycles of War," *Armed Forces Journal International* (July 1997): 40-41.
- <sup>5</sup> "Systems that won the war." *Janes Defence Weekly* (6 April 1991): 551.
- <sup>6</sup> Scales, 40.
- <sup>7</sup> R.M. Ogorkiewicz, "High-Fibre Diet for Armor," *Janes International Defense Review* (January 1996): 57.
- <sup>8</sup> Eric H. Biass and Doug Richardson, "Fighting Vehicles Today, Tomorrow and the Day After," *Armada International*. (December 1997/January 1998): 29.
- <sup>9</sup> R.M. Ogorkiewicz, "Future tank armors revealed: Developments in electric and explosive reactive armor," *Jane's International Defense Review* (1 May 1997): 50-pp.
- <sup>10</sup> "Impenetrable Russian tank armor stands up to examination." *Jane's International Defence Review* (1 July 1997): 15.
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- <sup>12</sup> David Eshel, "The Merkava and More: Israeli Engineers Pioneer Survivability Upgrades For Armored Vehicles." *Armed Forces Journal International* (May 1997): 42.
- <sup>13</sup> Christopher F. Foss, "Modernization Points Way to Future MBTs," *Jane's Defense Weekly* (18 June 1997) 24.
- <sup>14</sup> Scott R. Gourley, "Latest Future Combat System plan unveiled," *Jane's Defence Weekly* (2 July 1997): 26.
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- <sup>17</sup> John C. Woznick, "TERM: The Tank Extended Range Munition," *Armor* (March-April 1997): 22.
- <sup>18</sup> Biass, 34.
- <sup>19</sup> Christopher F. Foss, "Fuel-good factor for Abrams as trials end," *Jane's Defence Weekly* (30 July 1997): 29.
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- <sup>22</sup> James M. Dubik, *Sacred Cows Make Good Shoes: Changing the Way We Think About Military Force Structure*. Landpower Essay Series, No. 97-1. Arlington, VA: Association of the United States Army, Institute of Land Warfare, February 1997. 6.

<sup>23</sup> James M. Dubik, "The New Logic: The US Needs Capability-Based, Not Threat-Based, Military Forces," *Armed Forces Journal International* (January 1997): 42-44.

<sup>24</sup> Sandra I. Meadows, "In 2025, Fast, Compact Units Will Range Over Vast Arenas," *National Defense* (April 1997): 26-27.

<sup>25</sup> National Defense Panel. *Final Report of the National Defense Panel*. December 1997. 2.

<sup>26</sup> Meadows, 26.

<sup>27</sup> Randall L. Rigby, "Director Program Analysis and Evaluation Brief to the Army War College," (4 November 1997): 4.

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<sup>30</sup> John G. Roos, "Kinetic-Energy Wallop," *Armed Forces Journal International* (August 1996): 14.

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<sup>33</sup> Robert B. Killebrew, "The Army After Next: TRADOC's Crystal Ball Eyes the Service's Shape Beyond Force XXI," *Armed Forces Journal International* 134 (October 1996): 45.

<sup>34</sup> George Patten and Craig Langhauser, "The World's First 21st Century Tank," *Army RD&A* (March-April 1997): 16.

<sup>35</sup> *Ibid.*

<sup>36</sup> David M. Cowan, "Armor Modernization," *Armor* (May-June 1997): 10.

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<sup>42</sup> John G. Roos, "Another Gun Bites the Dust: New Wrinkles in Army's Armored Systems Modernization Plan," *Armed Forces Journal International* (May 1996): 30.

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<sup>44</sup> U.S. Army Armor Center, Director, Force Development. "The Impact of Precision Munitions on the Tank." Briefing Slides. January 1998. 29-36.

<sup>45</sup> George H. Harmeyer, "Force Development -- Where We Are Headed," *Armor* (September-October 1997): 4-5.

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