AIR MECH XXI: NEW REVOLUTION IN MANEUVER WARFARE

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE

by

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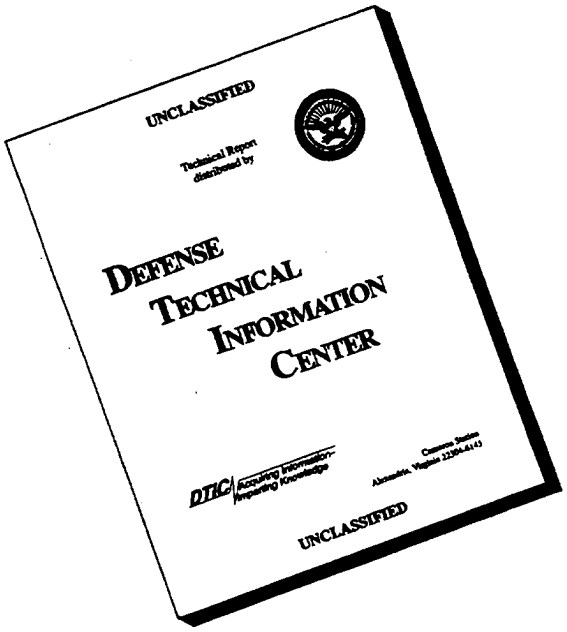

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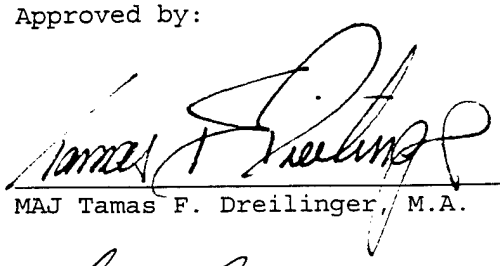

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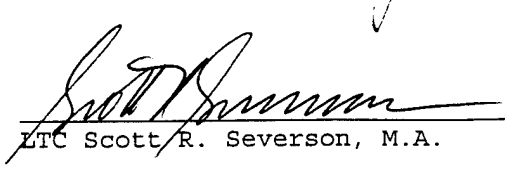

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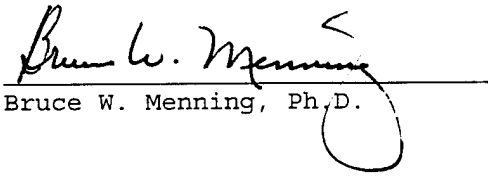

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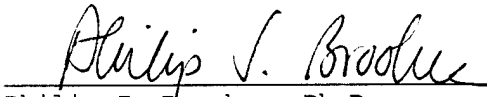

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ABSTRACT

AIR MECH XXI: NEW REVOLUTION IN MANEUVER WARFARE by MAJ Charles A. Jarnot, USA, 110 pages.

Air Mech XXI is a revolutionary concept of maneuver warfare that displaces the current heavy-mechanized doctrine as the dominate form of land combat in the next century. The concept, developed by the author, uses rotary wing aircraft to project a combined arms force that maneuvers at significantly greater speed and depth than current heavy armored formations. It solves the limitations in ground mobility, protection and firepower associated with current light force designs and maximizes the benefits of the digitalized battlefield and advances in precision weapons. The Air Mech XXI design provides a theaterwide force with air assault agility and the lethality to destroy heavy armor, while retaining a substantial mechanized combat capability. This concept sounds the end of the land battleship heavy tank doctrine and heralds the full integration of air and ground maneuver.

The proposed new warfighting doctrine is presented in an interim and objective divisional model. The interim design uses current helicopters and armored vehicles that are in production. The objective design uses purpose built aircraft and vehicles. The thesis compares the Air Mech XXI divisions to current U.S. Army organizations, to determine their relative combat value.

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INTRODUCTION

Purpose and Scope

The purpose of this thesis is to suggest that the current heavy mechanized warfighting philosophy of the U.S. Army needs to be replaced by an aircraft based maneuver doctrine. This study surveys the author's proposed Air Mech XXI maneuver concept, so titled to distinguish it from earlier airmechanization concepts, as a possible candidate to effect a new air maneuver based land force. The study's purpose is further refined to examine the Air Mech XXI model in the context of a divisional force structure. The proposed Air Mech XXI divisional models are compared to current divisional organizations in an effort to explore their relative combat value. The ultimate goal of this study is to present an argument for converting the U.S. Army's force structure from a predominately heavy design to one incorporating the Air Mech XXI concept.

The scope of the thesis covers divisional tables of organization and equipment down to the battalion level. The traditional roles of armor, artillery, and methods of command and control are addressed as they apply to divisional maneuver. Advances in information technology, termed as the "digitalization of the battlefield," are addressed as they pertain to the Air Mech XXI maneuver enabling assumptions. Tactical organizations and their key equipment are addressed that capitalize on

advances in technology involving lightweight-armored vehicles and improved lifting performance of rotary-wing aircraft. Employment doctrine is briefly discussed in order to explain the rationale behind the construction of the various organizations.

The scope of this study includes an interim Air Mech XXI divisional model that is equipped with aircraft, vehicles, and equipment that are currently in production today with only minor modifications. The equipment search includes foreign as well as domestic designs. The underlying purpose of the interim model is to show how current technology could be used to reconfigure current organizations to achieve airmechanization.

The scope includes a future objective Air Mech XXI divisional model that could be fielded by the year 2010. This objective design is based on purposed built aircraft and vehicles to maximize the benefits of airmechanization. Speculation on the future performance of rotary-wing aircraft and light-armored vehicles is based on an interpolation of current technological trends. In this example the scope of the thesis is focused on proposals or prototypes already suggested by industry. Technical problems involved with tactically transporting armored vehicles by rotary-wing aircraft are examined along with the tactical considerations of closely integrated air and ground maneuver.

The scope of the thesis briefly examines other efforts at airmechanization involving Russian and German models. No direct comparison is made to the proposed models in this study. However, their solutions to achieving air maneuver in a ground force is important to appreciating the aspects and technical difficulties addressed in the

proposed Air Mech XXI design. The German model, in particular, represents the most recent effort to fielding an airmechanized force and as a NATO member has greater relevancy to the U.S. Army force structure than the Russian design. The German model also offers a ready-made light-armored vehicle designed to be transported by American helicopters.

This thesis joins a growing number of published articles and monographs by U.S. Army officers such as Colonel Wallace P. Franz's article in Military Review, "Airmechanization, the Next Generation," that promotes new maneuver methods designed to break friction with the ground. The advances in information technology, long-range precision munitions, light-armored vehicles and rotary-wing aircraft make the concept of airmechanization worth exploring.

Research Question

Determine within the context of the U.S. Army, the net combat value of a proposed interim and objective Air Mech XXI Divisional model as compared to current airborne, air assault and heavy divisional models. Select from current technology, systems and equipment readily available that facilitates the fielding of a proposed interim Air Mech Divisional design by the year 2000. Estimate the advances in near future rotary-wing aircraft and light-armored vehicle characteristics that would facilitate the fielding of an objective Air Mech Divisional model by the year 2010.

Secondary Research Questions

Determine the optimum divisional force structure that balances the needs of air-assaulting light-mechanized forces and the air maneuver of attack helicopter and rocket artillery formations. Force structure should take into consideration current equipment limitations and reasonably forecast future capabilities to achieve an airmechanized force. The structure should address command and control as well as the possibility of redefining the roles of ground maneuver and artillery.

Is it possible to sling load a light-armored vehicle able to meet the troop and weapon requirements of the Air Mech XXI concept with the current UH-60 Blackhawk helicopter? The UH-60, now eighteen years in its fielding life cycle, still has plenty of potential for growth. The newer Lima model, introduced over seven years ago, increased the payload by twenty percent. The MH-60K special operations model has airframe modifications allowing an additional ten percent increase in lift capability over the Lima model.[1] Will these lift performances increases be sufficient along with advances in light weight armored vehicle designs to affect an airmechanized force capable of destroying heavy armor?

Will future rotary-wing aircraft technology be sufficient to lift a ten-to-fifteen ton armored vehicles over 700 kilometers round trip using terrain flight mode?

Will future armored vehicle technology be sufficient to achieve a level of protection up to thirty millimeter cannons and weigh only ten-to-fifteen tons combat loaded? Will these vehicles have room to

either transport at least eight infantry or house sufficient firepower to affect the Air Mech XXI concept?

Background

Heavy mechanized warfare has been the dominate form of land combat for over fifty years. Guerrilla type warfare, while of great concern, has not effected the worldwide balance of military power to the extent that conventional mechanized warfare has. Since its introduction by the Germans in the Second World War, it has remained the primary influence in land force structures in most armies today. Although nations developed airborne, air assault, and light infantry forces, they have remained subordinate to mechanized warfare. While such light organizations often use aircraft to gain positional advantage, they generally lack ground mobility, protection, and firepower to compete in direct fire fights against heavy armor. As a result, they are used as early entry forces or against a nonmechanized enemy in rough terrain. History has examples of light airborne forces suffering badly in operations directly against heavy armor, such as the British and Polish airborne units in Operation Market Garden during World War II.[2]

Armies have attempted to build light-armored vehicles capable of air transport to correct the mobility, protection, and firepower deficiencies of air-inserted forces. The best examples are the Russian BMD[3] and the German Wiesel[4] light-armored vehicles capable of helicopter transport, albeit the BMD via the massive Mi-6 and Mi-26 aircraft. While these vehicles show a remarkable degree of capability for their light weight, they are no match for heavy armor in a direct-fire fight. The natural physics involved in designing an aircraft and armored-

vehicle combination results in either a very light vehicle of limited combat capability or enormous aircraft that can only transport a few heavy vehicles to prepared landing areas.

Mechanized warfare enjoyed great success when first introduced against the slower foot infantry maneuver doctrine early in the Second World War. The early German victories with mechanized warfare resulted from the implementation of a new maneuver doctrine rather than simply the introduction of tanks on the battlefield.[5] Many of the Allies had better tanks than the Germans but suffered early defeats in part because they viewed tanks and artillery as supporting efforts to the foot infantry. In order to achieve a combined arms force with mechanized speed, the Germans modified the roles of infantry and artillery to support the advance of the tank. The Air Mech XXI concept takes a similar approach by modifying the traditional roles of ground maneuver and artillery to achieve a combined arms force that supports the advance of rotary-wing aircraft.

The U.S. Army Today

In the last one hundred years technological increases in firepower and protection have truly been dramatic. Brigadier General Wass de Czege, USA retired, argues that these increases have been far greater than increases in maneuver. "Increases in firepower and protection have been exponential compared to modest increases in cross country mobility since the advent of mechanization."[6] The current force structure and warfighting doctrine of the U.S. Army is dominated by the heavy-mechanized philosophy. Most of the American Army's combat power is located in heavy divisions consisting of over five hundred heavily

armored tanks and infantry fighting vehicles.[7] These forces are designed to use mechanized maneuver to gain positional advantage for the ultimate purpose of destroying the enemy with massed direct fires. Artillery, combat engineers, air defense, and aviation are in supporting roles to set the conditions for a favorable direct-fire fight.[8] Long-range fires or deep fight operations are intended to shape the close battle. To fight and survive in the direct-fire crucible, the American Army has fielded the world's heaviest and most thickly armored tank and infantry fighting vehicle (IFV) combination, the seventy ton M-1 Abrams tank and the thirty ton M-2 Bradley IFV.[9] These vehicles are designed almost exclusively for dueling with other armored vehicles. The M-1 mounts a massive 120 millimeter high-velocity direct-fire cannon and the M-2 IFV carries a high-velocity twenty five millimeter auto cannon and direct-fire heavy antitank missiles.

The remainder of the American force structure is made up of light units organized as air assault, airborne, and light infantry divisions. These light forces are designed for dismounted action in close terrain. They employ aircraft to gain a positional advantage in either airborne or air assault operations, but like their heavy force counterparts, their ultimate goal is closure with the enemy in a direct-fire fight. Light-force artillery, engineers, and aviation are all designed to support the light-infantry to this end. Generally these divisions are easier to move strategically and are often planned as early entry forces. The air assault division is the most difficult to move due to its large helicopter fleet. However, more of the air assault division's combat power can be moved per Air Force sortie than

is the case with a heavy division, that is, six UH-60 Blackhawks or AH-64 Apaches per C-5 Galaxy sortie as opposed to one M-1 Abrams tank.[10]

Heavy Division Drawbacks

The rigors of the direct-fire fight have increased the liabilities of modern U.S. heavy forces. The armored and mechanized divisions have lost their early maneuver advantages over foot mobile forces since most armies today possess a mechanized or motorized capability. Even the warlords of Somalia use armed pickup trucks.[11] The tank and infantry vehicles have greatly increased in size and weight to accommodate the necessary thick armor and increases in weapon size. The weight factor has reduced strategic mobility requiring large numbers of heavy cargo aircraft to move a relatively small armored force. To compensate, the U.S. Army has invested in additional heavy division sets of equipment and prepositioned them in expected theaters or on ships near trouble spots. The only other option is to move the force by sea lift which typically takes over a month to arrive in most potential theaters. The weight of heavy-armored vehicles also requires them to be transported by heavy duty tractor trailers from the port or storage site to the battle area. This is necessary to reduce the wear on the vehicle drive chain and to prevent the destruction of road networks. The weight and limited main gun elevation of the M-1 tank reduces its effectiveness in urban, mountainous, and wet terrain, typically found in potential theaters of operation like Korea. Heavy-armor often requires extensive engineer assistance to cross natural and man-made obstacles. For example, it took three days of intense bridging effort to effect the crossing of M-1 tanks over the Sava River in Bosnia unopposed![12]

Finally, the heavy division, with limited numbers of infantry and helicopters, is not often tasked for operations other than war (OOTW) because of its difficulty in projecting presence beyond the road networks or valleys.

Light Division Drawbacks

Despite their relative strategic mobility, light divisions are not the preferred force against an armored enemy. Although they possess varying levels of air assault agility, they lack the ground mobility, protection, and firepower to compete in direct-fire fights with heavy mechanized units. Only the air assault division has significant numbers of attack helicopters to meet an armored threat. Historically, attack helicopters have proved highly effective against attacking armor, unfortunately they have has limitations in engaging enemy forces in close terrain or in defensive positions. The light divisions use troop helicopters to offset the foot mobility of their infantry, but this has drawbacks. Because the light infantry are on foot, landing zones have to be very close if not on the objectives. This significantly reduces the survivability of the aircraft even against modest air defenses or small arms. Light forces faced with an armored threat will attempt to prepare defensive positions to gain a level of protection. However, even if successful in this, enemy armored forces often have the option to simply bypass the dug-in infantry.[13]

Technology Versus Application

The U.S. Army's keystone doctrine manual FM 100-5, Operations, identifies maneuver, firepower, protection, and leadership as the four

dynamics that make up the components of combat power. Technological capability naturally dominates the first three; however, it is leadership in all its dimensions that actually orchestrates the other components to either victory or defeat. It is the leadership factor that is the most difficult to change when emerging technology brings about a new tactical capability. One of the best examples of this is German defeat of the French in May of 1940 during World War II. The well-equipped French Army had large numbers of tanks that were superior in firepower and protection to German tanks. Despite this, the French were routed quickly by the leadership factor of generals, like Heinz Guderian who employed inferior equipment in a superior fashion. The French fell victim to the new maneuver doctrine of Blitzkrieg warfare. Resistance to change on the part of the French military leadership resulted in their maintenance of a World War I fighting doctrine where the maneuver doctrinal principle was still based on foot mobility.[14] Arguments against emerging mechanized warfare in the 1920s and 1930s centered on technical difficulties with the tank itself as justification for not adopting the doctrine. In fairness to these objections it is debatable that the tank of the 1920s or early 1930s could have been up to the task of meeting the demands of mechanized warfare. Potential does not necessarily mean ready success. The technical problems that are inherent to a given warfighting doctrine must be adequately answered. The opponents of mechanized warfare understood this as many touted the antitank rifle and later the antitank gun as the answer to mechanized attacks. New ideas on warfare are brought forward by a positive attitude focused on minimizing the effects of countermeasures

so as to realize the potential benefits of the new system or method. Stone walling a new approach by contending that current technological drawbacks will automatically preclude their use is a negative attitude that rarely advances the state of the art.

Innovative military leadership alone, however, will not assure success in battle either. Technology has a critical yet subordinate role to play in the development and application of a given warfighting doctrine. In this regard technology must, as a minimum, provide a level of performance that allows its user to achieve reasonable results albeit not the most effective or efficient. In plain language, technology must get the user in the ball park with sufficient capability to get the job done. A good example of this concept is Lieutenant General Claire Chennault's Flying Tigers in China during World War II. Chennault's P-40 fighter aircraft were laking in most technological performance parameters against the superior Japanese Zero. But was close enough in speed, range, and altitude ability as to allow the aircraft to engage the Zero in certain circumstances. Therefore, Chennault's challenge was to employ tactics techniques, and procedures that would place his Flying Tigers in those "certain circumstances." The result was a favorable three to one exchange ratio. However, had Chennault been forced to use even more outdated Brewster Buffalos the technological gap would most likely have resulted in the Flying Tigers not being "in the ball park." In such a scenario, no level of bravery or tactics would have been able to make up the difference against the superior technology of the Japanese Zero.[15]

Assumptions

Improved Situational Awareness: Digitalization of the battlefield will result in significant improvements in the situational awareness of tactical units down to squad level. Current U.S. Army Force XXI project efforts are underway that capitalize on the information explosion technology that is currently occurring in the private sector. Sensors ranging from unmanned aerial vehicles, satellites, aircraft, and ground systems will all be data linked to common collection points that will paint a highly accurate common tactical picture.[16]

Interim Air Mech XXI Division Model Must Use Currently Available Armored Vehicles and Helicopters: The armored vehicle selected must be capable of being sling loaded by the UH-60 Blackhawk minus troops. The Blackhawk, which is still in production, represents the most numerous assault helicopter with almost 1,400 fielded and has significant agility and a low tactical signature. The Chinook fleet numbers about 425 aircraft with the production line long since shut down.[17] The size of the Chinook fleet does not allow the aircraft to be dedicated to air maneuver in large enough numbers to effect airmechanization at the division level and still have sufficient aircraft to perform the absolutely essential role of aerial resupply.

It is assumed that due to constraints on the defense budget for the remainder of the 1990s, only low-risk, low-cost solutions that come from the use of currently available vehicles and aircraft should be considered. The goal of the interim Air Mech XXI Division is to prove the validity of the concept. Based on the lessons learned with the

interim design, development efforts can be realigned to field aircraft and vehicles that are tailored to maximize the Air Mech XXI concept. The timing of this is assumed to coincide with the expected replacement of the CH-47, UH-60, M-1, and M-2, which will be nearing their service life expectancy by the year 2010.[18]

Precision Munitions Attacks: The improved situational awareness brought on by the digitalization of the battlefield will facilitate great improvements in targeting capability. This factor combined with improvements in smart munitions launched from both ground and aerial platforms will allow large-scale precision munitions attacks of mechanized formations. This means that in the near future, indirect precision fires will replace massed direct-fires as the primary means of destroying large mechanized formations.[19]

Seventy Ton Tanks Obsolete: If indirect precision fires are going to replace the massed direct-fire fight, then there is no need to field thousands of seventy ton heavily-armored tanks. This assumption means that vehicles no longer have to be armored to take direct hits from other tanks. Armored vehicles need only be armored to protect against small arms and light-weight antitank weapons. Direct-fire fights will still take place between vehicles; however, these occurrences will be relatively rare and involve only a few vehicles. Under such circumstances, armored vehicles will need only a small utility cannon and a few antitank missile systems, such as the line-of-sight antitank (LOSAT).[20] These hyper-velocity missiles fire a guided penetrator at 1,500 meters a second out to 5,000 meters, which is the

same speed as most tank's main gun sabot rounds, which are only effective out to 3,000 meters.

Definition of Terms

Aircraft Combat Radius: The distance an aircraft can be assumed to fly out in a typical mission profile unrefueled and return. This figure does take into account course deviations in route of up to 15 percent necessary for tactical flight. It also takes into account the minimum time at the objective area for the aircraft to accomplish its mission. This figure does not include auxiliary fuel tanks but does include a fuel reserve.[21]

Authorized Carried Load: This figure describes the maximum number of specific items like missiles or passengers that an aircraft can carry. Space and other loading considerations effects the ACL in ways that pure payload weight can not adequately define. For example if there are only two seats in an AH-64 Apache then the ACL for crew members is two regardless of how much lift capability the aircraft may have.[22]

CH-47 Chinook Performance Data: The CH-47D Chinook first flew on 21 September 1961 and has been upgraded, such that all 450 Chinooks in the U.S. Army are the CH-47D version. The Chinook can sling load 18,500 pounds with a full load of fuel in hot-day conditions or better. The Chinook's combat cruise speed without sling loads is 130 knots or 240 kilometers per hour and with a sling load is 110 knots or 200 kilometers per hour. Combat radius with a sling load is about 150 kilometers and without is about 200 kilometers. Up to 22,000 pounds can be sling loaded for short thirty to fifty kilometer legs by sacrificing

fuel. ACL for troops with crash worthy seats removed is about fifty and with seats is thirty three.[23]

Combat Cruise Speed: The average speed that an aircraft will move during the ingress and egress portions of a typical mission. This speed assumes a low-terrain flight mode.[24]

Combat Vehicle Weight: This is the weight of the vehicle with all its assigned mission equipment like radios and weapons and the weight of all the planned combat troops or crew. This weight also includes maximum fuel and ammunition loads.

Payload: This figure describes the maximum amount of weight that an aircraft can carry after it is fully fueled and has the required crew members and equipment aboard.[25]

Sling Load Speed: The maximum speed a helicopter can attain with a sling load. This figure assumes tactical terrain flight and a heavy stable sling load. Often speeds are significantly slower when sling loads are light and large in surface area such as empty conexs.

UH-60 A/L Blackhawk Performance Data: The Blackhawk first flew on 17 October 1974 with the Alpha and Lima models making up the 1100 conventional air assault aircraft in the U.S. Army. About 65 percent are Alpha models and the balance Lima models. There are numerous other models with the other services and special operations which are not addressed in this thesis. Under most scenarios the Alpha model has a practical sling load of 6,500 pounds with a full load of fuel, the Lima model has a practical sling load maximum of 8,000 pounds fully fueled. Both models are limited by the hook and current maximum gross weight limits to 8,000 pounds sling load. The Alpha model can achieve this by

sacrificing fuel. For the purpose of this thesis the more modern Lima model is used for the interim Air Mech XXI Division model. This is consistent with current U.S. Army distribution priorities since the 101st Airborne Air Assault Division is equipped exclusively with Lima models. The combat radius of the UH-60 Blackhawk is about 200 kilometers without a sling load and about 150 kilometers with a sling load. The UH-60 combat cruise speed is 130 knots or 240 kilometers per hour without a sling load and 100 knots or 185 kilometers per hour with a sling load. ACL for combat equipped troops with crash worthy seats removed is twenty and with seats installed thirteen.[26]

Limitations

The main limitation of this thesis is the single proposal for an Interim and Objective Air Mech XXI Divisional models to promote the greater concept of the Air Mech XXI design implications. The Russian and German airmechanized models are discussed but are not used to compare with the proposed Air Mech XXI models. Another limitation is the self-imposed restriction to use only currently fielded aircraft and armored vehicles for the interim Air Mech XXI divisional model. This limits the possibilities offered by various prototypes.

Delimitations

This thesis will focus on the proposed organizational solutions to an interim Air Mech XXI division designed for fielding in the year 2000 and an objective model designed for fielding in the year 2010. Discussions on the validity of the Air Mech XXI concept in general will

be brief and focused on how the proposed Air Mech XXI divisional models would compare in overall combat value to the current divisional models.

Significance of the Study

This study literally effects how the U.S. Army will conduct operations in the twenty-first century. It is significant in being one of only a few published works proposing the airmechanization of the United States Army. It addresses the current problems with airborne and air assault force designs and is the first air maneuver model to fully exploit the benefits of the digitalized battlefield. As a concept proposal, this study has significance in being a basis for further debate on how to break friction with the ground in projecting land combat power in the future. Finally, this study has the potential for being the catalyst proposal that ultimately results in the U.S. Army adopting the Air Mech XXI maneuver doctrine.

Endnotes

[1]Christopher Foss, ed. Jane's All The World's Aircraft 1996 (Coulsdon U.K.: Jane's Information Group Ltd., 1996), 652.

[2]John D. Keegan, The Second World War (New York: Viking Penguin Press, 1989), 437-438.

[3]U.S. Army, FM 100-2-3, The Soviet Army: Troops, Organization and Equipment (Washington: Department of the Army, 1991), 4-144, 5-37.

[4]_____, ed. Jane's Armour and Artillery 95-96 (Coulsdon U.K.: Jane's Information Group Ltd., 1996), 364, 365.

[5]Kenneth Macksey, Gurderian Panzer General (London: Greenhill Books, 1992), 57-97.

[6]BG(R) Huba Wass de Czege, USA, author attended lecture given on advanced warfighting, 10 January 1996, Ft. Leavenworth, KS. handwritten notes in author's possession, (Cited hereafter as BGWDC.)

[7]_____, ST 100-3, Battle Book (Ft. Leavenworth: U.S. Army Command and General Staff College, 1995), 3-7.

[8]_____, FM 100-5, Operations (Washington, Department of the Army, 1993), 6-14.

[9]_____, ed. Jane's, Armour and Artillery 95-96 (Coulsdon U.K.: Jane's Information Group Ltd., 1996), 95,96,137,452. Review of tanks and IFVs of major armies indicate M-1 and M-2 heaviest combination.

[10]U.S. Army, ST 100-3, Battle Book (Ft. Leavenworth: U.S. Army Command and General Staff College, 1995), 3-7. Data compared to lift performance of C-5 as referenced in Jane's, All The World's Aircraft 1988-1989, 419.

[11]Major Emmett C. Shaffer, USA, operations officer 160th Special Operations Helicopter Regiment, interview by author, 12 November 1995, Ft. Leavenworth, KS. hand written notes in author's possession.

[12]Headline News, broadcast on Sava River crossing, CNN, 10 January 1996.

[13]Author's personal experience as an observer controller at the National Training Center, 28 rotations, 1989-1990.

[14]Kenneth Macksey, Gurderian Panzer General (London: Greenhill Books Ltd., 1992), 65-165.

[15]Daniel Ford, Flying Tigers: Chennault and the American Volunteer Group (Washington: Smithsonian Institutional Press, 1991), 51-75.

[16]GEN Hartzog, Commanding General U.S. Army Training and Doctrine Command, author attended lecture on the digitalized battlefield given to Command and General Staff College, 10 April 1996, Ft. Leavenworth, KS. handwritten notes in author's possession.

[17]_____, Army Aviation Reference Text for CGSC Students (Ft Rucker, AL: U.S. Army Aviation Center, 1995), 10-40.

[18]Ibid., 10.

[19]BGWDC.

[20]_____, Weapon Systems U.S. Army 1995 (Washington: Department of the Army, 1995), 183.

[21]_____, ST 100-3 Draft, Battle Book (Ft. Leavenworth, KS: U.S. Army Command and General Staff College, 1996), 20-67.

[22]Ibid., 20-67.

[23]CWO Charles Hibler and CWO Charles Aldrich, USA, senior CH-47 and UH-60 instructor pilots respectively, telephone interview by author, 27 October 1995, Ft. Rucker, AL. hand wriiten notes in author's possession.

[24]Ibid.

[25]Ibid.

[26]Ibid.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Introduction

Presented here is a review of works on airmechanization that describes the ideas of theorists, the proposed pure helicopter, antiarmor, heavy-lift designs, and existing Russian and German airmechanized models. These works help to define where this study's proposed Air Mech XXI model fits among these other proposals to achieve airmechanization. Surprisingly, there is very little published literature on the overall concept of airmechanization. Most military professionals seem to lump airmechanization as an anomaly of airborne or air assault operations. The U.S. Army, by its lack of published work on the subject, seems to have little published interest in mechanizing its air assault formations. As a result, much of the literature here is from non-American origin.

Airmechanization Theorists

The most significant published work that effects this study is Race To The Swift, Thoughts on Twenty-First Century Warfare by Brigadier Richard E. Simpkin, published in 1985. This epic work on the future of maneuver warfare represents the touchstone for all those seeking the next revolution in tactical mobility. Simpkin plays the role of his earlier countryman Liddell Hart, who in the 1920s and 1930s, promoted

the tank and mechanized warfare as the next dominate form of maneuver. Likewise, Simpkin promotes the use of the helicopter to replace the armored track as the next logical step in maneuver warfare. He is credited with coining the term "airmechanization" in this book to describe this new rotary-wing-based form of maneuver. However, a detailed reading reveals that the term is really a sort of english translation of an idea promoted in the 1930s by Soviet Marshall Tukhachevskii, to which Simpkin gives the credit for the term.[1]

Race to the Swift, Thoughts on Twenty-First Century Warfare is, however, more geared to the overall subject of maneuver warfare and analyzes the cyclic effects of technological advances on forms of warfare with a particular emphasis on maneuver. Chapter seven, entitled "The Rotary-Wing Revolution," is the most relevant to this thesis and highlights Simpkin's theories on tactical air mobility. The author is keen on the helicopter being used integrally with light-antitank forces to form airmechanized brigades[2] and divisions. Other areas that deal with this research are some historical observations that are applicable in understanding the difficulties in developing, fielding, and actually fighting a new maneuver warfare doctrine.

In analyzing the effects of technological advances on warfare, Simpkin developed the fifty-year cycle theory.[3] This idea is based on a review of history where the author states that new forms of locomotion since the industrialized age, effects maneuver warfare in approximate fifty-year cycles. Simpkin defines these advances in very specific terms, for example, he differentiates between diesel electric and nuclear submarines. The fifty-year cycle begins at the point that a

practical design emerges and is produced in meaningful numbers. Again, using the submarine example, Simpkin begins the diesel electric submarine curve at about World War I. The curve then usually represents a significantly ascending trend as representing a warfare value return.[4] The new system is shown to have a significant influence in combat operations prior to countermeasures being developed against it.

Continuing on the submarine example, Simpkin points out that the diesel electric submarine ruled the undersea fight for about fifty years, from 1914 until the early 1960s, where the nuclear submarine entered the scene. This new capability revolutionized maneuver performance to the extent that the submarine became a strategic missile and attack platform. Submarine tactical employment substantially changed and their combat value increased when compared to the diesel electric boats. Other mobility examples are given, such as the track which Simpkin shows descending in relative combat maneuver value. The author points out that while a maneuver technology may be descending it does not mean that its service life has ended. It indicates rather that its relative dominance is subordinated by a newer maneuver technology. Again the submarine example, many countries, particularly Germany, continue to build very sophisticated diesel electric submarines today. However, their design is focused at short-range coastal defense. Their relatively slow speed, small size and constant requirement to surface often make them a noncompetitor in wide ocean strategic submarine warfare.

Simpkin identifies the helicopter in the troop carrier and the attack version, as now in its apex of combat maneuver value. The

mechanization of most of the world's armies have greatly reduced the value of inserting nonmechanized troops even deep in the enemy's rear. Simpkin argues that the armed helicopter is likewise at its apex. Historically, the attack helicopter has proved to be an effective killer of large-moving armored formations. However, Simpkin's fifty-year cycle theory suggests it will decline in relevancy, due in part to its inability to conduct close terrain combat or hold terrain.

Simpkin's fifty-year cycle theory seems to have some validity in pointing out that advances in mobility technology need to be exploited early on to reap the benefits before effective countermeasures negate the advantage. The author states that its not simply a new weapon but a new way of moving combat power that seems to dominate the way wars are fought. The author's suggestion that helicopter technology overall is about half way through its life cycle seems valid considering that the new RAH-66 Comanche and the Russian Ka-50 Werewolf do not offer quantum leaps in performance. Comanche will use the Longbow radar with only twenty percent increase in speed and range.[5]

Simpkin describes the revolution in tactical mobility that the rotary-wing aircraft has made to the current day battle field. He draws interesting analogies to the development of the tank. At first it was initially a fire support platform for dismounted infantry. Twenty years later, the tank replaced the foot infantry as the dominate form of combat maneuver. In this example, Simpkin highlights some of the technical problems with mechanized warfare that plagued developers, theorists and ultimately field commanders. He contends that rotary-wing aircraft are experiencing the same sort of difficulties. His point

seems to be as a form of advice to future commanders, that is to not discount the potential of helicopters simply on the basis of their technical teething problems.

One of Simpkin's most important points that is very applicable to the airmechanization concept, is his example of the development of mechanized warfare. He shows how early tank enthusiasts like J. F. C. Fuller proposed pure tank formations of 400 to 500 tanks. He highlights Liddell Hart who argued for combined arms mechanized units with armored self propelled artillery, armored infantry carriers and then tanks all working as a combined arms team having the speed of the armored track.[6]

This issue of combined arms teams operating at the same maneuver speed, is a key point of the airmechanized concept. Currently U.S. Army helicopter forces operate as a semipure helicopter team in that the attack helicopter acts as both tank and supporting artillery platform for most air maneuver operations. Only modest efforts exist at sling loading mainly light artillery to support dismounted infantry. The armor branch is almost exclusively outside the U.S. Army's air assault doctrine which the author points out. Even the recent air transportable armored gun system (AGS) was cancelled, making the U.S. Armor branch essentially a heavy-tank corps.

Simpkin highlights the problems with the current U.S. Army heavy force structure and the complete absence of light-armored vehicles capable of air transportability. The cancellation of the AGS, to which the author of course was not aware, seems to be a step backward in the race for increased tactical mobility. Even if it had been fielded, there were no serious plans to field a companion infantry carrier

version. The AGS would have been used like the original World War I tanks, as a fire support platform for the dismounted airborne infantry! This author believes that if Simpkin were he alive today he would have found that ironic indeed.

Simpkin rejects an airmechanized model that is based on a heavy-lift helicopter and light-armored vehicle mating much the way the Russian and German models are today.[7] He argues that the duplication of having to develop both a heavy-lift aircraft and vehicle would lead to unnecessary complexity and expense. He instead suggests that the ultimate solution in achieving airmechanization is a concept he echoes from General von Senger, the main battle air vehicle (MBAV).[8] This combination helicopter and ground armored vehicle moves both through the air and makes quick landings to take cover in the terrain. The MBAV fires its weapons often using the ground for cover and concealment. A modular concept is envisioned with attack versions and troop carrying versions. The key difference is that the MBAV is armored and stays with the troops much the same way that an armored personnel carrier would.

The MBAV solution of a true flying tank is unfortunately farther in the future than Simpkin realized. He suggested this would be possible with eighties technology and pointed to the three major problems as being night vision capability, endurance and vulnerability. These three areas no doubt are important, however, the real show stopper is the rotary-wing idea itself. The nature of terrain with its forests, cliffs, hills, urban buildings, power lines, and general terrain relief does not allow even the nimblest of helicopters to perform like an

armored vehicle. The rotor blades would be a full time liability to both friendly troops and anything over six feet tall.

Endurance and vulnerability as Simpkin points, out are the other two technical problem areas facing the MBAV concept. So far there are only two proven methods for building a vertical-take off and landing machine with any tactical value: the rotary-wing method found in helicopters and the ducted fan, such as the AV-8 Harrier.

In order to gain an appreciation of the amount of lifting energy needed to construct a survivable MBAV, a comparison of a typical armored vehicle weight to horsepower ratio with a helicopter is useful. As an example, both the M-1 Abrams and the AH-1 Cobra attack helicopter have about the same amount of horsepower. The M-1 tank, however, weighs fourteen times as much as the Cobra. At the lighter end of armored protection, even the M-113 personnel carrier weighs three times as much as the Cobra and only provides protection against light arms fires and shell fragments. In order to construct a rotary-wing aircraft that offered at least small arms protection, the engines required would have to be roughly three times the size of current helicopter power plants.[9] Therefore, Simpkin and von Senger's main battle air vehicle is probably twenty five to fifty years down the road. This study agrees that a flying armored vehicle that makes tactical use of the ground, but does not rely on it for maneuver, will eventually be possible. However, such a vehicle will most likely have to wait on quantum leaps in lift technology.

Another major problem is with the vulnerability of rotor blades. It would be very difficult to build blades and the rotor head with the

shrapnel tolerance of even a lightweight-armored personnel carrier. Artillery fragments would quickly cause unacceptable out-of-balance conditions that can be catastrophic. Ducted fans may offer a method of providing some protection to the power plant but are much more inefficient at achieving the necessary thrust for hover which results in power requirement often three to four times greater per lifting ton than a helicopter. The factors of endurance, survivability, and the poor ground characteristics of rotary-wing aircraft, make the MBAV a distant concept.

Finally, Simpkin suggests a possible helicopter and light vehicle force structure for a division-sized element. This is related to the Air Mech division force structures proposed in this thesis. The author essentially recommends a model very similar to the current-day U.S. Army's Air Assault Division. He envisions this force along the lines of the Soviet operational maneuver group and depicts in his chapter entitled "Club Sandwich" the use of helicopter forces flying out to seize key terrain much the same way the U.S. Army air assault doctrine would depict.[10]

In summary of Simpkin's work, he is the first major author in the West to promote the term airmechanization as the next revolution in maneuver warfare. He advocates the expansion of the role currently played by helicopters from a supporting auxiliary to the main maneuver effort that goes beyond light infantry air assaults. Simpkin predicts the rotor will replace the track as the primary means of maneuver warfare in the early twenty-first century. The fifty-year life cycle of military technology that he shows through historical example is used to

support his arguments. Simpkin however does not adequately address the technical problems with rotary-wing aircraft and has underestimated the problems of building a combination ground and air vehicle. In doing so he dismisses the more feasible alternative of using heavy-lift helicopters and light-armored vehicles as a solution towards achieving airmechanization. The Air Mech XXI proposal differs with Simpkin by using a form of the heavy-lift option to achieve airmechanization.

"Airmechanization, The Next Generation," is a far-reaching article published in 1992, by Colonel Wallace P. Franz.[11] This article paints a general road map of the way towards achieving a form of air maneuver. Its greatest contribution to this thesis is Franz's list of seventeen key characteristics that a future force must have. The list assumes the fruits of the digitalized battlefield, where large numbers of ground and air sensors will paint a relative common picture of the battlefield for the commander. In this type of environment, Franz sees a great need for increasing the mobility of the force to capitalize on the information advantage of digitalization. Also he hints at the logical conclusion that greater mobility, will in turn prevent the friendly force from being a victim of precision munitions strikes.

Franz quickly covers the last century in maneuver warfare and points out that there are generally five levels of maneuver: the boot, the hoof, the wheel or track, the rotary-wing, and fixed wing. He claims that the U.S. Army is more track than rotary-wing and suggests an airmechanized solution based largely on Simpkin and von Senger's idea of a flying tank. Interestingly, he shows a great admiration for Russian accomplishments in their efforts to airmechanize, but does not seem to

endorse their heavy-lift model. He records the battle of Kara Marda Pass in the 1978 Somali and Ethiopian campaign. Soviet General Vasily Petrov used Cuban and Ethiopian troops to conduct a mechanized air assault of some seventy ASU-57 light-armored vehicles transported by helicopter behind enemy positions in the Pass.[12]

Franz highlights the Russian, Simpkin, and von Senger brigade and divisional airmechanized models. He draws a quick comparison to their designs and summarizes work by Simpkin and von Senger that was recorded by lectures not formally published. Franz claims that Simpkin suggested a robust division based on the current heavy-armored design that has a large attack helicopter brigade added. This model would use deep operations by attack helicopters as "independent" actions that would assist the heavy ground maneuver. Simpkin did advocate a similar concept in his book Race to the Swift, but was quick to promote a futuristic flying tank rather than using helicopters to assist heavy maneuver as Franz presents.

Franz describes a divisional model presented by von Senger in a lecture in 1983. The design had an airmobile brigade, a helicopter transport brigade, and an attack helicopter brigade. Von Senger saw this force as an operational reserve to stop penetrations in a cold war Soviet invasion of Western Europe scenario. Surprisingly, Franz does not elaborate on von Senger's influence within the Bundeswehr to eventually field a similar organization in the early 1990s and the development of the Wiesel armored vehicle.

This article makes the interesting statement that helicopters, in general, represent more operational than tactical mobility and that

tanks represent more tactical than operational mobility. Franz, like Simpkin, concludes that the answer to accomplishing both levels of mobility is a type of flying tank. The air/land Vehicle (A/LV) proposed by Franz is very similar to Simpkin and von Senger's main battle air vehicle (MBAV). He uses a modular pod to reconfigure the mission of the A/LV.[13] This study sharply differs with this approach to airmechanization. As stated earlier, the characteristics of rotary-wing aircraft, with disc diameters of at least thirty five to forty feet, are not well suited to ground movement like an armored vehicle. In addition, the vulnerability of rotors themselves would preclude their use in tank-like operations. This study agrees with the logical approach of such flying tank concepts but feels that more advanced vertical flight technology is needed to effect a combined aircraft and tank concept like Franz's A/LV.

Air Mobility: The Development of a Doctrine, is a book by Christopher C.S. Cheng, that examines the development of air maneuver in the U.S. Army and how the establishment of an organic air arm evolved into the current-day aviation branch.[14] The work is particularly useful to this study in that Cheng articulates the different advantages and disadvantages among air-landed, airborne, and air assault forces. He also focuses on the doctrinal aspects of air mobility as interpreted by senior U.S. Army leadership as well as technical problems that led to the current nonmechanized airborne and air assault force structures in the U.S. Army. Since this thesis proposes a future Air Mech divisional model, Cheng's work is very useful as a background in describing other paths in the road toward air mobility taken by the U.S. Army. This

historical perspective influenced this study's proposed force structure and fielding proposal.

The author reviews the background with the American experience in air maneuver starting from the Second World War to the present. He examines the early origins of a new type of army air arm different from the previous Army Air Corps. This organization and its growth is useful to the thesis in understanding the concept behind the rebirth of the Army Aviation arm after the separation of the U.S. Air Force in 1948.

Cheng highlights the unique feature of the U.S. Army's helicopter force, the flying warrant officer. When the Army Air Force separated, the Army retained a small organization of artillery spotting aircraft and a few fragile helicopters. Both machines were relatively unsophisticated and capable of primarily daytime fair-weather flight at very low altitudes. Instrument flying, flight with reference to panel instruments only, is a major portion of training pilots. Since these aircraft were relatively simple and not capable of instrumented flight, the U.S. Army designated warrant officers as the primary technician to perform flight duties. This also supported the Army's position that commissioned officers were mainly leaders and not technicians. This factor played in this study's development of an airmechanized force structure and affected the organization of battalions and squadrons. The assumption being that warrant officers do not receive the level of collective tactical training that commissioned officers do which this study considers essential in the execution of the Air Mech XXI concept. To compensate for this, the proposed Air Mech XXI organization has more

aviation battalions with better aircraft to leader ratios than current battalion-sized organizations.

Cheng describes how this arrangement provided a small number of commissioned officers from the other branches to act as the leadership for the few aviation organizations. Flight training for these commissioned officers was considered as just another additional skill like parachuting. These officers had to spend most of their time in their primary branch, such as infantry or armor, and only did short two- or three-year tours with aviation units. The warrant officer, however, stayed full time and flying became their only job. This system worked reasonably well in the 1950s and early 1960s; however, as the author points out, as the performance of helicopters increased, this pilot arrangement became strained. Each branch controlled a certain type of helicopter. The infantry branch controlled the troop carrier. The armor branch the scout and attack helicopter. The transportation branch the heavy-lift helicopters. Coordinated effort to formulate a cohesive air maneuver strategy was difficult without an aviation branch. Efforts remained isolated within their respective controlling branches. In addition, there was no professional aviation schools available for either the warrant officer or the part time flying commissioned officer to learn about tactics techniques and procedures for aviation employment.

The author points out that three factors are responsible for the U.S. Army's current nonmechanized air assault doctrine. The fist is that the early preturbine helicopters were not capable of lifting any more than a few soldiers much less a light-armored vehicle. This led to

the initial establishment of light-infantry tactical insertion tactics. Small helicopters would double as an air ambulance to evacuate wounded. The second factor is that the helicopter's introduction coincided with the Korean and Vietnam wars. Because of the difficult terrain, both of these conflicts placed high demands on dismounted infantry action. A relatively inexpensive and simple squad carrying helicopter was subsequently developed by the infantry who controlled troop transports. The result was the fielding of thousands of UH-1 Huey helicopters. The third factor was the lack of an aviation branch which could have centralized the development of helicopters.

In addition to the internal Army branch issues were the strong influences in the rivalry between the newly formed Air Force and the Army. Senior Army leaders such as Generals Matthew Ridgway and Maxwell Taylor after the Korean war recommended the procurement of large numbers of transport helicopters with payloads as much as five tons. Unfortunately the U.S. Air Force objected to the Army acquiring such a fleet of heavy-lifting aircraft and felt their air cargo role was being usurped by the Army. The Pace-Finletter agreement between the two service secretaries limited the Army's procurement to large numbers of light-weight squad carriers and only a few heavy-lift helicopters. [15] This inter-service friction likewise contributed to the cancellation of the AH-56 Cheyenne compound attack helicopter with speeds close to that of the current day A-10 Thunderbolt II. If the Air Mech XXI concept were to be fielded, this rivalry may occur again since the proposed future Air Mech aircraft (FAMA) would be similar in performance to Air Force cargo aircraft.

In summary of Cheng's work and relevance to this thesis, the author explains the historical backdrop that led to the current nonmechanized air assault doctrine of the U.S. Army. He captures the reluctance of the infantry branch and the opposition of the U.S. Air Force to allow anything larger than light-weight squad-carrying helicopters to be fielded in large numbers. The armor branch is restricted to aerial scouting and fire-support attack helicopters and are not key players in the air mobility/air assault doctrine developed almost exclusively by the infantry branch. The Air Mech Division model, that this study proposes, is actually the long-awaited participation of the armor branch in the business of air mobility. The Russians were able to field an airmechanized force over thirty years ago, primarily because of their better-combined arms cooperation in solving major technical challenges like air mobility. As Cheng's historical perspective indicates, the greatest challenge to the Air Mech XXI concept is the powerful branch parochialisms that exist within the U.S. Army.

The Russian Model

"Soviet Airborne Operations in Theater of War," is a comprehensive article by Dr. Graham H. Turbiville, Jr., that highlights the key characteristics of the Russian solution to airmechanization.[16] This literature and the associated references to the Russian airborne and air assault organizations is of significant importance to this thesis since the Russian model has been operational for over thirty years and has been tested in combat. The Russian airmechanized design follows the heavy-lift solution where aircraft, both fixed and rotary-

wing, transport a family of purpose built light-armored vehicles. These vehicles provide direct fire support, troop carriers, indirect fire support, and air defense artillery. Dr. Turbiville covers the background in Russian thought on using aircraft to improve a land force's mobility. Starting with Marshall Tukhachevskii in the 1930s, the Russians have been keen on trying to exploit the aircraft's ability to break friction with the ground. They have spent a great deal of effort to develop air maneuver forces which they intended to use in large operational level maneuvers. Dr. Turbiville points out that there is little difference in the thought application on the part of the Russians among air landed, airborne, or heliborne operations. Each is just considered another means of air maneuver in the context of a theater operation.

Significant to this study is the author's review of the early fielding of light-armored vehicles specifically designed for air transportability. The first of these was the ASU-57 light-armored assault gun. This vehicle first fielded in 1963 could transport six soldiers in addition to its crew. The top was open but the sides provided a degree of light-armored protection from small arms and shrapnel. The 57 millimeter gun could not stop a modern tank but would be very effective against buildings, other light-armor and infantry fighting positions. This vehicle could be parachute dropped, lifted by the Mi-8 hip series helicopters, or air-landed at a secure air strip by most of the Russian cargo aircraft. The ASU-57 was used to initially equip Soviet Airborne divisions and was used in the invasion of Czechoslovakia in 1968 where they were air landed into secure airfields

and secure key government buildings and radio stations. In rear areas, the appearance of even light armor, such as the ASU-57, would be beyond most local reaction security forces to stop.

The ASU-57 was the first major Russian installment on solving the tradition deficiencies associated with air inserted forces. The less mobile ASU-85 entered service as a heavier version, armed with an 85 millimeter cannon but only capable of only being air landed by cargo aircraft. The more versatile ASU-57 offered mechanized mobility, some armor protection, and a degree of fire power from their 57 millimeter cannon to parachute or helicopter inserted forces. But as the author points out, this was only the beginning of Russian efforts to mechanize their air maneuver forces. The ASU-57 was followed in the early 1970s by the remarkable BMD series of light-armored vehicles specifically designed for air transportability. The introduction of the BMD and all its variants shows an institutional commitment on the part of the Russians to the concept of airmechanization via the heavy-lift model. This is significant to this thesis since the proposed Air Mech XXI Division follows a similar pattern.

The coordination achieved by the Russians in fielding a sophisticated family of light-armored vehicles and compatible lifting aircraft is impressive. When the BMD-1 was first fielded in 1977, the U.S. Army employed the M-113 APC as its mechanized infantry carrier. The BMD could have easily defeated the latter in combat via its 73 millimeter gun or AT-3 Sagger wire guided antitank missile. All U.S. tanks at the time were vulnerable to both weapons. Admittedly, the BMD-1 offered minimal bulletproof protection for its crew and its

infantry traveled half exposed in the rear. The Russians continued to improve the BMD introducing a version armed with the more lethal and longer ranging AT-5 Spandrell antitank missile and a stabilized thirty millimeter automatic cannon. Both weapons are effective against even heavy-infantry fighting vehicles and the missile is effective against most tanks. Other versions appeared with troop carrying models offering complete armor protection, self propelled 120 millimeter howitzer/mortar to provide mobile fire support, and carriers for anti-aircraft weapons. At the same time improved lifting aircraft entered service like the IL-76 Candid jet transport and the heavy-lift Mi-26 Halo helicopter. As Dr. Turbiville describes in his article, the Russian fully mechanized airborne and air assault units represent the most capable combat formations able to execute air maneuver either by cargo aircraft or helicopter!

This article points out the centralized method in which aircraft are allocated for these air insertions. Dr. Turbiville states that the Russian-intended use of these forces against an enemy like NATO was to capture nuclear delivery systems or destroy key command and control centers. They were not designed to operate as a conventional force against heavy-armored formations.[17] As a result, the Russian model did not have to be able to compete against a heavy-tank force in a direct fire fight. This is a major difference in this study's proposed force structure, which is in fact intended to destroy heavy armor formations. Still, the Russian model is impressive in the way it addresses the combined arms approach to air maneuver. Today, the Russian airmechanization effort is suffering badly for lack of heavy-lift

aircraft. An updated conversation with Dr. Turbiville revealed that over half of the current Russian heavy-lift helicopter fleet has not flown this past year for want of repair parts. Since the break up of the Soviet Union, the numbers of aircraft available to the Russian Army, has sharply dropped.

The German Model

The Fallschirmpanzerabwehrbataillon, is a document that was provided by the German Army (Bundeswehr) Liaison office at the U.S. Army's Combined Arms Center at Fort Leavenworth. It describes in great detail the recent German approach to airmechanization. The German Army completed the fielding of three airmechanized brigades in 1994. These organizations are equipped with the German built Wiesel. This light-armored vehicle is sling loadable by UH-60 Blackhawk and Super Puma helicopters. The brigades have three battalions, each equipped with sixty one Wiesel vehicles. However, there are no organic aircraft assigned to the brigades. The German Army intends to centrally assign its fleet of about one hundred CH-53[18] helicopters, the task of air assaulting the battalions into position.

The German employment concept is to air assault the battalions into blocking positions and attack the enemy armor with light BO-105 antitank helicopters and towed artillery. The force can be air-landed or para dropped as well. The brigades are viewed as an operational reserve force designed to stop an enemy penetration, or in offensive scenarios, to seize key terrain in the advance of friendly heavy armor. These brigades are not viewed as a replacement for heavy armor nor are they intended to compete against armor in prolonged direct-fire fights.

The German approach is remarkable from the standpoint that they are the only NATO/Western military power to dedicate substantial resources in fielding a viable airmechanized force. The Wiesel vehicle, a study in itself, solves to some degree, the traditional mobility, firepower, and protection problems associated with air inserted forces. The German model influenced this study to adopt the Wiesel vehicle for the proposed Air Mech XXI interim division model. The battalion structures between the German design and this study's, arrived at independently, turned out to be very similar.

In summary, the German model is a scaled down version of the Russian design. It likewise uses lightweight armored vehicles to gain air assault agility, but once inserted, it fires and maneuvers much like their heavier-armored counterparts. These approaches to airmechanization can be summarized as traditional mechanized maneuver doctrine with an air transportability feature. The strength of the German model is its light-weight vehicle design which allows sling loading from midsize helicopters. This greatly enhances survivability compared to heavy-lift aircraft signatures. The weakness of the model is the lack of an all-weather heavy-attack helicopter and the reliance on a relatively small fleet of heavy-lift helicopters centrally controlled. The German Army is developing, jointly with the French, a new sophisticated attack helicopter, the Tiger, which will in the future address the former deficiency. However, there are no plans to field more lift helicopters.

The Pure Attack Helicopter Approach

"The Role of the Airmechanized Raid in Operational Maneuver," is a monograph by Major Jerry R. Bolzak that examines the possibilities of using an improved U.S. Army Air Assault Division as a raiding force behind a Soviet-type front-level assault in central Europe.[19] Bolzak uses the term airmechanization in a similar way as Simpkin in that its definition does not necessarily include the insertion of light-armored vehicles by helicopter. This monograph is useful to this thesis in that it examines the fragility of such a basically pure helicopter maneuver force. He reviews comments by General Saint, former European NATO commander, who was concerned with the vulnerability of a pure helicopter force.

Bolzak suggests a pure helicopter attack force which employs light infantry inserted by helicopters. The lack of firepower, ground mobility, and protection of Bolzak's light infantry brigades in his airmechanized raid is addressed by the author. In his model of airmechanization, the infantry become more the protectors of aviation assembly areas and logistic sites. Bolzak's design is similar to J. F. C. Fuller's pure tank models of mechanized warfare in the 1920s. He intends to carry out the air maneuver with helicopters and sling loaded artillery. The light-infantry is not the principle maneuver arm or the main enemy defeat mechanism. The fifty-year-old problem of ground mobility, firepower, and protection with U.S. Army airborne or air assaulted forces is not addressed in this monograph.[20]

Surprisingly, the author reviews the Russian mechanization of their airborne and air assault forces, yet does not comment on the

advantages of their mechanized capability once inserted. His monograph depicts the Russian model but does not compare or contrast its advantages in ground mobility, firepower, and protection. There is even some implied doubt cast on the ability of such a model to gain sufficient heavy-lift helicopter support.

Bolzak's work is important to this study in that it shows the optimum helicopter attack model. His work is representative of views held by many Army Aviation officers, that helicopters can accomplish all the necessary deep maneuver tasks. This study rejects the pure helicopter solution much the same way Gurderian, Hart, and others rejected the pure tank solution to mechanized warfare. The proposal made in this thesis is actually driven in part, on the notion that attack helicopters can't do it all! They are very mobile and can deliver heavy aerial fires, but lack the close terrain combat capability of ground mechanized units needed to complete the destruction of the enemy. The Air Mech XXI proposal is actually a combined arms solution based on the agility of rotary-wing aircraft.

The Heavy-lift Approach

"Airmechanization: determining Its Tactical Viability on the Airland Battlefield," is a monograph by Major Darrell E. Crawford, 1988, that is an excellent study that comes closest to the model proposed in this thesis.[21] Crawford, like Simpkin, correctly identifies two possible roads toward airmechanization, the combination helicopter/tank vehicle and the heavy-lift option of light-armored vehicles inserted by heavy-lift helicopters. The author promotes the heavy-lift option which is the same general path taken by this study.

Crawford envisions an advanced cargo aircraft (ACA) built along the lines of the CH-54 Skycrane helicopter that allows an armored vehicle to be carried closer to the aircraft's center of gravity thus improving maneuverability over sling loads. This is very similar to the independently arrived solution that this study proposes. He stipulates that the ACA should be able to lift an armored vehicle weighing twenty five tons. He suggests that industry officials say that such a helicopter is possible.[22] Its interesting to note that the author did not mention that the Russian Mi-26 Halo, the world's largest helicopter, is already capable of lifting nearly twenty five tons. In addition, it has been operational for fifteen years which implies that rotary-wing technology can improve on this performance.[23] The author describes using in his model Air Mech Brigade, the Cadillac Gage Stingray light tank. This vehicle weighs twenty one tons and uses the low recoil 105 millimeter main gun, which fires all the same ammunition as the standard NATO 105 millimeter including depleted uranium antiarmor projectiles. The Stingray is very similar to the U.S. Army's M-8 Armored Gun System, which was not available when Crawford did his study. He describes an armored personnel carrier that consists of a modified M-2 Bradley weighing twenty four tons. Lighter versions of the multiple launch rocket system (MLRS) is also included as are some towed howitzers.

Crawford builds his model Air Mech Brigade with a ground force regiment of two light-tank battalions and one light-mechanized battalion. The aviation complement is fairly large with 422 helicopters divided into three regiments, one heavy-lift and two attack-helicopter formations. Crawford's Air Mech Model equips and organizes the

formation to act much the same as a conventional armored force immediately after they have been inserted by aircraft. The principle effort to defeat the enemy remains the fire and maneuver of the ground mechanized and armored units albeit now sporting twenty five ton vehicles. The attack helicopters are seen in their traditional role of supporting the ground maneuver units.

This study sharply departs from Crawford's model in that the proposed Air Mech XXI Division is equipped and organized to use the attack helicopters and long range rocket artillery as the principle defeat mechanism utilizing long-range precision munitions. The ground maneuver element is not designed to engage in traditional massed direct fire fights. As a result, the need for building enormous twenty five ton lifting helicopters and fielding lighter direct-fire tanks is viewed as unnecessary. This shift in the purpose of maneuvering ground forces and the pairing of long range artillery with attack helicopters results in a significantly different approach to airmechanization than Crawford's proposal.

Crawford's model is a stand alone experimental proposal that does not indicate a progressive road map of development within the U.S. Army to achieve his desired Air Mech Brigade. For example, his advanced cargo aircraft would take at least ten years from definition to initial operational status. The author supports the key assumption that the principle defeat mechanism of enemy armored forces is the direct-fire fight. His airmechanized model uses helicopters to transport essentially a lighter version of the traditional heavy-mechanized model. He uses lighter versions of the same components found in armored units.

Crawford's work is an excellent monograph that focused the airmechanized debate towards the heavy-lift helicopter and light-armored vehicle solution. He essentially uses helicopters to gain a positional advantage on the enemy then uses conventional mechanized fire and maneuver to destroy the force. Attack helicopters are again found in supporting roles. This thesis likewise uses the heavy-lift helicopter and light-armored vehicle combination but takes an entirely different approach to the roles played by artillery, aviation, and ground maneuver in the overall achievement of airmechanization. This study also proposes an interim Air Mech XXI model as well as estimating future requirements for an objective model.

The Light-Antiarmor Approach

"Determining The Optimum Aviation Organization for the Operational Level of War," is a thesis by Major Carlton L. Hood, 1984, that examines the U.S. Army aviation force structure. He proposes an airmechanized division to be used as the operational level strike force in the defense of western Europe from a Soviet-style attack.[24] Hood proposes an airmechanized division that is very similar to the model eventually used by the German Army in the early 1990s. His model has as its ground component, a light-antitank vehicle force that is sling loaded into position by helicopters. This force fixes the enemy while an aviation brigade heavy with attack helicopters attacks to defeat the enemy. Hood's model is the logical evolution of the light air assault doctrine where antitank systems like the TOW missile are moved by helicopter into blocking positions.

The author's focus is the fielding of an airmechanized division that follows the Simpkin and von Senger model. Hood's proposal centers around a very robust attack helicopter equipped air cavalry brigade of over 250 aircraft. This formation conducts deep attacks in the enemy's rear and moves quickly over friendly areas to reinforce a ground unit experiencing a strong enemy attack. His model has a midsize lift brigade with a single CH-47-type battalion of less than fifty aircraft. Hood's airmechanized division does not employ light-armored vehicles to be sling loaded forward by helicopters. Instead it employs a light infantry and a light-antitank regiment to be air transported over friendly terrain to "complement" the attack helicopters as a blocking force. The antitank regiment does employ a motorized light vehicle similar to the TOW jeep and may be lightly armored. However, this motorized antiarmor regiment is not intended for fire and maneuver or for even providing the infantry some ground mobility once they are inserted.[25]

Hood's approach is similar to the U.S. Army's air assault division in which the total number of aircraft and their associated battalions are reflected in the air assault division's aviation brigade. The numbers of light infantry battalions are three times as many as Hood's model but the aggregate motorized antitank formations are nearly equal. A review of the thesis accounts for this trend since a good deal of his background research highlighted the history of air mobility and the fielding of the 101st Air Assault Division.

Hood makes a strong case of the airmechanized division being more cost effective than traditional heavy-armored or mechanized

divisions. This area is related to this study in terms of total Army force structure. Hood does not explore the total Army force structure issue but his comments on cost analysis is useful to this study in measuring the affordability of an air mechanized force. His basic cost analysis techniques seem sound.

In summary, Hood's proposed airmechanized division is of the von Senger type. His proposed force uses light dismounted infantry or fast antitank systems to act as a blocking force while large formations of attack helicopters maneuver to destroy the enemy. This is essentially the doctrine of the current U.S. Army air assault division with the exception that they use far more light infantry in an attempt to execute a classic direct fire fight. This model represents a middle ground between the pure helicopter approach of Bolzak and the heavy-lift model of Crawford. Both, however, differ significantly from this study's proposal which exploits emerging technology to avoid direct fire fights, while still retaining a substantial mechanized maneuver capacity.

Summary of Related Literature

The works reviewed are representative of key efforts published to define the concept of airmechanization and their associated history. Simpkin's book Race to the Swift stands out as the most analytical work done on future maneuver warfare. It provides a detailed overview of the historical efforts to gain mobility and suggests several axioms for analyzing future trends. Simpkin also describes two basic approaches toward airmechanization. One is the flying tank concept and the other is the heavy-lift concept. Other models reviewed in this chapter, help

to define this study's proposed Air Mech XXI design and where it fits in with the other approaches to airmechanization. Pure helicopter, helicopter and antitank mix, and the heavy-lift options are presented by their proponents to set the back drop for analyzing the merits of the Air Mech XXI proposal.

Endnotes

[1]Richard E. Simpkin, Race to the Swift, Thoughts on Twenty-First Century Warfare (London: Brassey's defense Publishing Ltd., 1985), 46.

[2]Ibid., 128,129.

[3]Ibid., 3-19.

[4]Ibid., 7.

[5]CWO Ronald Ferrell, USA, RAH-66 expert, interview by author, 6 April 1996, Ft. Leavenworth, KS. handwritten notes in author's possession.

[6]_____, The Race to the Swift, Thoughts on Twenty-First Century Warfare (London: Brassey's Defense Publishers Ltd. 1985), 27.

[7]Ibid., 127.

[8]Ibid., 121-125.

[9]Christopher Foss, ed. Jane's Armour and Artillery 1996 (Coulsdon U.K.: Jane's Information Group Ltd. 1996), 584,588, comparison of weight to horsepower, AH-1 Cobra weight and horsepower data reference, U.S. Army, AH-1 Operators Manual (Ft. Rucker: U.S. Army Aviation Center, 1992), chapter 7.

[10]_____, Race To The Swift, Thoughts on Twenty-First Century Warfare (London: Brassey's Defense Publishers Ltd. 1985), 145-165.

[11]Wallace P. Franz, "Airmechanization, The Next Generation," Military Review, (February 1992), 57-66.

[12]Ibid., 62.

[13]Ibid., 65.

[14]Christopher C. Cheng, Airmobility, The Development of a Doctrine, (Westpoint CN.: Connecticut Praeger Publishers Inc. 1994), passim.

[15]Ibid., 85-119.

[16]Graham H. Turberville Jr., "Soviet Airborne Operations in Theater of War," Foreign Policy, (January 1985): 164-169.

[17]Ibid., 166, 167.

[18]International Institute for Strategic Studies, The Military Balance 1995-1996 (London: International Institute for Strategic Studies, 1996), 45.

[19]Jerry R. Bolzak, "The Role of the Airmechanized Raid in Operational Maneuver," (SAMS Monograph, U.S. Army Command and General Staff College, 1990), passim.

[20]Ibid., 38.

[21]Darrell E. Crawford, "Airmechanization: Determining its Tactical Viability on the Battlefield," (SAMS Monograph, U.S. Army Command and General Staff College, 1989), passim.

[22]Ibid., 15.

[23]Norman Polmar and Floyd Kennedy, Military Helicopters of the World (Annapolis: Naval Institute Press, 1981), 138.

[24]Carlton L. Hood, "Determining the Optimum Aviation Organization for the Operational Level of War," (MMAS Thesis, U.S. Army Command and General Staff College, 1984), passim.

[25]Ibid., 157.

CHAPTER 3

RESEARCH METHODOLOGY

Addressing The Primary Research Question

This study intends to solve the problem of determining the net combat value of the proposed Air Mech Divisional models by comparing it to the current U.S. Army Divisional models in use. The format for the comparison will be a decision matrix. This will afford a method of structuring the analytical discussions of each divisional model in a logical manner. It will also allow a detailed method of defining what net combat value is through a series of evaluation criteria applications.

The initial decision matrix will have four options, the proposed interim Air Mech XXI division and the current U.S. Army airborne, air assault and heavy divisional models. A second decision matrix will follow that has the objective Air Mech Divisional model along with the other divisional models that have equipment planned for their use in the year 2010. Six states of nature or evaluation criteria will be applied against the four models. The key to this process is an understanding of the definitions used to describe the evaluation criteria. Equally important is the clear articulation of the measures used in assessing the performance of the models. The evaluation criteria will be firepower, mobility, protection, and scenario performance in operations other than war (OOTW) and general war. The definitions for each

evaluation criteria will come from the U.S. Army's FM 100-5, Operations.[1] Each of the evaluation criteria will be equally weighted. Scoring will be on a subjective scoring of first, second, third, and fourth place finishes for each evaluation criteria. Detailed discussions will follow each scoring to support the placing of each divisional model design.

Secondary Research Question Analysis

There are several supporting questions that will be answered by the outcome of the evaluation criteria as it is applied to each model. The question of optimum force structure mix that balances the needs of air assaulting a ground maneuver force and an attack helicopter element, will be answered by the decision matrix. A discussion of the mobility and firepower evaluation criteria versus the proposed Air Mech XXI model will answer the question specifically. The ability to sling load an armored vehicle able to meet the requirements of airmechanization will be addressed in the evaluation criteria scoring discussion as well. Questions concerning the development capabilities of future lifting aircraft and armored vehicles suitable for the Air Mech XXI concept will be addressed in the Air Mech XXI concept description in chapter four.

Research Outcome

Several theorist and national militaries have struggled with the question of improving land force maneuver through the air. It became necessary early on, to address the question of defining the concept of airmechanization and how this differs from other methods of air maneuver. Surprisingly there appeared to be only two broad competing

models for defining an air mechanized force, the flying tank model and the lifting of armored vehicles by helicopter. The next step in the research took the study on an examination of differing force structure options. This proved to be more complex than initially expected, stemming from the realization that deleting, adding or changing military unit structures effected several other performance variables. The danger was to focus on one effect in manipulating the varying force designs, only to discover that a particular battle operating system or other vitally important area was left wanting. The study never did find the optimum approach to this dilemma and choose instead the trial and error method in judging the effects of force structure changes.[2] A side note to this process was that in looking at other national military force structure solutions, economic considerations were dominate.

One significant difficulty in researching force structure data is that often there is no audit trail or explanation by the owning militaries as to why changes in force structures were made. There is an excellent illustration of this in the current U.S. Army's Aviation Restructuring initiative. Where previously there were two UH-60 Blackhawk organizations there are now five. Each one has about the same number of aircraft with differing internal company alignments being the distinguishing factor. U.S. Army Aviation Branch Representatives recently questioned at a student training session at the U.S. Army's Command and General Staff College could provide no clear answers to questions on the varying force structures. More telling was the inability to define the differences in the missions performed by these five different organizations.[3]

The study further found that in conducting research in force structures, equipment often affects the organizational models. A good example of this is a look at tank companies and their personnel. There are few variations in numbers and crew members assigned among most national militaries. Air defense organizations, however, are dramatically effected by the intent of the organization, such as the U.S. Army tendency to highly decentralized batteries of one type of weapon system, that is, the Stinger air-to-air missile. The Russian units, by contrast, tend towards centralized mass and have large numbers of overlapping and complementary weapon systems, that is, 2S6 gun missile vehicles and SA-8 surface-to-air missile systems.[4] The study's solution to these variances was to focus on major maneuver formations down to the battalion level and their aggregate number of key systems. As a result, the Air Mech XXI proposed force structure does not go below battalion level.

Reference texts, such as Jane's publications, use manufacture's data that sometimes reflect a sales agenda in marketing value rather than a useful number that reflects actual performance. An excellent example of this was the numbers portrayed in the sling load performance of the UH-1 Huey helicopter. The figure of 4,000 pounds hook capacity was published with no further explanation. An analysis, however, of the empty and maximum gross weights revealed that the actual sling load performance is 2,600 pounds. The hook may well be able to hold 4,000 pounds, but does not reflect the true lifting performance.[5]

The study also discovered that there were several examples of grossly incorrect data given to aircraft and vehicles that conflicted

with information gleaned from interviews with actual operators. An example of this was the published sling load performance of the U.S. Army's CH-47D Chinook helicopter. Jane's All The World's Aircraft 1994-95 states that the CH-47D can sling 22,798 pounds with a full load of fuel. Interviews with instructor pilots at the U.S. Army Aviation Center at Fort Rucker, Alabama, quote the operator's manual stating that this figure is 18,500 pounds.[6] This constitutes over a two-ton error towards an unrealistic over estimation. In a study such as this, where helicopter lifting performance is critical to the proposed force model, such errors are unacceptable. To avoid these errors, the study relied heavily on actual operator experience when ever possible.

To ensure that data researched would stand up to field review, a conservative percentage of error was entered when calculating such things as combat radius and sling-load performance. The author's experience as an observer/controller at the National Training Center, four-year assignment in the U.S. Army's air assault division, and bachelor's and master's degrees in aerospace were used to judge data published in various reference texts.

Interviews with actual operators, however, point to issues, such as unit standard operating procedures, that would require the aircraft to fly in combat with two-door gunners, survival kits, and varying loads of radios and ammunition. Armored vehicles in actual use collect substantial amounts of mud and dirt that can effect a vehicle's sling load weight by as much as 10 percent. These real-world factors were considered in this study. The result is that the data and their conclusions have an increased degree of confidence than simply

replicating book values. A draw back to this approach is that critical analysis of the study may call into question the validity of these operating factors which are difficult to quantify.

The study used the development histories of different vehicles and aircraft to gain a better appreciation of what could be expected in performance of equipment that could be available in the year 2010. The advantage of using this technique is the conservative nature of statistical percentages. For example the lifting performance of a certain class of aircraft can be calculated to reveal the average rate of increase over the past thirty years. This number can then be used to predict an expected level of performance for a future date. While other variables may come into play that may skew such simple linear analysis, there remains a common trend that can lend to a sound conclusion of what the range of actual performance may be.

How the Air Mech XXI Model was Developed

The author has worked on this concept for nearly twenty years, dating back to undergraduate studies at Western Michigan University in 1978, under the mentorship of Dr. Sherwood Cordier. The approach to developing a land force air maneuver model, centered heavily on the constant comparison of the lifting performance of current helicopters and the weights of available armored vehicles. This literally became a "marriage" search to find the ideal combination. Over one hundred different light-armored vehicles were matched to the lifting performance of dozens of different helicopters. With each possible combination, the question was always applied as to how well the armored vehicle would stand up to a direct fire fight with heavy armor. As the author's

experience in armored warfare grew from assignments as a tank platoon leader, the results were discouraging. Historical accounts of light versus heavy armor engagement led to the early conclusion in the mid-1980s, that light-armored vehicles sling loaded by helicopters could only support but not displace heavy mechanized maneuver.

The author concluded from assignments as an attack helicopter pilot, that such platforms would not be able to conduct close terrain combat. Attack helicopters were viewed in the analysis as elements that required large treks of terrain to exploit their chief advantage of air mobility. To restrict their employment in close terrain operations seemed to be akin to using tanks in urban street fighting! In attempting to construct a division that relied on rotary-wing agility, the close terrain dimension needed to be addressed.

The author concluded that the U.S. Army's air assault doctrine was not the answer to an air maneuver force capable of destroying heavy armor. Even the large numbers of attack helicopters found in the air assault division would be limited against armor in woodland terrain or in defensive positions. Another problem is the limitation of attack helicopters to carry sufficient ordnance to destroy significant numbers of heavy tanks. The final analysis of the air assault division model, led to the author's conclusion that it was a pure attack helicopter solution. The other elements in the division, light infantry and light artillery, lacked the ground mobility, protection, and firepower to compete in a fight with heavy armor.

The solution to building an air mobile force able to destroy armor in detail, seemed locked between the pure attack helicopter option

and the fielding of monster rotary-wing aircraft to transport light tanks. Faced with solutions that probably would not solve the problem, the author re-examined the validity of the base assumptions. If the keys you have will not open the door, then change the lock! The author revisualized the whole problem during December of 1995. The solution to an air maneuver force that could displace the heavy force design, lay in the redefining of the roles of the combat arms elements. New advances in situational awareness, brought about through the digitalization of the battlefield, long-range precision munitions and sensor technology seemed to point towards the end of massive direct fire fights. This opened up the possibilities of building a force structure that freed attack helicopters from having to attempt close terrain combat and facilitated the air assault agility of the armor and artillery.

Armed with a new set of base assumptions, the author focused next on using currently available aircraft and equipment that could be re-configured to fulfill the new modified roles for ground maneuver and fire support. The German Wiesel was the logical choice as a base interim vehicle since it was designed to be sling loaded by the U.S. Army's most numerous lift helicopter, the UH-60 Blackhawk. The up-armored version of the HMMWV was considered but was not selected because the vehicle is 2,000 pounds heavier which meant that vehicle and personnel could not be sling loaded together. Compared to the Wiesel, the HMMWV, being a wheeled vehicle, has less cross country performance, has less armor protection, and is not amphibious. The Wiesel had the added advantage of being smaller, allowing two to be internally carried in a CH-47 or CH-53 helicopter. This internal carrying feature would

facilitate a faster speed and closer terrain flight mode for the CH-47 and CH-53 aircraft. The HMMWV option did have the advantage of greater cargo area, less operating cost due to commonality with the large fleet already in the US inventory, and faster road speed. Ultimately, a detailed cost analysis and field testing would be necessary to determine whether the Wiesel or an up-armored HMMWV would make the best interim Air Mech vehicle.

High mobility artillery rocket system (HIMARS) technology was tapped to envision a trailer version that provided massive fire support with air assault agility. Since artillery could now move at the same approximate speed as attack helicopters, they could provide the massive weight of fires to destroy most of the massed armor. This in turn doubled the endurance or range of attack helicopters that could now trade half their ordnance loads for fuel.

The final factor applied to building the Air Mech XXI force design was the requirement that everything in the division had to be transportable by helicopter. Ideally, eighty percent of all the division's equipment should be transportable by UH-60 Blackhawk with the remaining twenty percent by CH-47 Chinook. This is not that significant of a problem for weapon systems, but rather a nightmare for the logistics tail. The current U.S. air assault division for example, has literally hundreds of ten ton trucks and numerous 5,000 gallon tankers to sustain operations. Obviously this equipment is not transportable by helicopter. This results in a force that has local air assault agility out to 150 to 200 kilometers, but is tied like a ball and chain to the division base support, which is dependent on hundreds of heavy trucks.

This reduces the sustained mobility of such a force to mechanized speed. To avoid this mechanized dependency, the Air Mech XXI division incorporated three assault helicopter regiments for the purpose of sling loading the required fuel, ammunition, and lightweight maintenance shops in order to sustain overall air assault agility. Trucks would be used extensively throughout the division's logistic and support structure but would consist of lightweight vehicles such as the high mobility multipurpose wheeled vehicle (HMMWV) series. These sling loadable vehicles are now available in 1 1/4-ton models with a three passenger over cab design, greatly improving cubic hauling space.[7]

Portable 500-gallon fuel blivits would be used to sling load the significant fuel requirements of the Air Mech XXI division. This would be supplemented by U.S. Air Force C-130 sorties that would either air-land fuel in forward strips or para drop blivits in landing zones. The future objective Air Mech design would be substantially less fuel sensitive given the 300 percent increase in range of a tilt rotor design over a pure helicopter and a midair refueling capability.

Endnotes

[1]U.S. Army, FM 100-5, Operations (Washington: Department of the Army, 1993), chapter 2.

[2]Institute for Strategic Studies, The Military Balance 1995-1996 (London: Institute of Strategic Studies, 1996), 145-354.

[3]_____, Aviation Restructuring Initiative Student Text, (Ft. Rucker: U.S. Army Aviation Center, 1995), passim.

[4]_____, FM 100-2-3, The Soviet Army: Troops, Organization and Equipment (Washington: Department of the Army, 1991), 4-144.

[5]Christopher Foss, ed. Jane's All the World's Aircraft 1996, (Coulsdon U.K.: Jane's Information Group Ltd., 1996), 558-562.

[6]CWO Charles Hibler, USA, Senior CH-47 instructor pilot, telephone interview by author, 27 October 1995, Ft. Rucker, AL. hand written notes.

[7]AM General, "AM General Corporation: Number One in Tactical Vehicles," (Military Technology, March 1995), 42-48.

CHAPTER 4

ANALYSIS OF THE INTERIM AND OBJECTIVE AIR MECH XXI DIVISION MODELS

Introduction

The Air Mech XXI concept and proposed divisional models will be presented first. The concept will be followed by a description and organizational breakdown of the heavy, airborne, and air assault divisional models. The definitions of the evaluation criteria will follow the division models. Each evaluation criteria will include a discussion on how the criteria will be measured. The decision matrix will then be shown followed by an analysis that explains the scoring performance of the various models.

The Air Mech XXI Concept

Even before World War II, theorists envisioned using aircraft as a means of projecting armored vehicles over the ground. Soviet Marshall Tukhachevskii, in the early 1930s, published ideas about mechanized airborne troops to project combat power in a form of deep operations.[1] Recently, British Brigadier Richard E. Simpkin promoted a modern version of airmechanization in his 1985 book Race to the Swift. Simpkin built on the Main Battle Air Vehicle (MBAV) flying tank concept which was originally the brainchild of Germany's General Ferdinand von Senger und Etterlin.[2] The German Army, influenced by von Senger, fielded three

"air mech" brigades equipped with the lightweight helo-transportable Wiesel armored vehicle in 1994.[3] The Russians since the 1960s, have developed the lightweight BMD to equip airborne and air assault units along with huge helicopters to transport the vehicles. The term airmechanization, therefore, has come to be understood as some form of air mobility with a ground-mechanized capability. However, the German and Russian airmechanized units, despite their advantages in ground mobility, protection and firepower over U.S. light force designs, can not compete in a direct fire fight against heavy armor. The four ton Wiesel or the eight ton BMD armed with light cannons and antitank missiles, are no match for the seventy ton M-1 tank and its heavy direct fire cannon. In addition, both nations have had difficulty fielding the numbers of heavy lift helicopters required to affect an airmechanized doctrine.[4]

The Air Mech XXI concept charts new ground in airmechanization by departing from the force design assumption that the direct fire fight is the ultimate enemy defeat mechanism. The explosion in information technology is already digitalizing the battlefield. This in turn will lead to far greater situational awareness. Even at company level, ground and airborne sensors with radio and nonjammable fiber optic links, will make it nearly impossible for an enemy armored formation to approach undetected. Heavy mechanized units will be tracked at great distances and destroyed by indirect precision munitions attacks (PMA). PMAs will render large-scale direct-fire fights between massed armored formations obsolete.[5] During Desert Storm, indirect fires both precision and nonprecision, destroyed more Iraqi armor than tank to tank direct fire fights.[6] If massed direct fire is no longer the prime

objective of maneuver, then armored vehicles no longer need to be equipped with huge direct fire cannons, heavy depleted uranium armor plate, and weigh seventy tons! Armor protection need only be designed to meet small arms, shrapnel, and hand held weapon threats. Armored vehicles no longer encumbered with meeting the rigors of tank-to-tank duels, can be designed light enough to gain air assault agility, yet possess the lethality through high technology indirect weapons to destroy massed armor!

Armor Redefined

Air Mech XXI redefines armor away from the current heavy Iowa Battleship model to the light Aegis Cruiser design. Air Mech armor provides the close terrain combat force missing in pure attack helicopter operations and the ground mobility, protection and firepower missing in light infantry units. The air assault agility of this force will allow units to quickly gain positional advantage against armored formations from any direction or flank. Once air inserted this force then uses its mechanized capacity to ground maneuver into battle positions. Air Mech armor then executes precision munitions attacks (PMAs) from safe standoff positions using exact targeting data from organic and higher echelon sensors. Following the PMAs, Air Mech infantry maneuvers in close to complete the destruction of the enemy. Direct fire between armored vehicles will be a relatively rare occurrence involving only a small number of participants. To win these few direct fire engagements, Air Mech Vehicles (AMVs) will rely on improved situational awareness to enable first shot kills via packs of hypervelocity missiles similar to the current line of sight antitank

(LOSAT) missile. Even against an enemy entrenched in prepared defensive positions, Air Mech armor units will be able to air assault to a positional advantage, dismount their infantry and reduce the defenses supported by precision munitions, heavy artillery and close air support.

Artillery Redefined

Air Mech XXI redefines the traditional role of artillery from directly supporting ground maneuver to a main effort in itself. Artillery rocket and missile systems would team up with attack helicopters to form an aerial strike force that engages large heavy armor formations at great distances. Air mech artillery moves away from cannon systems in favor of rocket missile platforms. The trailer mounted artillery rocket system (T-MARS) is a proposal that marries the multiple launch rocket system (MLRS) pod to a one-time-use trailer mounted launch platform (see figure 1). T-MARS would be sling loadable by UH-60L helicopters giving the artillery air assault agility.[7] T-MARS systems would be issued as a unit eliminating the need for heavy launch vehicles. The concept would allow the artillery commander to air-insert T-MARS anywhere on the battlefield including the enemy rear or flank areas, then fire them via data link. Enemy counter battery would be useless since they would destroy an unattended empty trailer! T-MARS greatly increases the ability to mass fires since all the T-MARS available could be fired at once! The air assault agility of artillery would be used in conjunction with attack helicopter deep attacks and would provide the majority of the massed firepower. This would free attack aircraft to engage softer high payoff targets, carry more fuel for greater range and endurance and provide artillery targeting and

battle damage assessment data. The economy of cannon fired munitions would come from lightweight 155 millimeter howitzers, also sling loadable by UH-60s,[8] directly assigned as battalions to maneuver regiments. Over time these would be replaced by heavy 155 millimeter mortars mounted on future air mech vehicles (FAMV) and assigned as a battery in each maneuver battalion. These heavy mortars would probably travel in sections with the maneuver companies and provide responsive fires out to a maximum range of about fifteen kilometers. The 155 millimeter caliber would allow the heavy mortars to fire the full family of ammunition including simple high explosive, duel purpose, scatterable mines, and precision antiarmor munitions.

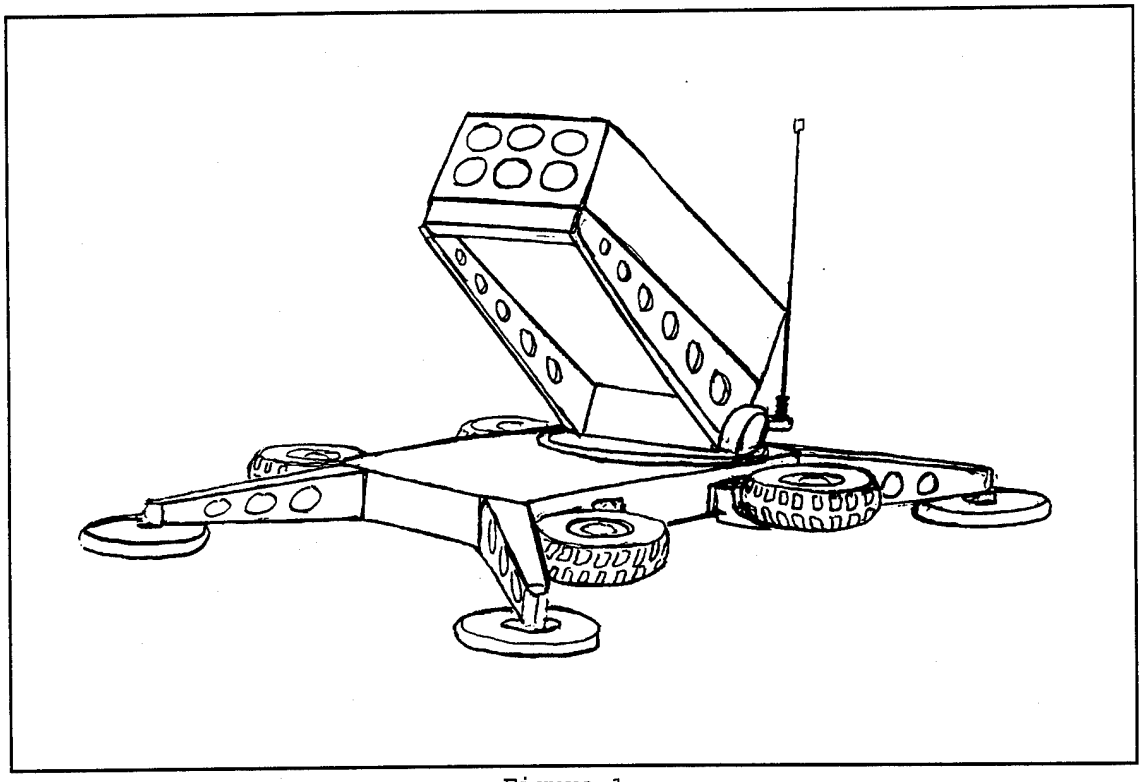

Figure 1.
Trailer Mounted Artillery Rocket System (T-MARS)
Drawing by Major Chuck Jarnot

Command and Control Redefined

Air Mech XXI forces operate at a speed and depth that despite improved digital communications, requires a new delineation of command and control responsibilities. Air Mech XXI divides the battlefield according to battle space rather than the traditional linear partitions. The strike force of attack helicopters, air assault capable artilleryand air defense, which conducts nearly all of their operations in the airspace medium, is responsible for all airspace. The agility of aircraft, the responsiveness of long ranging rocket and missile artillery and the need for quick air defense reaction demands a controlling authority equally as responsive. A division staff cell, which does not directly control airspace users, would not meet the needs of a fast paced precision munitions attack. Other nonstrike elements would coordinate for airspace use with the strike force where a small lag in responsiveness would be acceptable. The Air Mech XXI armor force, which conducts most of its operations on the ground, likewise is responsible for the tactical management of terrain. This will greatly simplify the clearance of fires and the speed of the ground maneuver since all ground warfighters are owned by the Air Mech XXI armor force. Finally, the Air Mech XXI force uses functional regiments rather than the traditional separate battalions and companies. This frees divisional staffs to concentrate on planning and places a full colonel in "command" of various supporting efforts versus loose supervision by a chief of staff.

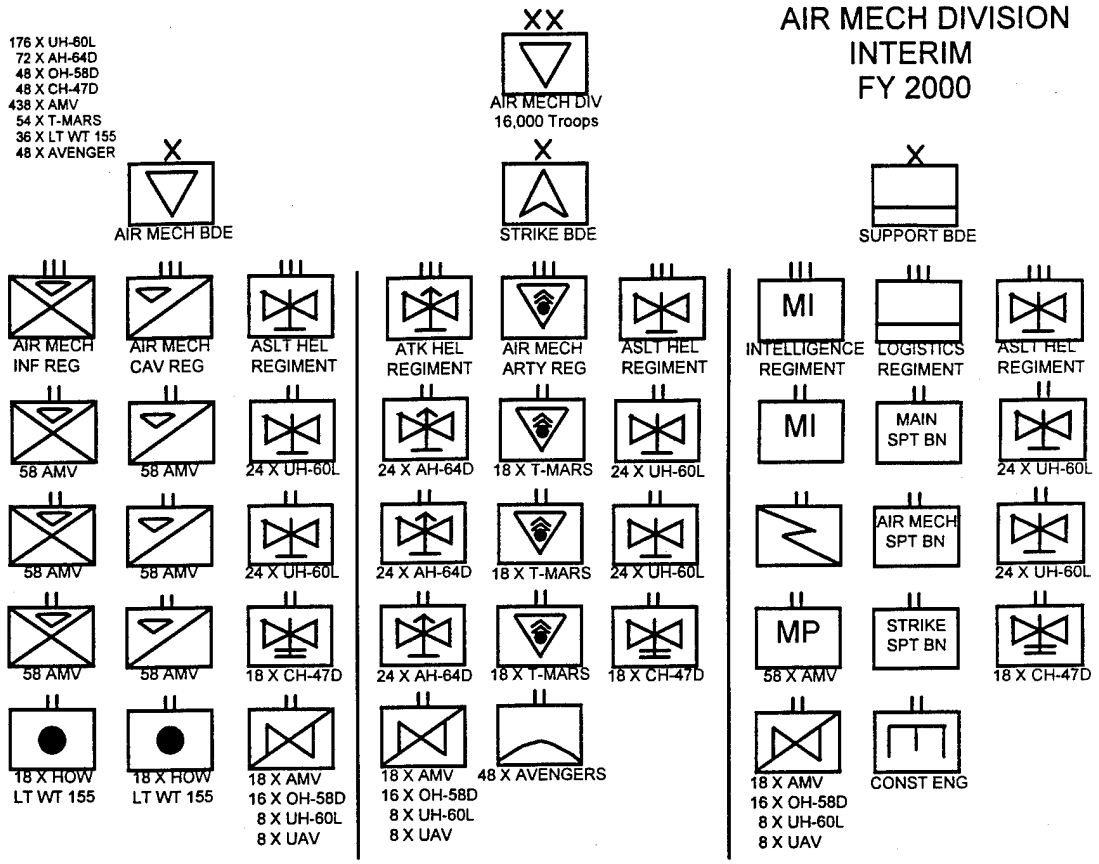

Figure 2

Air Mech Division

The Air Mech XXI Division (see figure 2), is proposed as an interim then objective model for the U.S. Army. The interim design uses currently available equipment, vehicles, and aircraft and could be fielded in the year 2000. The objective design would feature purpose built vehicles and aircraft and would self deployable to any theater. Both Air Mech models would be organized as a three-dimensional force with one air mech brigade, one strike brigade and one support brigade, each commanded by a brigadier general. The Air Mech XXI Division would have sufficient rotary-wing aircraft to air assault half its combat

force in a single lift and to rely entirely on air lines of communication and resupply. The interim design would typically operate to a depth of 300 kilometers and the future objective model out to 700 kilometers.

The Air Mech Brigade

The interim air mech brigade is organized with one air mech infantry regiment and one air mech cavalry regiment each equipped with the German designed Wiesel armored vehicle. This armored tracked

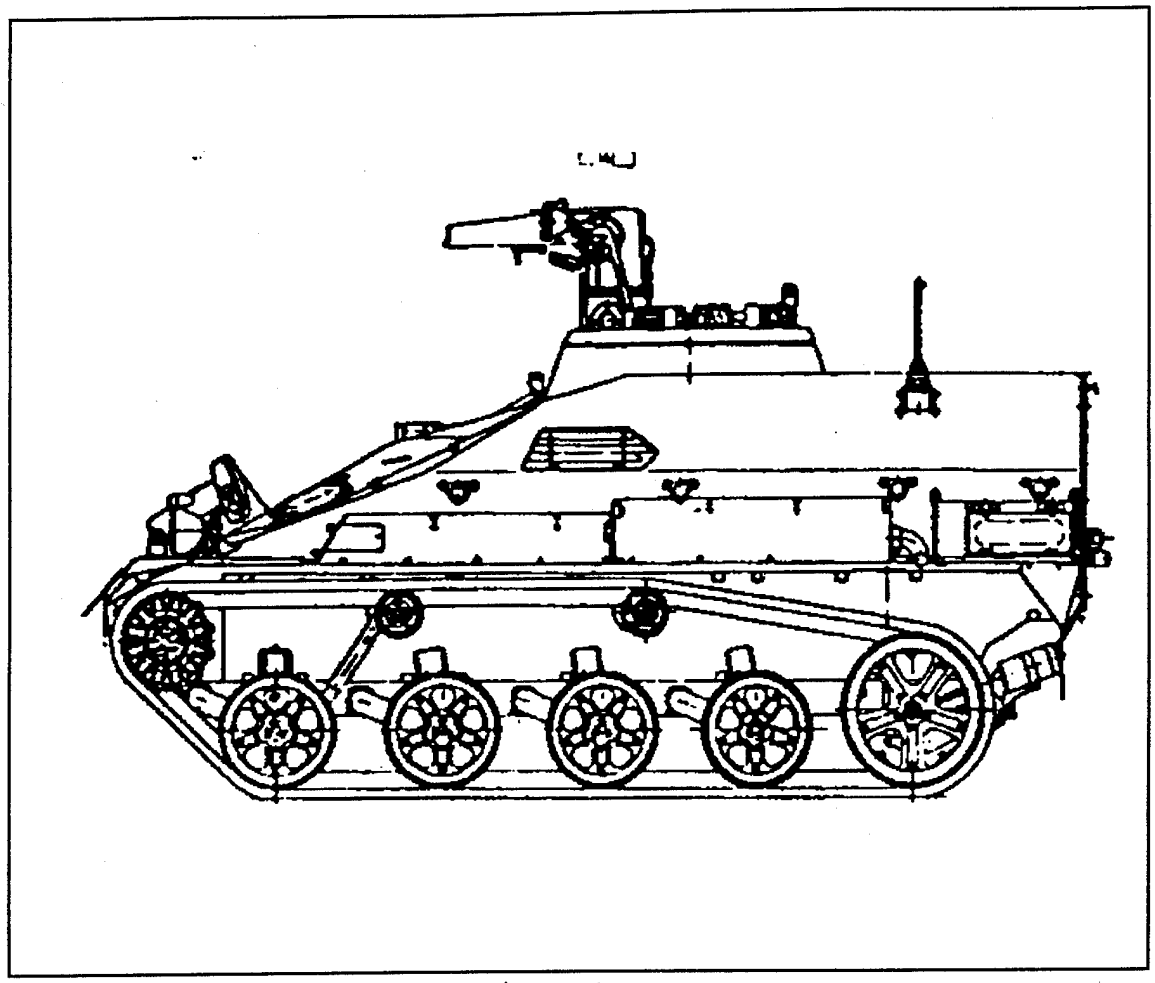

Figure 3.
Wiesel Air assault Armored Vehicle
Jane's Armour and Artillery 1995 p 364

vehicle is light enough to be sling loaded by UH-60L Blackhawk helicopters and comes in infantry carrier, fire support, and antitank missile versions. The Wiesel provides tracked mobility and armored protection up to 7.62 millimeter for its crew of six soldiers or two soldiers and heavy weapons (see figure 3).[9] The Wiesel greatly enhances air assault survivability by allowing landing zones to be well displaced from their objective sites. Each regiment has its own lightweight 155 millimeter howitzer battalion for direct support. The brigade has an assault helicopter regiment to provide the lift for the Air Mech infantry and cavalry regiments. The assault regiment provides supplemental fires with UH-60s armed with Hellfires and Hydra 70 rockets as well as fires from the reconnaissance squadron OH-58D Kiowa Warriors. The brigade acts as the division's anvil and is employed in blocking positions against enemy armor and uses sensors to conduct precision attacks against approaching armor. It also conducts follow on fire and maneuver using its mechanized infantry to reduce enemy strong points and complete the destruction of the enemy following precision munitions attacks.

The Strike Brigade

The interim strike brigade is organized with one attack cavalry regiment equipped with AH-64D Apache Long Bow helicopters organized as three squadrons of twenty four each. The attack cavalry regiment has its own reconnaissance squadron equipped with OH-58D Kiowa Warriors, unmanned aerial vehicles (UAVs) and ground scouts mounted in Wiesels. The brigade has one air mech rocket and missile artillery regiment organized with three battalions of eighteen trailer-mounted artillery

rocket system (T-MARS) prime movers each. The brigade has its own assault helicopter regiment to provide lift for the T-MARS and aerial resupply to the attack helicopter regiment. In addition, the assault helicopter regiment can supplement the aerial fires of the attack cavalry regiment. The brigade is the division's hammer and operates as an attack helicopter/rocket artillery team that can quickly execute an overwhelming precision munitions attack (PMA) on an armored force out to 300 plus kilometers. As the proponent for all the division's airspace, the brigade also employs the air defense battalion which uses Avenger systems that can be sling loaded by UH-60L helicopters.

The Support Brigade

The support brigade has one logistics regiment which is organized with two forward support battalions tailored for the air mech and strike brigades and a base support battalion. Additional logistic support is embedded in robust company size organizations in each of the combat battalions. Most of the resupply of the brigades will come via the assault helicopter regiments organic in each brigade. The division will operate nonlinearly from remote assembly areas separated by long distances. Aerial resupply is therefore the primary means of supporting the Air Mech XXI division. The brigade also has support responsibility for the intelligence regiment. This organization works directly for the division commander and provides the necessary intelligence gathering, analyzing, and distributing to the combat elements. The brigade has an organic assault helicopter regiment to provide aerial logistics to the brigades, reinforce major air assaults, and supplement aerial fires.

Future Air Mech Aircraft

The future Air Mech aircraft (FAMA) would replace the UH-60 and CH-47 in the Army inventory beginning on or about the year 2010 (see figure 4). The aircraft would most likely resemble an improved version of the current V-22 Osprey tilt rotor. The FAMA would be required to transport internally a ten to fifteen ton vehicle over 700 kilometers using close terrain flight flying at 200 plus knots and return in one fuel load. Already the V-22 can nearly meet this parameter with a six-ton load demonstrating the feasibility of such performance.[10] The FAMA would use bomb-bay type doors to wrench the Air Mech vehicles to the ground. This combines the advantages of internal and external loading which allows greater range and stealth without prepared landing areas. The FAMA would feature a cruise speed of 250 knots and aerial refueling which would make the aircraft self-deployable worldwide. The division as a whole would of course not be self deployable. However, the ability to move key weapons systems without reliance on Air Force cargo aircraft would greatly enhance force projection. The attack aircraft in the objective Air Mech Division would be an improved RAH-66 Comanche that was modified as a compound helicopter and designed to cruise at 250 knots. This modification would involve application of the Piasecki vectored thrust ducted propeller (VTDP) concept and would result in a pusher tail configuration similar to the AH-56 Cheyenne.[11] This higher cruise speed combined with aerial refueling would likewise make the Comanche self deployable to any theater worldwide. Several design proposals from Piasecki have been done for AH-64 and AH-1 aircraft.

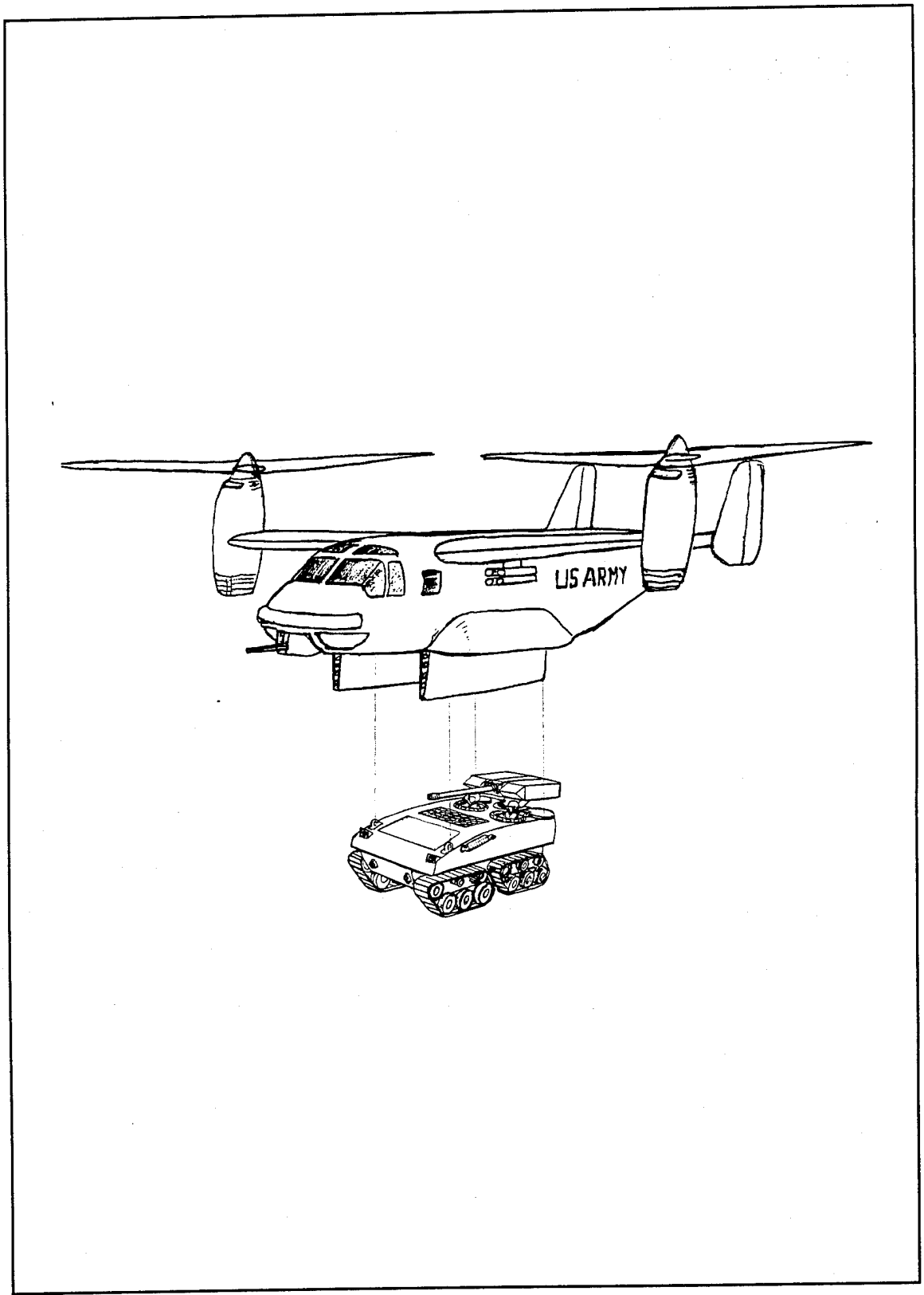

Figure 4.
Future Air Mech Aircraft
Drawing by Major Chuck Jarnot

Future Air Mech Vehicle

The future Air Mech vehicle (FAMV) would be approximately the size of an M-113 armored personnel carrier but would use advanced composite armor (see figure 5). Dual engines and tracks would be employed to add redundancy in the event of hits from mines or antitank weapons. Internal blast shields would also be used to limit damage from armor penetrations and the unmanned pedestal weapons turret would provide hull defilade attacks without exposing the crew. The FAMV would externally all look the same to complicate enemy intelligence efforts, but internally would be configured as a tank, personnel carrier, command and control vehicle, self propelled mortar, and air defense platform.

The FAMV tank would have a crew of two with a two man dismount team. The personnel would be seated to the rear and use virtual reality visors to observe and identify targets from vehicle-mounted sensors or input from higher echelon. Millimeter wave radar and thermal vehicle sensors would be supplemented by direct view periscopes. In the center, a bank of vertically launched antitank, antipersonnel, antiaircraft, and reconnaissance missiles would provide the long-range eyes and indirect firepower to execute precision munitions attacks. The pedestal turret would feature a general purpose cannon of thirty to fifty millimeter caliber and stations to put direct-fire hypervelocity missiles or other weapons as required. The personnel carrier version would have infantry seating in place of the bank of vertically launched missiles. Armor protection overall would be similar to present day M-2 Bradley infantry fighting vehicles. This equates to impacts up to thirty millimeter cannon rounds and light hand-held antiarmor weapons. Already United Defense manufactures a version of the M-113 to this specification.

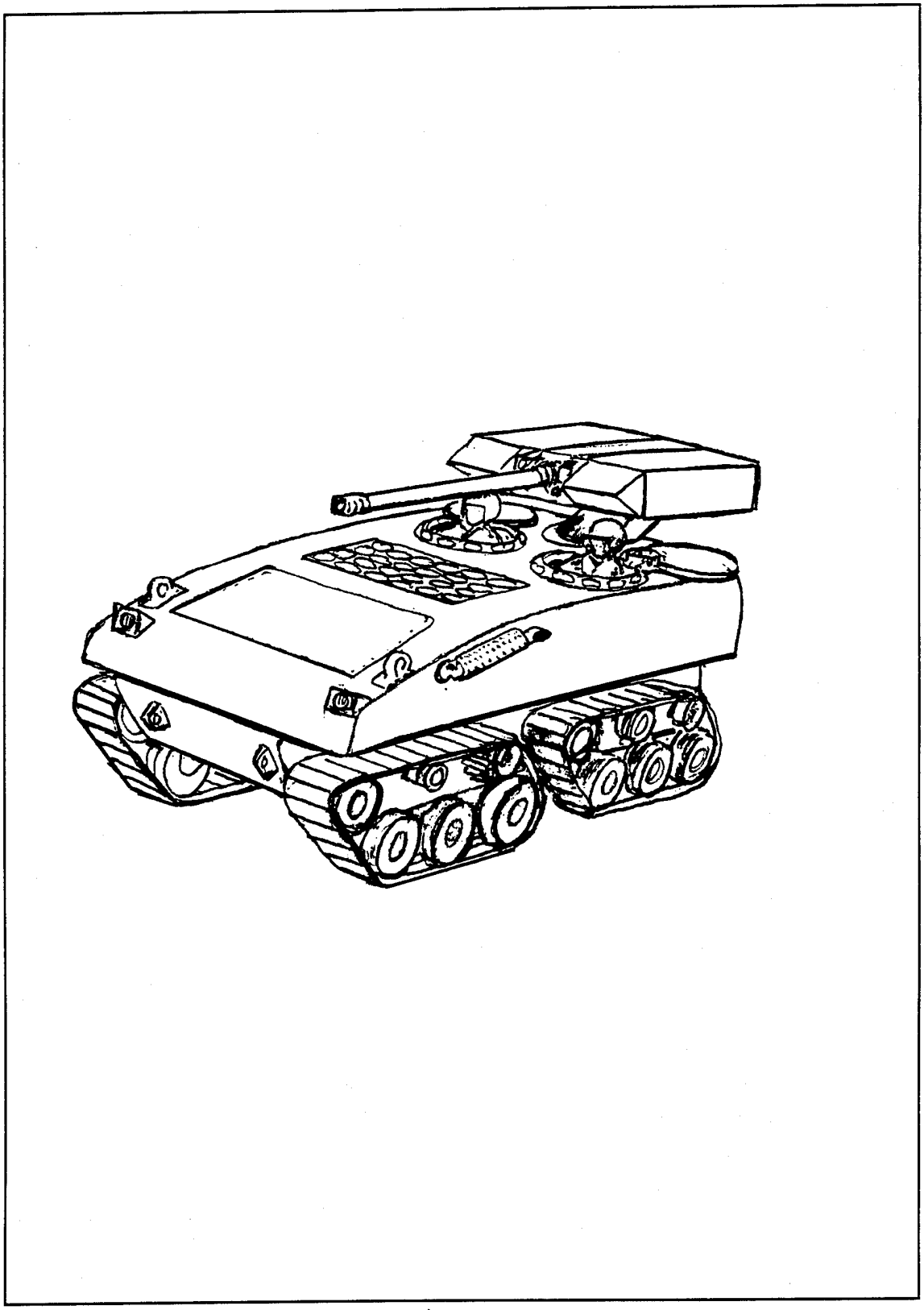

Figure 5.
Future Air Mech Vehicle
Drawing by Major Chuck Jarnot

What About Enemy Air Defenses?

Air defenses are of great concern to all military aircraft operations, but recent history has shown that with proper planning and preparation, they can be defeated. Western airpower planners learned well the enemy air defense lessons from Vietnam and especially the 1973 Arab Israeli War. Since then, few aircraft, both fixed and rotary-wing, have been lost in combat operations. This is particularly significant given the increased sophistication of hostile air defenses and the number of missions (sorties) flown. For example, during Desert Storm only one AH-64 Apache was shot down; and in Somalia, no AH-1 Cobras were lost after a year of operations. Recent losses that did occur, resulted from accidents during combat conditions or high-risk special operations. Recently, Israeli Cobra and Apache attack helicopters have conducted attacks in Southern Lebanon with no reported losses, despite several daylight missions.[12] Today aviation commanders routinely exploit air defense limitations concerning terrain relief, dependence on radar, vulnerability to countermeasures, and their relatively static firing modes. In the future, Air Mech XXI commanders will continue to have serious regard for enemy air defenses but will have enhanced survivability from the use of displaced landing zones made possible by standoff weapon platforms and mechanized air assault forces. In the final analysis, antiaircraft weapons are similar to antiarmor systems, they are not to be ignored, but their effectiveness can be negated by proper tactics, techniques, and procedures and will seldom stop determined air or armor maneuver respectively.

What About Weather Limitations?

Helicopter technology has greatly improved over the past decade. The Vietnam vintage aircraft like the AH-1 Cobra and UH-1 Huey are limited to thirty five knot winds, quarter mile visibility, and have only night vision goggles for night operations. The AH-64A model Apache is capable of operations in up-to-forty five knot winds and can fly in near zero visibility day or night using its unique "flying FLIR" (forward looking infrared) system. However, the Apache's laser-guided Hellfire missile needs much better visibility. By 1998, the AH-64D Longbow Apache will be available using its millimeter wave radar to attack targets at maximum range with no visibility requirements.[13] The RAH-66 Comanche, will further improve on this mark with the added capability to fly in up-to-eighty knot winds.[14] The era of the all-weather attack helicopter is quickly approaching. Lifting aircraft have likewise shown great improvements in weather tolerance. Helicopters, like the newly fielded special operations MH-47E Chinook equipped with radars and FLIRs, already possess significant poor weather capability. The Air Mech XXI division will never be completely all-weather, but there are few places on the globe where weather conditions will exceed eighty knot winds for very long. Even in such extreme circumstances, the Air Mech XXI division has a significant mechanized capability, allowing it to continue to maneuver. Contrast these brief weather halts for aviation with the extended delays to heavy-armored maneuver caused by seasonal thaws, rains, and flooding! Which force model is ultimately more weather sensitive, the Air Mech XXI division or the armored division?

Air Mech XXI Summary

The Air Mech XXI concept offers a revolutionary maneuver doctrine that better exploits the improved situational awareness, gained through battlefield digitalization. It provides the speed advantage of air maneuver to act on the information without sacrificing ground mobility, protection, and firepower necessary to conduct close terrain combat. The Air Mech XXI maneuver doctrine will render the world's heavy-tank armies obsolete. The concept exploits the advantages in U.S. airpower and facilitates a national strategy of rapid land-force projection from CONUS bases. The Air Mech XXI division will be a force for all seasons, able to defeat large armored formations or employ its aircraft, light-vehicles, and infantry in disaster relief operations. In the era of shrinking defense budgets, the U.S. Army can ill-afford to maintain a large heavy force structure effective in only a few deployment scenarios. The choice for the U.S. Army's Force XXI developers is clear, either use new technology to enhance the old "battleship" model of land combat or enable the next revolution in maneuver warfare!

The Heavy Division

The U.S. Army currently has six of its ten divisions organized as heavy divisions. The heavy division can be either a mechanized infantry division fielding five mechanized infantry battalions and five armored (tank) battalions or an armored division with six armored battalions and four mechanized infantry battalions. These ten battalions are assigned to three heavy brigades. Each heavy division has an armored Divisional Artillery (DIVARTY) organization that acts

like a brigade. DIVARTY has three armored self-propelled howitzer battalions designed to each support one of the heavy brigades and one multiple launcher rocket system (MLRS) battery for general support. The heavy division has an aviation brigade with two attack helicopter battalions, one general support helicopter battalion, and a cavalry squadron. The heavy division is supported by another brigade like organization called DISCOM for divisional support command. DISCOM has three forward support battalions designed to have one each support one of the heavy brigades and a main support battalion to provide support to the rest of the division. An engineer brigade is assigned with three combat engineer battalions designed to each support one of the heavy brigades. Finally, there are several separate battalions that support division operations, such as the signal and intelligence battalions.

The heavy division has about 350 M-1 Abrams seventy ton tanks and about 250 M-2 Bradley thirty ton infantry fighting vehicles (IFVs). These heavily-armored vehicles make up the majority of the combat power of the division. The other combat arms within the division are all designed to support the maneuver of these vehicles. The heavy brigades are the division's main effort elements, and their goal is to close with and destroy the enemy with direct fires.

The Airborne Division

The U.S. airborne division is structured basically the same as the heavy division with three ground-maneuver brigades, a DIVARTY, an aviation brigade, DISCOM, and separate battalions. However there are no armored vehicles except a single light-armored battalion equipped with old Sheridan reconnaissance tanks. Each maneuver brigade has three

battalions of foot mobile infantry. The battalions do employ a few light-armored antitank missile carries (TOW HMMWVs). DIVARTY uses lightweight 105 millimeter towed howitzers with no MLRS elements. The airborne division has excellent strategic mobility since it trains to be inserted via parachutes from U.S. Air Force cargo aircraft. The division does have an aviation brigade with one light-cavalry squadron, one light attack helicopter battalion and one UH-60 assault helicopter battalion. The UH-60 unit does give the division some limited air assault capability with the capacity of inserting one infantry battalion in a single lift.

The U.S. Army does have two light infantry divisions which were not selected for comparison. This is because they are organized almost identically to the airborne division and would have resulted in no difference in the comparison analysis. The only significant difference between the light infantry division and the airborne division is the parachute capability of the latter.

The Air Assault Division

The U.S. air assault division is the closest model to an airmechanized force as described by Simpkin. The division has over 300 helicopters which are basically used to air insert a typical light infantry division. The air assault division in organized and equipped to fight as a helicopter assisted light infantry force. The division's infantry brigades are not mechanized, the DIVARTY is mainly equipped with light 105 mm towed howitzers designed to support the light-infantry maneuver. The division's aviation brigade has nine helicopter battalions consisting of three attack, three assault, one medium lift,

one general support, and one aerial reconnaissance (squadron). The aviation brigade is structured as a large supporting force with no subordinate regiments to focus on massing the effects of the nine battalions, such as attack helicopter regiments. The division is organized nearly the same as the airborne and light-infantry models with the significant exception of the large number of helicopters.

The division uses its attack helicopters to "set the condition"[15] for the air assault of the three light-infantry brigades. The division may employ attack helicopters deep on independent operations, one of Simpkin's requirements for airmechanization; however, normally the three battalions are assigned supporting roles for the three infantry brigades. A similar employment arrangement is used for the three assault helicopter battalions who are affiliated one each to the three infantry brigades.

Evaluation Criteria defined

As stated in the research problem, the analysis involves an examination of the combat value of the various divisional force models. The aggregate of the evaluation criteria represents the definition of combat value in this study. Since war itself is an art and not an exact science, subjective judgments are used throughout this analysis in measuring the effects of the evaluation criteria.

Strategic Mobility Defined: The U.S. Army's keystone doctrinal manual FM 100-5, Operations, defines mobility in the context of having the "freedom of maneuver".[16] This study further focuses the definition to articulate the speed at which a force can move. In the strategic area this means the speed at which a force can move intercontinentally.

There are many variables that affect the speed at which a divisional size force can be projected into a theater of operations, such as prepositioned ships with equipment, etc. For the purposes of this study, however, a simplified calculation is made that assesses the strategic mobility of a divisional size force by estimating the number of C-5 U.S. Air Force cargo aircraft sorties it would take to transport the force's key weapon systems. The study recognizes that many more sorties are needed to transport the logistic and support elements of the entire force. The focus here, however, is on the mobility of the weapon systems that constitute the model's combat power.

Tactical Mobility Defined: The "freedom to maneuver" as stated in FM 100-5 for the definition of mobility, is applied to the tactical level of war to address a force's ability to move its combat power on the battlefield. Many enemy, terrain, and weather conditions affect a divisional's rate of movement in a tactical environment. To examine the inherent capability of the divisional models to move on the battlefield, this study uses the unopposed rate of march. This provides a useful measure where units are deployed in a manner that expects enemy contact. The rate for each model is calculated in kilometers per twenty four hours for key weapon systems.

Protection Defined: FM 100-5 defines protection as the "conservation of the fighting potential of a force."[17] This study further focuses the definition to examine the ability of a force to withstand the direct and indirect fires of heavy enemy mechanized force. The measurement is an intuitive judgment that is based on the two key factors of armor protection and tactical mobility. Additional protection from fires derived from elaborate engineer efforts is not

considered because they mask the inherent ability of a given model to withstand enemy fires. The tactical mobility is considered to a degree because it effects the ability to avoid being engaged by enemy fire.

Firepower Defined: FM 100-5 defines firepower as "destructive force".[18] This study focuses this definition as a forces's capability to destroy large heavy mechanized enemy formations in both offensive and defensive operations. The measure applied in this study is a subjective assessment of the firepower of weapon systems based on combat force ratios from the U.S. Army Command and General Staff's ST 100-3, Battle Book.

Operations Other That War (OOTW) Defined: FM 100-5 defines OOTW as operations that involve a wide range of activities, such as "disaster relief, nation assistance, security assistance, counter-drug operations, arms control, treaty verification, support to domestic authorities, and peacekeeping."[19] It further states that a conflict may either be already in progress or could result during one of the above activities. This study focuses on the flexibility of a given force model to perform useful activities during such operations. This important but difficult evaluation criteria to measure requires intuitive subjective judgements as to which organization would be most useful in such scenarios. To this end the following assumptions are applied to the subjective analysis. Dismounted infantry are generally more effective in humanitarian assistance missions. Mechanized forces are more effective in security operations where deterrence is a factor against other armies. Aviation units are effective in all OOTW scenarios.

General War Defined: FM 100-5 defines war as "large scale operations against another armed force." Was is further defined as

being limited or general in nature. Limited wars involve operations where less than the nation's total resources are used for limited objectives such as Desert Storm. General war involves the entire nation's resources for survival, such as World Wars I and II.[20] For the purposes of this study, this definition is focused to involve the battlefield performance of a division sized unit against a heavy mechanized enemy. The measure applied is a subjective judgment that is based on three of the four factors of combat power, protection, maneuver, and firepower.

Decision Matrix (see tables 1 and 2)

Table 1.--Air Mech Interim Division Model FY 2000 (Least is Best)

	Strategic Mobility	Tactical Mobility	Protection	Firepower	OOTW	Limited Gen. War	Total
Heavy Division	4	3	1	1	4	2	15
Airborne Division	1	4	4	4	3	4	20
Air assault Division	2	2	3	3	1	3	14
Air Mech Interim Division	3	1	2	2	2	1	11

Table 2.--Air Mech Objective Division Model FY 2010 (Least is Best)

	Strategic Mobility	Tactical Mobility	Protection	Firepower	OOTW	Limited Gen. War	Total
Heavy Division	4	3	1	2	4	2	16
Airborne Division	1	4	4	4	3	4	20
Air assault Division	3	2	3	3	1	3	15
Air Mech Objective Division	2	1	2	1	2	1	9

Heavy Division Versus Evaluation Criteria

The heavy division is very difficult to move strategically. It requires approximately 350 C-5 sorties to move its key weapon systems. The 350 seventy-ton M-1 tanks can only be transported two per C-5 sortie. Other armored weapon systems, such as the M-2 infantry fighting vehicle and M-109 self-propelled artillery, can be transported four-at-a-time per C-5 sortie.

The heavy division uses the armored track for its tactical mobility. This results in a tactical rate of movement of approximately thirty kilometers per hour. All terrain obstacles both natural and man-made degrade the tactical mobility of heavy units. Steep terrain and wet weather conditions also degrade mobility and in some cases cause a virtual halt to further movement. Fog and high winds marginally reduce

the rate of movement of heavy forces. The armored track offers superior cross-country mobility performance as opposed to wheeled vehicles.

The heavy division has excellent protection from enemy direct and indirect-fires due to the high technology armor of its fighting vehicles. In addition the armored track affords good cross-country mobility performance which allows heavy division elements to often avoid enemy fires. Of particular note is the thickness and sophistication of the armor found in the heavy division's M-1 tanks. Depleted uranium plate has been added to the armor in many of the latter model tanks to withstand the direct-fire of enemy high velocity cannons. Even the division's infantry fighting vehicles employ a high level of armor protection designed to defeat many direct fire threats.

The heavy division has excellent firepower derived from its large number of direct fire weapon systems. Chief among these is the large direct-fire 120 millimeter tank gun. The division employs a large number of direct-fire antitank missiles mounted on the heavily armored M-2 IFV. This vehicle also mounts a high velocity twenty five millimeter automatic cannon designed to destroy other infantry fighting vehicles. Supplementing this significant direct fire array are two battalions of attack helicopters with antitank guided missiles, rockets, and thirty millimeter cannons.

The heavy division is of marginal value when operating in most operations other than war (OOTW) scenarios. Of the entire spectrum of OOTW mission profiles, disaster relief, nation assistance, security assistance, counterdrug operations, arms control, treaty verification, support to domestic authorities, and peacekeeping; only peace keeping,

making, and enforcing offer any substantial opportunity to deploy heavy armor. The heavy division has a relatively small number of dismounted infantry and aviation units necessary to perform most of the subtasks involved in OOTW operations. The 500 plus armored vehicles in a heavy division are not well suited to any other task than destroying other large armored formations. In scenarios of peace making, enforcing or peace keeping between armies equipped with large armored forces, the heavy division's armor can be very useful as a deterrent. The protection afforded by its armored vehicles can also provide a great deal of survivability in such scenarios where frequent artillery and armor clashes occur between well equipped forces.

The state of war either limited or general offers the best use of the heavy division model. The very nature of such scenarios means that most likely large volumes of armor and artillery will be employed in the conflict. The heavy division is purposed designed to compete in such an arena. The armor protection, large direct fire capability, and the capacity to travel cross country over broken terrain are this model's greatest attributes. Another significant feature of this model is the ability to operate in areas where weapons of mass destruction are being employed such as nuclear or chemical munitions.

Airborne Division Versus Evaluation Criteria

The airborne division has excellent strategic mobility with the capacity to parachute into any theater in the world within hours to a few days from deployment. In the U.S. Army model, this capability is enhanced by the large number of cargo aircraft fielded by the U.S. Air Force. New systems, like the C-17, greatly improve the ability to move

the airborne division's equipment into austere assault strips. The airborne division is the only forced entry means into a theater of operations that the U.S. Army has concerning conventional forces. The airborne division achieves this strategic mobility at great sacrifice to armor protection, ground mobility, and firepower. Essentially, the airborne division is a large dismounted infantry formation supported by light 105 millimeter artillery and a limited number of helicopters. The airborne division has very poor tactical mobility. Its brigades are all foot mobile with only one assault helicopter battalion to move troops. The U.S. model has one light armored battalion equipped with the old M-551 Sheridan recon tank that can be para-dropped or air-landed. This, along with a small number of light-armored high mobility multipurpose wheeled vehicles (HMMWV) armed with TOW antitank missiles, represents the only mechanized maneuver capability within the division.

The airborne division has very poor protection qualities especially when opposed by enemy heavy armor. The dismounted infantry need at least eight to twenty four hours preparation to dig into defensive positions. This is necessary to achieve a reasonable degree of protection from artillery and heavy direct-fire weapon systems. As stated in the definition of protection, such engineer like efforts are not considered in this study when analyzing the inherent protection characteristics of a division. The lack of ground mobility also reduces survivability. Once the dismounted infantry elements are located they are not capable of moving quickly to avoid concentrations of indirect-fires.

The amount of firepower in an airborne division is largely limited to weapons that are man portable. The U.S. airborne model has excellent small arms, light 60 millimeter mortars, and the new man portable Javelin antitank guided missile. However, few rounds of ammunition can be carried by foot mobile soldiers and the weapons themselves are no match for the heavy weapons that a heavy mechanized force has. The division artillery is also limited to lightweight 105 millimeter howitzers of short-range firing a relatively small warhead. Even the division's single attack helicopter battalion is equipped with light scout-type helicopters (OH-58D Kiowa Warriors) that carry a quarter of the rockets or antitank guided missiles of other U.S. Army attack helicopter units.

The airborne division is ideally suited for most OOTW scenarios. The division has a large number of dismounted infantry to perform most of the close terrain security tasks involved with many typical OOTW mission profiles. Logistics requirements for the division are light which allows the airborne division to be easily sustainable for long term operations like Haiti or Somalia. The large number of infantry also serve as excellent resources in manpower intensive humanitarian relief operations.

The most demanding deployment mission profile for the airborne division is the limited or general war scenario. The airborne division lacks the protection, ground mobility, and firepower to compete effectively against heavy mechanized forces. These limitations normally relegate the airborne division to supporting roles using their parachute ability to seize objectives deep in enemy territory or used in difficult

terrain in support of heavy mechanized maneuver. Some tactical applications even call for the division to break up in small elements as stay behind forces to conduct raids against the enemy's rear areas.

The Air Assault Division Versus The Evaluation Criteria

The air assault division has good strategic mobility since most of its troops and equipment can be air landed into theater. The large organic helicopter fleet, however, requires a fair number of Air Force cargo aircraft sorties to transport. Although the air assault division has no forced entry capability, it can move quickly intra-theater via its large number of helicopters. The division's attack, assault, and cargo helicopters are technically capable of self deployment, with auxiliary fuel tanks, worldwide within a week to ten days. This technique is avoided due to the significant amount of logistical and maintenance support required. More often U.S. Air Force cargo aircraft are used to move the helicopters into a theater. The air assault division has good tactical mobility. The large number of assault and cargo helicopters facilitates brigade size single lift air assaults out to distances of over 150 kilometers.[21] The ground mobility of the division's infantry units is poor, however, since they are only foot mobile. The division does have one light-armored HMMWV antitank company per battalion that are helicopter transportable. These units armed with the TOW antitank guided missile offers the only mechanized maneuver capability in the division. While the assault helicopters provide an excellent degree of tactical mobility, they are not usually able to insert or pickup infantry units in contact with enemy especially if they are mechanized.

The protection factor of the air assault division is poor. The division has no armored vehicles other than the light-armored antitank companies. The helicopter assembly areas are vulnerable to indirect fires and the division artillery howitzers are all exposed towed versions. The ability of the air assault force to survive is helped by the ability to quickly displace combat power over great distances via the helicopters. This feature does aid in dispersing assets as well. Since most of the combat power of the division consist of dismounted infantry and towed lightweight artillery units, the division has to expose itself to enemy fires as it conducts air assaults nearly on top of the enemy locations. This greatly reduces the survivability of the aircraft as well as the units they are transporting. The most survivable units in the air assault division are the three attack helicopter battalions. These units are often employed in tank-like fashion to engage enemy armored formations using stand off to provide a level of protection.

The air assault division has a fair degree of firepower primarily located in their three attack helicopter battalions. The remainder of the division, however, has poor firepower capabilities. The light infantry battalions each have an antitank company of TOW missiles mounted in light-armored HMMWVs. The division artillery also has one battalion of heavy 155 millimeter towed howitzers to supplement the three battalions of lightweight 105 millimeter towed howitzers. Overall the division depends a great deal on the ability of its three attack helicopter battalions to blunt the attack of enemy heavy-armored

formations. The rest of the division lacks the firepower to compete with a heavy mechanized force.

The wide ranging tasks and usually large geographic areas associated with OOTW scenarios plays to the strengths of the air assault division. The helicopter mobility and heavy-lift capability of the division is ideally suited to perform most humanitarian tasks. The large number of infantry provide the necessary troops for manpower intensive tasks that are usually characteristic of OOTW scenarios. The attack helicopters provide an excellent means of quickly dominating border incursions during peace keeping operations. They also provide a means of applying firepower without committing large numbers of ground units that may become decisively engaged.

The greatest challenge to the air assault division is its application in limited or general wars. The division can operate against heavy mechanized forces when acting in a supporting role with other friendly heavy forces. By itself the division is at risk and relies almost exclusively on its three attack helicopter battalions to destroy enemy mechanized formations. In this regard the division can perform some defensive tasks against heavy forces but has great difficulty in conducting fire and maneuver in offensive actions against armor. The dismounted infantry battalions are ill suited to heavy combat lacking protection, ground mobility, and firepower to compete against heavy forces. The attack helicopters have difficulty in destroying enemy armor in close terrain or dug in defensive positions.

The Interim Air Mech XXI Division Versus The Evaluation Criteria

The interim Air Mech XXI division would have good strategic mobility. The aircraft could self deploy or could use the more practical solution of U.S. Air Force cargo aircraft. Normally six aircraft could be transported per C-5 sortie. The division's light-armored vehicles could be transported with twelve vehicles per C-5 sortie. The lightweight T-MARS rocket artillery would only require a few C-5 sorties as well. The Air Mech XXI model has no forced entry capability unless its Air Mech infantry regiment were trained in parachute operations. A possibility given the advantages of mechanization.

Tactical mobility is the greatest attribute of the interim Air Mech XXI division. The division's combat power would be 100 percent air assault and mechanized capable. This combination allows the division to operate tactically at all three scales of mobility; foot, mechanized, and air assault. The ability to air assault its combat power means that all terrain obstacles, both man made and natural, have no effect on the force. The Air Mech Division could quickly gain positional advantage on a mechanized enemy using its helicopters, then gain close terrain positional advantage using its light armored vehicles. More importantly, the division's heavy firepower, in the form of rocket and missile artillery, is 100 percent air assault capable with an additional ability to provide mechanized prime movers. The Air Mech XXI Division would be able to out maneuver its mechanized enemy and more quickly spring a massed precision munitions attack based on a maneuver speed five times greater than its heavy mechanized quarry.

The interim Air Mech XXI division would have a fair level of protection. All of the ground maneuver units would use the German made lightweight Wiesel armored vehicle. This would provide protection up to 7.62 millimeter ball ammunition and shrapnel protection. The artillery systems mainly consist of T-MARS rocket and missile weapons that are designed to be emplaced and fired remotely. This provides an obvious counterbattery survivability edge. The helicopters provide a great deal of dispersion to the force overall. In addition, aircraft survivability is greatly enhanced by the fact that landing zones can be displaced from their objective areas because the maneuver force is mechanized. The division would be vulnerable in its aircraft assembly areas and the light-armored vehicles would have to avoid massed direct-fire fights with heavy armor.

The interim Air Mech XXI division would have good overall firepower characteristics. The emphasis in this design is on indirect firepower. The majority of the killing systems are found in the division's strike brigade where attack helicopters are teamed with heavy rocket and missile artillery. The maneuver formations also use indirect fires as their primary means of destroying enemy armor. Ground based Hellfire antitank missiles, with their remote designation capability, and precision mortars are employed in the ground maneuver units. The division model does expect direct fire fights from enemy units that survive the strike brigade's precision munitions attacks and other elements such as enemy recon units. Here the division employs large numbers of Javelin antitank missiles along with forty millimeter automatic grenade launchers.

The interim Air Mech XXI division would have good application characteristics in typical OOTW scenarios. The large numbers of lift helicopters and sizeable numbers of infantry would be an excellent asset in the security and humanitarian relief operations. The light-armored Wiesel vehicles would give infantry units small arms protection as well as providing excellent ground mobility. Even the artillery units, with large numbers of light trucks, would be useful in many OOTW tasks. The Air Mech XXI design would be ideally suited to large scale peace keeping missions since its air assault capability would allow it to quickly move combat power to a crises area. In addition, the high degree of long-ranging indirect-fire systems would provide a means of deterring border incursions by heavy-mechanized forces without committing ground maneuver forces.

The interim Air Mech XXI division would have excellent capabilities in a limited or general war scenario. Here the division's advantage in maneuver speed would make it the ideal formation for quickly outmaneuvering a heavy mechanized force and destroying it with its large volume of standoff indirect fires. In cases against a nonmechanized enemy, the division is still very effective since its ground maneuver element uses lightweight tracked vehicles that have greater all terrain capability than heavy tanks and IFVs. In cases where border standoff exists the division would be very effective as it deployed large volumes of T-MARS systems to provide overwhelming firepower without the counterbattery threat posed to conventional artillery organizations. In addition, the attack helicopter regiment provides the highly mobile firepower that could be used along a wide

ranging border, facilitating a rapid deployment of combat power without committing ground elements to decisive direct-fire fight.

Model Comparison

Each model is rank ordered against each other based on their evaluation criteria performance. A brief narrative describes the scoring.

Strategic Mobility Compared

The airborne division model rated best in this category based on the fewest number of C-5 sorties needed to move the key weapons systems and maneuver troops (see tables 3 and 4). The air assault division rated next best with the Interim Air Mech XXI model rated closely behind. The difference between the two being the additional sorties to move the larger number of helicopters and the light armored vehicles in the interim Air Mech XXI model. The heavy division rated least in this category due to the difficulty in transporting the heavy tanks and IFVs.

Tactical Mobility Compared

The interim Air Mech XXI model rated best in this category based on its capability to move all of its combat power by air assault and mechanized techniques giving it the greatest number of kilometers of advance per day. The air assault model scored the next best due to its helicopter capability which provides a high degree of mobility in the conduct of air assaults. The heavy division was next followed by the airborne division which is almost completely foot mobile.

Table 3.--C-5 Sortie Rate per Key Weapon System[22]

Item	Items per C-5 Sortie	Item	Items per C-5 Sortie
M-1 Tank	2	UH-60 Blackhawk	6
M-2 IFV	4	AH-64 Apache	6
M-109 SP-155	4	CH-47 Chinook	0
MLRS	2	OH-58D Kiowa Warrior	12
M-551 Sheridan	4		
Wiesel (AMV)	12		
Towed 105 Howitzer	12		
Towed 155 Howitzer	4		
T-MARS	12		

Protection Compared

The heavy division scored the best in this category having the best armored protected vehicles. The interim Air Mech XXI division model scored next best based on its use of light armored vehicles and remote firing T-MARS artillery systems. In addition the Air Mech XXI design offered the most rapid dispersion capability which enhances survivability. The air assault division followed based on its ability to use its helicopters to disperse its force. The airborne division model was least best since it has almost no armor protection and lacks any significant dispersion capability because of its foot mobility and few helicopters.

Table 4.--Strategic Mobility of Division Models (rounded to nearest ten)

Item	Heavy Division	Airborne Division	Air Assault Division	Air Mech Interim Div.
M-1 Tank	350	0	0	0
M-2 IFV	240	0	0	0
M-109 SP-155	70	0	0	0
MLRS	9	0	0	0
M-551 Sheridan	0	50	0	0
Wiesel (AMV)	0	0	0	440
Towed 105 Howitzer	0	50	50	0
Towed 155 Howitzer	0	0	20	40
T-MARS	0	0	0	50
UH-60 Blackhawk	30	40	120	180
AH-64 Apache	50	0	70	70
CH-47 Chinook	0	0	50	50
OH-58D Kiowa Warrior	20	50	30	50
Total C-5 Sorties	350	30	60	120

Firepower Compared

The heavy division model scored best in this category based on the large number of heavy-direct firepower weapons systems. The interim Air Mech XXI divisional model scored next best based on the large volume of heavy rocket and missile artillery systems. In addition, the division would have a large number of attack helicopters and light-armored vehicle direct-fire systems. The air assault division model followed based on its three attack helicopter battalions. The airborne

model scored least best based on only one attack helicopter battalion and mainly lightweight man portable weapon systems.

Operations Other Than War Performance Compared

The air assault model scored best in this category based on the large number of infantry and helicopters needed to perform the wide ranging tasks associated with OOTW operations. The interim Air Mech XXI division model scored next best based on its flexibility in dealing with all the possible OOTW scenarios. It would have excellent capacity to perform the tasks requiring large numbers of helicopters, infantry, and project overwhelming firepower to deter heavy mechanized forces in peace making, keeping, or enforcing scenarios. The airborne division followed based on its large number of infantry for the many manpower intensive tasks of OOTW operations. The heavy division scored least best based on its limited ability to perform humanitarian relief operations and its low density of helicopters necessary in many OOTW scenarios.

General and Limited War Performance Compared

The interim Air Mech XXI Divisional model scored best in this category based on its superior performance against slower mechanized forces, which characterize the principle threat in limited and general war scenarios. The speed of mobility and its high volumes of indirect firepower make the Air Mech model difficult to engage while at the same time it can quickly deliver a heavy degree of firepower. The next best model was the heavy division with its high firepower capacity combined with excellent protection characteristics. The air assault model followed based on its ability to deliver significant amounts of

antiarmor fires via its three attack helicopter battalions and its ability to disperse for protection. The least best model was the airborne division which has poor ground mobility, few helicopters and low-volumes of firepower.

Objective Air Mech XXI Division Model Compared

The objective Air Mech XXI division model uses the same organization as the interim model but has purposed designed lifting aircraft and armored vehicles. The future Air Mech aircraft (FAMA) proposes an improved Osprey-type tilt rotor that can lift fifty percent more than the current V-22. Bomb-bay type of doors would facilitate the vehicle to be wrenched to the ground allowing the combined advantages of internal and sling loading. The ten to fifteen ton future Air Mech vehicle (FAMV) greatly improves the level of armor protection and lethality by being able to carry significantly more firepower than the interim's four ton Wiesel vehicle.

In comparison with the other divisional models, the objective Air Mech XXI division scores nearly the same as the interim Air Mech XXI model. The improved aircraft and armored vehicles of the objective design however, displaces the rank order in the evaluation criteria of strategic mobility and firepower. The future Air Mech aircraft would be easily self deployable giving it the edge over the air assault design. The future Air Mech vehicle would significantly improve the firepower of the objective Air Mech XXI model via a large number of vertically launched missiles. This would result in the objective design displacing the heavy division in the rank ordering of firepower.

Endnotes

[1]Richard E. Simpkin, Race to the Swift, Thoughts on Twenty-First Century Warfare (London: Brassey's Defense Publishers Ltd., 1987), 119.

[2]Ibid., 123.

[3]Bundeswehr, Fallschirmpanzerabwehrbataillon (Ft. Leavenworth, KS: German Army Liaison Office, 1996), passim.

[4]International Institute for Strategic Studies, The Military Balance 1995-1996 (London: Institute for Strategic Studies, 1996) 45, 115.

[5]Wass de Czege, Huba, Brigadier General (retired), US Army, author attended lecture on advanced warfighting in the early twenty-first century, 10 January 1996, Ft. Leavenworth, KS., handwritten notes in author's possession.

[6]Department of defense, Final Report to Congress, Conduct of the Persian Gulf War (Washington, DC: US Government, 1992) data from page 408 indicates 3,600 rounds of tank ammunition expended versus 2,048 tanks deployed, and General Schwarzkopf reporting "...we have destroyed or rendered inoperable...over 29 Iraqi divisions (20,000 armored vehicles)..." during CNN broadcast 28 February 1991.

[7]Christopher Foss, ed. Jane's Armour and Artillery 95-96 (Coulsdon U.K.: Jane's Information Group Ltd. 1996) 675. Weight of pod is 5,600 pounds, allowing for 2,400 pound trailer, total weight = UH-60L external limit 8,000 pounds.

[8]Ibid.,675.

[9]_____, ed. Jane's, Armour and Artillery 95-96 (Coulsdon, U.K.: Jane's Information Group Ltd., 1996), 364, 365.

[10]_____, ed. Jane's, All the World's Aircraft 1996, (Coulsdon, U.K.: Jane's Information Group Ltd., 1996), 497.

[11]Ibid., 621.

[12]Headline News, broadcast showing Israeli AH-1 and AH-64s firing at Hezbolla positions in daylight, CNN, 19 April 1996.

[13]Author's personal experience with the training of AH-64, AH-1 and UH-1 aircraft, Ft. Rucker, AL., while assigned to the Aviation Training Brigade, 1993-1995.

[14]CWO Ronald Ferrell, USA, expert on RAH-66, interview by author, 6 April 1996, Ft. Leavenworth, KS., handwritten notes in author's possession.

[15]COL Nelson, USA, Chief of Staff 101st Air Assault Division, interview by author, 28 September 1995, Ft. Leavenworth, KS., handwritten notes in author's possession.

[16]U.S. Army, FM 100-5, Operations (Washington: Department of the Army, 1993), 2-14.

[17]Ibid., 2-9.

[18]Ibid., 2-2, 2-9.

[19]Ibid., 2-0.

[20]Ibid., 1-3.

[21]Author's personal experience based on four year assignment in the 101st Air Assault Division, 1984-1988.

[22]Christopher Foss, ed. Jane's All the World's Aircraft 1988 (Coulsdon, UK.: Jane's Information Group Ltd., 1988), 419. (C-5) and a correlation to weight and size with the key weapon systems, Jane's Armour and Artillery (Coulsdon, UK.: Jane's Information Group Ltd., 1996), 137, 175, 452, 570, 681, 683.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

Conclusion of Analysis

The results of the analysis suggest that the Air Mech XXI interim and objective divisional models offers greater overall combat value than the U.S. Army's current divisional models. The evaluation criteria served to demonstrate that a division with air assault agility and the capacity to destroy large armored formations, has obvious utility value in all spectrums of tactical operations.

The analysis further suggests that the current U.S. Army force structure is dated in past maneuver doctrine. The force structure of both heavy and light divisions are built around the assumption that the primary defeat mechanism of massed enemy formations is the massed direct fire fight. All other arms in the division, support the ground maneuver units to achieve favorable conditions to this end. The liabilities of heavy divisions appear, by data presented, to be ever increasing with a resulting decline in their overall combat value. The light divisions appear to be unable to replace the overall combat capability of heavy forces despite the addition of attack helicopters. This is due to a lack of ground mobility, protection and firepower. Historical data presented, suggest that the days of hundreds of tanks dueling on an open plain are over!

The viability of the Air Mech XXI concept is based on the assumptions of battlefield digitalization, increasing situational awareness, and the dominance of precision indirect weapons over direct fire. If a mechanized force can be tracked at great distances using a variety of sensors and engaged at long range precision weapons, then the heavy armor of tracked vehicles becomes obsolete. Armored vehicles no longer encumbered by the requirements of direct fire tank to tank duels, can be made light enough to achieve air assault agility. Prove one of these assumptions wrong and the Air Mech XXI concept becomes nothing more than an improved air assault division with extraground mobility.

The results of the analysis concludes that even the Interim Air Mech XXI division, using off the shelf systems has the potential to destroy heavy mechanized forces. The current level of attack helicopter and long range rocket and missile technology, already demonstrated in live fire tests and numerous simulations, have great potential for destroying large armored formations. This together with a mechanized air assault force, to conduct the close terrain fight, offers the U.S. Army a division that truly has greater overall combat value than the current mix of ultra heavy and ultra light divisions.

The analysis examined the potential performance of an objective Air Mech XXI division employing purpose built aircraft and armored vehicles. Assuming the basic Air Mech XXI principle is sound, such a future force would have even greater combat value, by correcting the deficiencies in range, protection and firepower associated with current conventional helicopters and the ultra light weight Wiesel armored vehicle. The increase in capabilities that the objective Air Mech XXI

division would enhance the benefits of the Air Mech XXI concept to the same extent that a Desert Storm armored division did over earlier World War II models. Radius of action would more than double as well as armor protection, ground mobility and overall firepower.

The study highlights the recognized difficulty in trying to convince the senior leadership of the U.S. Army to abandon the 70 ton land battleship and its associated direct fire fight doctrine. As Cheng points out in his book Air Mobility, the pressures of U.S. Army internal branch parochialisms are very substantial. The armor branch and the heavy mechanized wing of the infantry branch, will most likely view the Air Mech XXI concept as a direct threat to their existence. Challenges to the Air Mech XXI concept will probably be similar to the criticism of the mechanized concept following the First World War. Technical problems with helicopters will be exaggerated to the point of infusibility and a picture will be painted of enemy soldiers behind every ridge with an RPG or shoulders fired missile, destroying hordes of helicopters in mid flight. Such dooms day scenarios were described for tank maneuver and the effects of antitank guns.

Technical problems certainly exist with the Air Mech XXI concept. However, the potential benefits of mechanized forces and heavy rocket artillery, capable of air assault agility, should drive Army planners to solving those technical problems. In addition, the armored community should not view the rotor as a threat, but rather a means to gain even greater mobility on the battlefield. The absence of the armor branch in the current air assault doctrine is largely corrected by the Air Mech XXI concept. The U.S. Army should learn from the Russian and

German airmechanized models and strive for a combined arms approach to air maneuver. The post cold war era may follow some of the same trends as was present in the years between the world wars. First Russia and now Germany are developing a substantial airmechanized capability. Historically, these two countries have been at the forefront of new developments in maneuver warfare!

Recommendations

The U.S. Army should immediately begin computer analysis of the Air Mech XXI concept. This could be done in the context of the current annual Prairie Warrior simulation, held at the U.S. Army Command and General Staff College. This exercise already employs a future division-sized element known as the Mobile Strike Force. The purpose of this force is to test the digitalization of the battlefield and the precision munitions attack techniques forecast by Force XXI planners. The next iteration of Prairie Warrior could replace the heavy divisional model used for the mobile strike force with the interim Air Mech XXI divisional model.

Based on positive results, the Regular Army should consider converting the 101st Air Assault, 10th Mountain, and 82nd Airborne Divisions to the Air Mech XXI model. The latter should retain its airborne capability for the ground regiments. Three heavy divisions should be retained to reduce overall force structure risk and as a hedge against the recognized deficiencies of the interim design. The remaining three or four divisions should be organized as motorized infantry divisions. These units should be based on light-armored HMMWVs, towed artillery, and a single aviation regiment with a

reconnaissance, attack, and assault helicopter battalion. These medium-weight forces would be used as follow and support missions or in security operations in rough terrain. Active heavy divisions should be retired with the fielding of the objective Air Mech XXI division models on or about the year 2010. The total force structure would then be four Air Mech XXI divisions and six motorized infantry divisions. The National Guard could retain one to three heavy divisions.

In the final analysis, the U.S. Army has two broad choices for fielding a force for the twenty first century. It can either use emerging information and precision weapons technology to enhance the current land "battleship" doctrine or apply it to achieve the next revolution in maneuver warfare. The Russians and now the Germans are already well down the airmechanization path. The writing is on the wall, the future of land warfare will see forces break friction with the ground. If Air Mech XXI is not the warfighting doctrine of the next century, then something very much like it will be!

BIBLIOGRAPHY

Books

Cheng, Christopher C. S. Airmobility: The Development of a Doctrine. Westport, CT: Praeger Publishers, 1994.

Ford, Daniel. Flying Tigers: Chennault and the American Volunteer Group. Washington: Smithsonian Institutional Press, 1991.

Foss, Christopher F. ed. Jane's Armour and Artillery 1996. Surry, England: Jane's Information Group, 1996.

_____. ed. Jane's All the World's Aircraft 1996. Surry, England: Jane's Information Group, 1996.

Keegan, John D. The Second World War. New York: Viking Penguin Books, 1989.

Macksey, Kenneth. Gurderian Panzer General. London: Greenhill Books, 1992.

Polmar, Norman and Kennedy, Floyd D. Military Helicopters of the World: Military Rotary-Wing Aircraft since 1917. Annapolis, MD: Naval Institute Press, 1981.

Simpkin, Richard E. Deep Battle: The Brainchild of Marshal Tukhachevskii. New York: Brassey's Defence Publishers, 1987.

_____. Race to the Swift: Thoughts on Twenty-First Century Warfare. London: Brassey's Defence Publishers, 1985.

Journals and Periodicals

AM General Corporation. "AM General Number One in Tactical Vehicles." Military Technology (March 1995): 42-48.

Crist, Stanley C. "Making the Case for An Airborne Infantry Fighting Vehicle." Armor (September-October 1995): 23-24.

Etchechury, James. "The Armored Gun System Debate: Let It Begin Before Its Too Late." Armor (January-February 1991): 32-34.

Eshel, David. "Trends in Future Tank Developments." Military Technology (October 1992): 10-21.

Franz, Wallace P. "Airmechanization The Next Generation." Military Review (February 1992): 59-64.

Foss, Christopher F. "New Russian Airborne Assault Vehicle." Jane's Intelligence Review (May 1993): 217-218.

Fuller, J. F. C. "Tactics and Mechanization." Infantry Journal (May 1927): 190-195.

Gourley, Scott R. "Honing a Sharper Edge." Armed Forces Journal (May 1995): 53-54.

Kinnear, James. "Russian Armour Developments-Airborne AFVs (1950-93)." Jane's Intelligence Review (March 1994): 109-113.

Kreft, Fritz-Herman. "Design Rules in Main Battle Tank Development." Military Technology (October 1992): 22-35.

Lehner, Charles. "Light Enough to Get There, Heavy Enough to Win." Armor (July-August 1994): 10-14.

Nobles, David L. "Light Armored Cavalry, The Right Force at the Right Time." Armor (January-February 1995): 15-18.

Roos, John G. "Light Weight, Real Wallop." Armed Forces Journal (May 1995): 48-52.

Rozman, Tom. "Making Light Forces More Flexible and Responsive." Armor (January-February 1991): 18-20.

Segal, David. "Whatever Happened To Rapid Deployment?" Armed Forces Journal (March 1991): 39-40.

Sparks, Mike. "M113s Maximize Mechanized Infantry Mobility and Firepower in Contingency Ops." Armor (January-February 1995): 6-14.

Turbiville, Graham H., Jr. "Soviet Airborne Assault." Marine Corps Gazette (October 1987)

_____. "Soviet Airborne Operations in Theater War." Foreign Policy (February 1985): 160-183.

Tusa, Francis. "Increased Firepower Weighs Heavily on Light Armor." ____ Armed Forces Journal (March 1991): 42.

Theses and Studies

Bolzak, Jerry R. "The Role of The Airmechanized Raid in Operational Maneuver." School of Advanced Military Studies Monograph, US Army Command and General Staff College, 1990.

Crawford, Darrell E. "Airmechanization: Determining Its Tactical Viability on the Battlefield." School of Advanced Military Studies Monograph, US Army Command and General Staff College, 1988.

Holcomb, James F. "Soviet Airborne Forces and the Central Region: Problems and Perceptions." Soviet Army Studies Office, Fort Leavenworth, KS, 1987.

Hood, Carlton L. "Determining The Optimum Aviation Organization for the Operational Level of War." Master of Military Art and Science Thesis, US Army Command and General Staff College, 1991.

Inman, Michael T. "Operational Maneuver in the 90's: Is Army Aviation a Viable Option?" School of Advanced Military Studies Monograph, US Army Command and General Staff College, 1990.

Jacobs, William M. "Massing the Third Dimension in Airland Battle-Future: The Aviation Division." School of Advanced Military Studies Monograph, US Army Command and General Staff College, 1991.

Kral, Anthony H. "Logistic Support of an Armored Division in a Deep Attack." Master of Military Art and Science Thesis, US Army Command and General Staff College, 1991.

Turbiville, Graham H. Jr. "Soviet Airborne Troops." US Army Combined Arms Center, Fort Leavenworth, KS, 1987.

Webb, George S. "Prescription for the Counterstroke: The Airmechanized Division at the Operational Level of War." School of Advanced Military Studies Monograph, US Army Command and General Staff College, 1986.

Government Documents

Department of Defense. Final Report to Congress, Conduct of the Persian Gulf War. Washington, DC: US Government, April 1992.

US Army. FM 100-1-2, Soviet Army: Troops, Organization and Equipment. Washington, DC: Department of the Army, 1991.

_____. FM 100-5, Operations. Washington, DC: Department of the Army, 1993.

_____. Weapon Systems: United States Army 1996. Washington, DC: Department of the Army, 1996.

_____. Aviation LNO Handbook. Fort Rucker, AL: United States Army Aviation Center, 1995.

_____. ST 100-3, Battle Book. Fort Leavenworth, KS: US Army Command and General Staff College, 1995.

_____. ST 101-6, G-4 Battle Book. Fort Leavenworth, KS: US Army Command and General Staff College, 1995.

_____. FM 90-4, Air Assault Operations. Washington, DC: Department of the Army, 1989.

_____. FM 100-103, Army Airspace Command and Control. Washington, DC: Department of the Army, 1991.

_____. Army Aviation CGSC Student Reference Text. Fort Rucker, AL: United States Army Aviation Center, 1995.

German Army. Fallschirmpanzerabwehrbataillon. Ft. Leavenworth, KS. German Army Liaison Officer, 1996.

First Hand Sources

Aldrich, Charles. Chief Warrant Officer, US Army, Senior instructor pilot in UH-60 Blackhawk Helicopters, telephone interview by author, 27 October 1995, hand written notes, Fort Rucker, AL.

Hibler, Charles. Chief Warrant Officer, US Army, Senior instructor pilot in CH-47 Chinook Helicopters, telephone interview by author, 27 October 1995, hand written notes, Fort Rucker, AL.

Roberts, Charles. Cable News Network reporter, broadcast on Sava River crossing viewed by author, 2 January 1996, US Army Command and General Staff College, hand written notes, Fort Leavenworth, KS.

Shaffer, Emmett C. Major US Army, member 160th Special Operations Helicopter Regiment, interview by author, 5 November 1995, hand written notes, Fort Leavenworth, KS.

Steinhauer, Dale R. Phd., US Army Knowledge Network, Ft. Leavenworth, KS. Battle Damage Assessment data provided by division for Desert Storm, May 1996.

Wass de Czege, Huba. Brigadier General US Army (retired). Lecture attended by author, 4 January 1996, Eisenhower Hall, US Army Command and General Staff College, hand written notes, Fort Leavenworth, KS.

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