THE SEDUCTIVE EFFECTS OF AN EXPEDITIONARY MINDSET

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Abstract

The U.S. Army is in the midst of undergoing a radical transformation, adopting a "capabilities-based" and "modular-type" force structure, to combat "full spectrum" conflict for future threats. The premise behind restructuring all U.S. Army forces in this manner is that threats will be ambiguous and they will no longer present a situation where US military forces would necessarily fight a single opponent in a conventional manner at a known location. Although there is no clear agreement about the likelihood of any specific threat, most experts agree that the United States must transition from the focused strategy of containing a single state-centric threat to a broad, effective strategy able to confront a wide range of potential conflicts, from low to high intensity, anywhere in the world.

U.S. strategy has deliberately made a trade-off between considering where and who a specific threat may be to considering and classifying the various types of threats the United States may face. In order to create the appropriate force structure in the U.S. Army, military planners have "forecasted" the common features of the full-spectrum of conflict and have proposed the development of various "expeditionary" capabilities that address future threats. Many contend that mobility is now the key ingredient in transitioning to this new capabilities-based strategy. Consequently, U.S. Army planners have recently begun to focus on the common aspects of how U.S. forces will confront a wide variety of future threats and have identified specific equipment and procedures that will facilitate "shaping and entry operations," "operating and maneuvering from strategic distances," and "intra-theater operational maneuver." This monograph will analyze three mobility technologies that address "expeditionary" goals and assess their contributions to "worse case" security issues and the "most likely" security issues. The specific technologies addresses in this paper are; the Future Combat System (FCS), the Joint Heavy Lift (JHL) Aviation program, and the Joint Mobile Offshore Base (JMOB) sea-basing program.

Despite the ambiguous security environment, there is no longer much debate about the relevance of ground forces' significant contributions for achieving a national strategic objective. However, within the U.S. Army there continues to be much debate on the phase of conflict that U.S. ground forces are the most relevant. This monograph contends that ground forces are most relevant during phases associated with stability and reconstruction operations and that although the U.S. Army contributes as part of a joint, interagency, and multinational force during major combat operations, it must leverage the combat power of its sister services in this phase of conflict.

This assessment has dramatic implications for how the U.S. Army allocates funds for air, sea, and ground mobility-enhancing technologies.

Although these technologies, upon reaching full maturation, will provide immeasurable benefits, their focus on speed and overcoming anti-access challenges are too centered on major combat operations. Since these technologies come with an extraordinary price tag, some portions of their funding should be invested in alternative programs more related to stability and reconstruction operations. Specifically, this monograph contends that a portion of the budget tied to these technologies should be reallocated to language training, cultural awareness training, counterinsurgency, and counterterrorism programs. Furthermore, this reallocation can be accomplished with only a fraction of the overall budget and without cancelling these programs in their entirety.

INTRODUCTION

Where are we in History? Why does the U.S. Army seek an Expeditionary Force? How the U.S. Army, as part of a joint, interagency and multi-national force, designs and structures its future force will play a significant role in the overall success or failure of securing U.S. interests and achieving a strategic end-state in future conflict scenarios. Although there is great debate on the precise nature of future threats, most agree that the security environment has shifted dramatically since the terrorist attacks on 9/11 and are characterized by complexity and uncertainty. In this setting, the U.S. Army is seeking to establish new formations with new technologies and procedures that significantly speed up response time and help negate anti-access constraints. Thus, the capabilities the U.S. Army seeks in its modular force structure and in the joint force are often defined by the key performance parameters of speed and mobility in austere environments.

These key performance parameters give some indication of how political and military leaders have defined the problem in confronting future threats. Although couched in terms of confronting a "full spectrum" of conflict, it appears that by embracing the key performance parameters of speed and mobility, political leaders and military planners have focused primarily on how the U.S. military can "defeat an enemy force in a specified space and time with simultaneous and sequential battles."[1] However, experts have also forecasted that conflicts may become protracted and may "require sustained, multidimensional campaigns, not just the defeat of an enemy's military forces."[2] This initial line of thought may indicate that an incomplete problem statement exists because it does not completely address how political conditions, beyond a decisive battle, can be defined through military action and how speed and mobility play into the success of subsequent, perhaps non-kinetic, phases of an operation.[3] In essence, what this monograph will attempt to address is whether or not certain power projection capabilities can contribute not only to winning the war, but to "attaining a better peace."[4]

In order to evaluate whether the full problem set is being addressed when seeking new mobility-enhancing technologies, the effects they produce across the full spectrum of conflict must be evaluated.

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[1] Richard M. Swain, "Filling the Void: The Operational Art of the Army," in B.J.C. McKercher, ed., *Operational Art: Developments in the Theory of War* (New York: Praeger Publishers, Inc., 1996), 160.

[2] *"The Army in Joint Operations: The Army Future Force Capstone Concept,"* TRADOC Pamphlet 525-3-0, (Ft Monroe, VA, US Training ands Doctrine Command: 7 April 2005, p. 4.

[3] William J. Gregor, "The Politics of Joint Campaign Planning," paper presented at the 2005 International Biennial Conference of the Inter-University Seminar on Armed Forces and Society, Chicago, Illinois, 21-23 October 2005, 11.

[4] Basil Liddell-Hart, *The Strategy of Indirect Approach*, p. 202

Specifically, what capabilities do overcoming time-distance and access challenges provide U.S. Forces when they confront adversaries that employ traditional, irregular, disruptive, and catastrophic methods singularly or in combination?[5] Furthermore, how useful will speed and mobility be when the conduct of future warfare will include "combinations of conventional and non-conventional, kinetic and non-kinetic, and military and non-military actions and operations" occurring throughout various phases of an overall campaign?[6] Do speed and mobility provide a vital function for the U.S. Army in all of these phases or do other conditions become important? One must carefully analyze the metrics we are seeking and avoid building future capabilities based only on the current war we are fighting. In other words, one must be cautious of the seductive effect of an expeditionary mindset.

This intended purpose of this monograph is not to explore debates in detail regarding the forecasting of future conflict. For this, Joint Force Command's *Joint Operational Environment* (JOE) is used as a benchmark to describe future conflict.[7] The focus is, rather, on how new logistical capabilities and procedures used by the U.S. Army, as part of the joint, interagency and multi-national force, can assist not only in the army's traditional war fighting role, but in the larger realm of how the U.S. military works together with other elements of power to attain a national strategic end-state. This research will highlight three specific new logistics technologies and procedures and evaluate them not only for their contribution towards adversarial crisis response operations like traditional combat, but for their effectiveness in supporting adversarial and non-adversarial crisis response operations like peacekeeping, stability and reconstruction operations (SRO), military support to civilian authorities (MSCA), and humanitarian and disaster relief, both at home and abroad. These three technologies and processes will be used to analyze the effectiveness of speed and mobility against the four types of challenges in the future operational environment. Additionally, they will provide a framework for the thinking processes of U.S. political and military leaders as they attempt to define how the U.S. Army can be best "organized, trained, and equipped primarily for prompt and sustained combat incident to operations on land."[8] This analysis will illustrate what primary roles have been envisioned for U.S. Army ground forces in the future security environment. Only by analyzing certain mobility-enhancing technologies and procedures for their "expeditionary" roles as well as their ability to sustain operations for possible protracted periods of time can decision-

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[5] Department of Defense, *Capstone Concept for Joint Operations*, Ver. 2.0. August 2005. 4.

[6] *Ibid*, 5.

[7] *The Joint Operational Environment: Into the Future*, USJFCOM, March 2004, 1.

[8] Department of Defense Directive 5100.1, Title 10 United States Code.

makers make informed decisions about the direction of the United States' premier land-power force: the United States Army.

The discussion of our future security environment and the implications it has for logistic practices and procedures, particularly those that enhance speed and mobility, leads to a wider discussion of what policy choices must be made in the transformation of the military. Therefore, the focus of this research asks: **Can the U.S. Army's use of new joint power projection technologies and procedures aid in defeating any adversary, using the "decisive battle" paradigm, and, more importantly, play a decisive role to help control any situation across the range of military (and interagency) options used to attain national strategic objectives and to win the peace?**[9]

This monograph seeks to answer the research question by addressing these issues in three primary sections. The first section provides a brief overview of the projected security environment and how the U.S. government, the Department of Defense, and the U.S. Army respectively are organizing themselves to confront the national security issues of the twenty-first century environment. This discussion provides the context for defining an "expeditionary mindset" and understanding why the U.S. Army seeks these capabilities. *Joint Publication 5-0* and *TRADOC Pamphlet 525-3-0* will be used as a framework for discussing how the "employment of military forces are used to achieve strategic and operational objectives through the design, organization, integration, and conduct of strategies, campaigns, major operations, and battles."[10] This framework speaks directly to why the U.S. Army believes that the desired effects of an expeditionary force can be achieved by attaining new mobility-enhancing technologies and procedures. The second section provides a broad overview of the intended capabilities of three important mobility-enhancing technologies organized into ground-based, air-based, and sea-based categories. This section will outline the "mechanical characteristics" and key performance parameters of each of the following technologies:

Future Combat System (FCS) and U.S. Army modular formations - ground

Joint Mobile Off-Shore Base (JMOB) and sea-basing concepts - sea

Joint Heavy Lift Concept (JHL) aircraft – air

The third section provides an overview of the methodology used to evaluate effectiveness of speed and mobility. Using this approach, a rigorous analysis of each of these mobility technologies and procedures,

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[9] Pierre Lessard, "Campaign Design for Winning the War…and Peace," *Parameters*, Summer 2005, 38.

[10] *Joint Publication 1-02* Department of Defense Dictionary of Military and Associated Terms (12 April 2001 as amended through 9 June 2004), 385.

and their ability to confront the common aspects of conflict the United States is likely to face in the future from traditional adversaries, irregular challenges, catastrophic threats, and disruptive challenges, will be conducted.[11] To conduct this analysis, these technologies and procedures will be measured against the following criteria: 1) Does the technology/procedure reduce the amount of time for deployments? 2) Does the technology/procedure assist in mitigating anti-access/area-denial constraints? 3) What strengths and weaknesses does each proposed mobility platform offer during combat operations in the "seize initiative and dominate" phases vice what it provides when a preponderance of stability operations are conducted in the "stabilize and enable civil authorities" phases?[12]

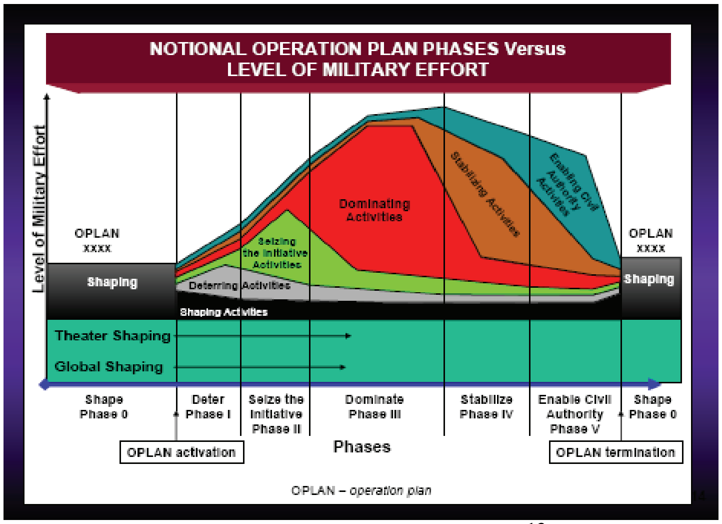

Figure 1: Planning Phases from JP 5-0[13]

Based on this assessment, should decision-makers focus Key Performance Parameters more towards major combat operations with a near peer competitor (most dangerous) or more towards subsequent protracted operations to maintain stability once hostile forces are defeated, but not yet fully destroyed (most likely)? A final overarching question will assess whether technological challenges and costs of developing, procuring, and manufacturing these technologies collectively are feasible? Are these

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[11] The National Defense Strategy of the United States of America, March 2005, p. 2-4.

[12] Joint Publication 5-0, "Joint Operational Planning," revised third draft, 10 August 2005, iv-30 – iv-37. This publication defines "phases" as "a definitive stage of an operation or campaign during which a large portion of the forces and capabilities are involved in similar or mutually supporting activities for a common purpose." It defines operational planning into five phases: phase 0; Shaping Activities, phase 1; Deter Activities, phase 2; Seize Initiative Activities, phase 3; Dominate Activities, phase 4; Stabilizing Activities, and phase 5; Enable Civil Authority Activities.

[13] *Ibid,* 122.

three mobility-enhancing technologies cost-effective when compared to alternative choices for achieving a national strategic end-state?

While addressing the above questions, the effects of speed of action and countering anti-access constraints from the three identified "advanced military lift platforms" will also be measured against the four types of emerging adversarial challenges and various non-adversarial challenges the U.S. Army, as part of the interagency and joint force, will face in the future. To accomplish this, research must analyze all the salient features of traditional, irregular, catastrophic, and disruptive challenges as well as features associated with peacekeeping operations, disaster and humanitarian relief efforts, and military support to civilian authorities and identify and separate out all the distinct differences/similarities. At this point, speed and mobility considerations can be weighed against the differences/similarities in each category and evaluated for effectiveness.

The monograph will conclude by assessing the effects that mobility-enhancing technologies have not only on the decisive battle but also the roles they play in the achievement of the national strategic end-state of "winning a better peace."[14] Although it is clear that these joint mobility-enhancing technologies and procedures help the U.S. Army meet the "expeditionary" goal of being "rapidly deployable, employable, and sustainable throughout the global battlespace," this monograph's conclusions challenge the assertion that these capabilities are of vital importance.[15] After comparing these technologies to their potential uses in "full spectrum" conflict, this monograph concludes that an "expeditionary force" capable of being "rapidly deployable, employable, and sustainable" is structured better for the most dangerous scenario of facing a potential near-peer competitor or conducting major conflict operations and it lacks sufficient capabilities for the most likely scenario that ground forces will be most relevant for conducting protracted operations to achieve and maintain stability. Finally, this monograph advocates that the most relevant role for the U.S. Army, in order to achieve a desired national strategic end-state, is to embrace the notion that "stability, support, transition, and reconstruction operations" is a core mission and that it is of paramount importance that the U.S. Army, as part of a joint, interagency, and multinational force, take the lead in conducting these types of operations and recognize that that other services may have a greater role in major conflict operations throughout the spectrum of conflict. Ultimately, this means that the U.S. Army must go further than simply recognizing that "SSTR operations are a core mission priority" and reorient its transformational efforts to not only be the most preeminent

[14] Lessard, 38.

[15] Department of Defense, *The National Military Strategy of the United States of America*, 2004, p. 15.

land power for its kinetic role in major conflict operations, but also be better "organized, trained, and equipped" for its role in stability, support, transition, and reconstruction operations.[16]

EXPEDITIONARY: WHAT IT MEANS AND WHY THE ARMY WANTS IT

Before any evaluation can be conducted regarding the effectiveness of mobility-enhancing technologies and procedures for the future security environment, a discussion about the precise meaning of "expeditionary" and why the U.S. Army, as part of a joint force, seeks this characteristic must occur. In general terms, "expeditionary" is defined as "a journey organized for a particular purpose," or "designed for military operations abroad."[17] The *Capstone Concept for Joint Operations, Ver. 2.0* defines an expeditionary force as "a force that is organized, postured, and capable of rapid and simultaneous deployment, employment, and sustainment."[18] In the context of the future security setting, Joint Military and U.S. Army documents more specifically define the term "expeditionary" in the context of "speed and simultaneity."[19] Rapid response and the ability to confront opponents at multiple locations at the strategic, operational, and tactical levels theoretically "allows U.S. Forces to more effectively control each phase of a campaign or conflict and dramatically improve prospects for success."[20] The speed and simultaneity at the strategic level allows political and military decision-makers the ability to "deter conflict, preclude certain enemy options, and limit conflict escalation."[21] At the operational and tactical levels, rapid, simultaneous actions:

> increase deployment momentum and enable more rapid seizure of the initiative through concurrent force flows and immediate employment of arriving forces, creating dilemmas for an adversary when the joint force is able to threaten him at multiple locations throughout the theater….Furthermore, it allows commanders to respond rapidly to opportunity or uncertainty and to employ

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[16] Department of Defense Directive 3000.05, Military Support for Stability, Security, Transition, and Reconstruction (SSTR) Operations, 28 November, 2005, 2.

[17] Merriam-Webster Dictionary

[18] Department of Defense, *Capstone Concept for Joint Operations*, Version 2.0, August 2005, 21.

[19] *"The Joint Operational Environment: Into the Future,"* Coordinating Draft, (Suffolk, VA, US Joint Forces Command: 11) January 2005.

[20] *"The Army in Joint Operations: The Army Future Force Capstone Concept,"*TRADOC Pamphlet 525-3-0, (Ft Monroe, VA, US Training and Doctrine Command: 7 April 2005, p. 4.

[21] *Ibid*, 2-2.

capabilities before an adversary has time to adjust, compelling him to react rather than initiate.[22]

Even with some of this precision in the definition of "expeditionary," the exact meaning of the term is not complete until it is quantified and qualified. For this, the U.S. Army uses the following conditions of deploying legacy forces as a benchmark for success: a combat-capable brigade *anywhere in the world* within 96 hours, a full division in place within 120 hours and five divisions in a theater of operations within 30 days.[23]

The real issue at stake for the U.S. Army's expeditionary mindset is not necessarily how far its force has to travel to get to a threatened region, but how quickly that force can get there, how it will gain access, and how its affects can immediately be felt by opposing forces. Although satellite and internet technologies help connect the world through virtual cyberspace, they cannot completely eliminate the physics involved when the United States decides to use its military to physically move forces and equipment around the world. Additionally, the use of remote sensing and targeting platforms, along with the air superiority that U.S. military leaders and policy makers have become accustomed to, gives military forces an important advantage by providing valuable intelligence data and the ability to strike opponents from strategic distances without subjecting U.S. service members to the dangers of ground combat. However, the use of present mobility-enhancing technologies can only accomplish so much in terms of decisively defeating opponents and controlling all situations. There is no such thing as a "virtual" presence in the future security environment. A physical manifestation, in terms of the actual deployment of U.S. service members and equipment, is often necessary to accomplish a strategic end-state in various threatening regions. Since strategic end-states may not necessarily be defined merely by the defeat of an adversary; military forces may also be used to conduct stability and reconstruction operations, support to civilian authorities, and humanitarian and disaster relief, to name a few. Furthermore, planners should not expect that military forces along with other elements of national power will always achieve a rapid political resolution to conflict without being engaged in multidimensional campaigns in a protracted manner. Therefore, time and accessibility still pose potential problems when the United States decides to intervene militarily. Since time and accessibility cannot be completely eliminated as a factor, calculated efforts must be made to reduce their effects. For deterrence purposes, the efforts related to how the U.S.

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[22] *Ibid*, 2-2.

[23] General Eric K. Shinseki, "Remarks at the Eisenhower Luncheon at AUSA on 12 October 1999," Army Public Affairs Homepage, (accessed 5 December 2005); available from <http://www.dtic.mil/armylink>

improves its ability to rapidly deploy and intervene must be made known to the international community and, more particularly, to potential opponents.

However, with all the accomplishments in the field of power projection in the past decade, it is becoming increasingly obvious that simply increasing the availability of present logistical transportation technologies may not be enough to offset the U.S. military's inability to gain access in certain war zones within specified deployment time-lines. In an operation testing the military's ability to rapidly deploy, most units were incapable of arriving within specified timelines.[24] Since a combat-capable brigade must be on the ground anywhere in the world within 96 hours, this initial force must inevitably be transported via aircraft. Many continue to believe that even with newly acquired technologies such as the C-17 aircraft, the military will fall short in its capability to deploy the required combat forces and necessary ground equipment during the initial phases of a deployment. Therefore, senior leaders have taken additional steps to ensure that the military is more prepared to respond to the growing spectrum of conflicts.

Sweeping changes must also be initiated in doctrine, organization, and combat equipment. These new initiatives would have to be in addition to the changes already established in logistical procedures and transportation technologies. The next phase of military transformation is to make fundamental changes in strategic thinking – logistic considerations must continue to, at least partially, define some primary elements of future combat equipment and operations.

When looking toward the future, many envision a smaller, more integrated, logistically unencumbered force with greater lethality and flexibility. Additionally, "we will know less and less about not only whom we will fight, but when, where, and how conflict will occur."[25] Through various programs, such as Joint Vision 2010, Army after Next, and the Navy's Forward…from the Sea, initiated within the Department of Defense, the various branches of the military have begun to redefine parts of its force structure and the composition of its equipment. In theory, a larger force could be replaced with a smaller, more versatile force. Accomplishing this rather robust task will require a transformation in how the military is configured. Equipment will be designed specifically for ease of transport as well as for lethality and survivability. The time aspect of getting a particular piece of equipment from point A to point B and its ability to overcome anti-access obstacles has now become a driving force behind its procurement. Although these efforts may be considered a

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[24] *Task Force Hawk,* conducted in 1999, determined that the Army was still experiencing difficulty in mobility.

[25] Headquarters, United States Army Training and Doctrine Command, *Mission Needs Statement for the Future Combat System*, 1.

revolution in military affairs, one must wonder if they address the true nature of the problem.

When addressing the Army's transformation efforts, not everyone agrees on which strategies and technologies should be adopted. This uncertainty is compounded because the U.S. Army and its sister services are not always in agreement on specific research and development priorities and they do not have an unlimited source of funding for all their various military projects. Senior leaders are now faced with a multitude of new policy considerations. Tradeoffs between lethality and ease of transport, how new technologies will fully mature, risks between near-term readiness and security concerns and long-term transformational capabilities, and whether or not the wishes of the department of defense can be realistically accomplished by the defense industry in a timely manner are just some of the concerns voiced by policy makers and senior leaders. Many warn that simply adopting new technologies cannot be a panacea for military transformation. In establishing goals for the military, a senior military planner jokingly provided this example, "if theater commanders and military leaders were asked to describe the capabilities they would really like for a future airlifter, they would probably reply something like this: We want a cheap, compact, totally self-loading aircraft, which flies at Mach 2.5, is invisible, can carry a tank platoon in a single lift, and lands in a cow pasture without stirring up the manure."[26] Of course, the Department of Defense must take advantage of new technologies, but it must also be realistic in what can be accomplished. The tradeoff between gaining certain technological advantages and the associated cost and time to develop particular capabilities reaches a point of diminishing returns where it is no longer practical to seek such a capability.[27] Policy makers should, then, seek only those technologies that can provide the military with realistic power projection capabilities without compromising other aspects of military operations.

In subsequent portions of this paper, an analysis of specific logistical capabilities will be conducted looking at what that the U.S. Army is seeking to overcome in its specified deficiencies in the emerging strategic environment. Many in senior leadership positions contend that, despite a decade of making improvements, the joint force is incapable of projecting forces quickly and gaining access in an anti-access/area-denial environment. Although the validity of this statement has yet to be proven, the U.S. Army has made this one of its top priorities. The discussion does not intentionally leave out new "combat" technologies developed for the

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[26] Alexander P. Shine, *Theater Airlift 2010*, Maxwell Air Force Base Homepage, (accessed 20 December 2005); available from <http://www.airpower.maxwell.af.mil/airchronicles/apj88/shine.html>

[27] William C. Martel, class lecture, Seminar on Security Planning and Policy Analysis course, Fletcher School of Law and Diplomacy, Tufts University, 26 February 2002.

US military, but focuses, rather, on how logistic technologies can support US policies and objectives in their own right. Each new technology will be analyzed against current capabilities to determine its ability to positively influence the US military's ability to fight and win decisive battles in the future and ultimately to contribute to the overall success of the national strategic end-state.

In each instance, with the drastic increase in defense spending from the mid 1990s, the monetary constraints of developing and implementing new capabilities have been drastically reduced. However, addressing specific acquisition costs and budget constraints associated with each innovation is beyond the scope of this paper. For the purpose of policy analysis, an assumption is made that the development and evaluation of these technologies is, at least, fiscally possible. Consequently, instead of asking which power projection technologies to invest in, the more relevant question may be which acquisition strategy will best manage uncertainty while maximizing the benefits of the technological innovation.

THE FUTURE SECURITY ENVIRONMENT

The National Security Strategy of the United States of America, dated March 2006, and the more recent *National Military Strategy of the United States of America* along with *The National Defense Strategy of the United States of America*, dated 2004 and 2005 respectively, express that the future security environment is characterized by uncertainty. They go on to stress that because the United States cannot possibly predict specific events before they unfold, the Department of Defense must organize its military forces with a "capabilities-based" approach and be skilled at "handling unanticipated problems."[28] However, *The National Military Strategy* explains in the "1-4-2-1" force sizing construct that military forces must be "sized to defend the homeland, deter forward in and from four regions, conduct two, overlapping swift defeat campaigns, and win decisively in one of the two campaigns."[29] Because the future security environment is so dynamic and based on uncertainty, The National Military Strategy goes on to stress that the focus in planning relies "less on a specific adversary and where conflict might occur and more on how an adversary might fight."[30]

Although there is much debate regarding the nature of future conflict and the role the military will play in achieving a national strategic

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[28] Department of Defense, *The National Defense Strategy of the United States of America*, March 2005, 2.

[29] Department of Defense, *The National Military Strategy of the United States*, 2004, 21.

[30] *Ibid*, 3.

end-state, these key documents along with supporting government documents and some contemporary academic sources will be used at face value to analyze the effectiveness of proposed mobility platforms in this research. If the U.S. Army, as part of a joint, interagency, and multinational force, must focus on *how* an opponent will fight, then the fundamental principles that need to be applied to the design of future power projection capabilities must be based on more than just the one-size-fits all catch phrase of being capable of full-spectrum operations. Instead, the emerging security challenges where the United States may face threats in four overlapping categories; Traditional, Irregular, Catastrophic, and Disruptive, needs to be the benchmark for designing equipment. Furthermore, the U.S. Army must be prepared to operate in a security environment that is characterized by a "wider range of adversaries, a more complex and distributed battlespace, and technology diffusion and access."[31]

In order to evaluate how well the U.S. Army has articulated required Key Performance Parameters (KPPs) in Joint Operational Requirements Documents for specific mobility enhancing/power projection technologies, a more detailed description of these fundamental principles regarding the future security environment is warranted.[32] The following paragraphs will highlight certain criteria from government documents and from Thomas Barnett's book, *The Pentagon's New Map*.[33] These specific documents will be used in order to best describe future conflict and the military capabilities needed to "prevail against (all) adversaries."[34]

It is important to first describe the types of threats U.S. military forces can expect to counter in the future. President Bush summarized emerging threats in a speech at West Point in 2002 by stating, "America is now threatened less by conquering states than we are by failing ones. We are menaced less by fleets and armies than by catastrophic technologies in

[31] *The National Military Strategy of the United States*, 2004, 4-6.

[32] Key Performance Parameters, (KPPs) are the criteria that must be adhered to in order to procure a particular piece of military equipment.

[33] Thomas P.M. Barnett is a strategic planner who has worked in national security affairs since the end of the Cold War and operates a private consulting practice. He is a *New York Times* best selling author and a nationally known public speaker. Dr. Barnett is in high demand within government circles as a forecaster of global conflict and an expert of military transformation, as well as within corporate circles as a management consultant and conference presenter on issues relating to international security and economic globalization.

[34] "Prevailing Against Enemies" is used in NMS to emphasize that this process includes integrating all instruments of national power within a campaign to set the conditions for an enduring victory.

the hands of the embittered few."[35] *The National Defense Strategy* summarizes four distinct but overlapping threats to U.S. interests.

"Traditional Challenges" comprise the type of threat U.S. military forces are most capable and familiar in dealing with. These types of threats can be characterized by the state-on-state competition reminiscent of the Cold War time frame. This type of threat comes from "states employing recognized military capabilities and forces in well-understood forms of military competition and conflict."[36] Although many contend that U.S. military dominance coupled with allied superiority reduces the likelihood that any opponent will use this approach to threaten the United States, the NDS still advocates that these challenges remain important and that the U.S. military cannot reduce its current combat capabilities to counter these types of threats. Additionally, many articulate that we may face a near-peer competitor in the future and conflict may take this form.

"Irregular Challenges" are those types of threats that emanate from those who "employ unconventional methods to counter the traditional advantages of a stronger opponent."[37] These threats may come from state actors, but non-state actors are most commonly associated with irregular-type conflict. This type of threat usually takes on the form of terrorist and/or insurgent activities. Although, historically U.S. military forces are less familiar with this type of threat, this is the type of threat the United States is dealing with today in its "Global War on Terrorism" and in places like Afghanistan and Iraq. This type of challenge depends less on traditional forms of military engagement and focuses more on protracted campaigns that can "erode U.S. influence, patience, and political will."[38] What complicates success in countering these types of threats is that the U.S. Army and the joint force alone cannot achieve total victory in a strategic sense. Military force must be used in combination with other interagency, international, non-governmental organizations, and multinational capabilities. This concept, known as the "active defense in depth" stresses the importance of the synergistic effects needed from an interagency process.[39] The problem, however, is that there is no specific government "interagency" responsible for coordinating and directing a synergistic approach to cross-department problems. Various organizations still contend with competing demands, differing priorities, and diverse cultures. Furthermore, there is "no single, national level organization

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[35] *The National Security Strategy of the United Sates of America*, September 2002, 13.

[36] Department of Defense, *The National Defense Strategy of the United States of America*, March 2005, 2.

[37] *The National Defense Strategy of the United States of America*, 3.

[38] *Ibid*, 3.

[39] Department of Defense, *The National Military Strategy of the United States of America*, 6.

issuing guidance, managing competing agency policies, and directing agency participation…."[40]

Because experts have now realized that "irregular threats" are better managed through a synergistic approach from multiple government agencies, stop-gap measures have been created in the absence of a single, national level organization. In the infant stages of developing interagency cooperation, U.S. Central Command created and used successfully in Afghanistan and later, in Iraq, a new interagency organization called the Joint Interagency Coordination Group (JIACG). This organization, facilitated by the Secretary of Defense, had 30 military positions and over 30 non-military positions consisting of people from the Federal Bureau of Investigation, the Central Intelligence Agency, Customs, the National Security Agency, Defense Intelligence Agency, New York's Joint Terrorism Task Force, the Justice Department, the Treasury Department, and the State Department. This staff focused on four primary tasks: "political-military (ambassadorial) duties, intelligence fusion, civil-military operations, and CIA specific operational advice."[41] Despite its many successes, the effects of the JIACG were ultimately limited because members could only offer their expertise as members of a specific agency and their unofficial input. Anything more than this dipped into the politics of the Washington Beltway and could be misconstrued as policy guidance. While consensus was not difficult in this group at the tactical and operational levels, garnering support and consensus from all the parent organizations at the strategic level was virtually impossible.[42]

In order to more effectively understand "irregular threats," it is important to link the concept of extremist ideologies and specific failed or failing states highlighted in various government documents to the specific geographic regions where these threats are likely to emanate. For clarity purposes, this monograph will adopt Thomas Barnett's term, "the non-integrating gap" to refer to these specific regions.

In its most basic form, the term "extremist" can be defined as "any person (or group) who advocates ethnic, gender, or racial hatred or intolerance: advocates, creates, or engages in illegal discrimination based on race, color, gender, religion, or national origin; advocates the use of or uses force, violence, or unlawful means to deprive individuals of their rights."[43] The term "ideology" is defined as "a systemic body of concepts especially about human life or culture; a way of thinking used by a group or individual to express their beliefs and social values."[44] There are many types and classifications of extremist ideologies throughout the world and

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[40] Matthew F. Bogdanos, "Joint Interagency Cooperation: The First Step," *Joint Forces Quarterly,* Issue 37, 15.

[41] *Ibid*, 12.

[42] *Ibid,* 16.

[43] Department of the Army Pamphlet 600-15, 1 June 2000, 11.

[44] Ibid, 11.

many political, religious, and ethnic groups that promote ideologies that run counter to U.S. National Security goals and fuel growing conflicts.

Specifically, the "non-integrating gap" is the region that covers roughly the landmasses from the Western Hemisphere, through most of the African continent and the Middle East, and extends towards Asia. These regions are of particular concern because "they are dangerously disconnected from the globalized world." Barnett contends that globalization and its interconnectedness and interdependence is required to "bind countries together in mutually assured dependence."[45] His logic, which corresponds with some tenets advocated in the NDS, advocates that regions that do not embrace globalism are plagued by "politically repressed regimes, widespread poverty and disease, routine mass murder, and most important, the chronic conflicts that incubate the next generation of global terrorists."[46]

Figure 2 Barnett's Non-Integrating Gap[47]

The absence of an effective government in the "non-integrated gap" creates conditions where states are either unable or unwilling to deal with groups adhering to extremist ideologies. Furthermore, because there is no government to exercise effective control of the territory, terrorists or insurgents, and criminals can create sanctuaries to further their radical causes.[48] This presents a two-fold problem for intervention. First, although the NMS stresses the importance of *how* an enemy fights, the U.S. Army continues to be compelled to design mobility platforms for specific regions where conflict might occur. In fact, the U.S. Army places a premium on designing equipment that fits the goal of being expeditionary in nature. Speed, simultaneity, overcoming anti-access constraints are stressed as important key performance parameters because

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[45] Thomas P.M. Barnett, *The Pentagon's New Map,*(New York: G.P. Putnam's Sons, 2004), 122.

[46] *Ibid,* 132.

[47] Barnett, inside cover.

[48] Department of Defense, *The National Defense Strategy of the United States of America*, March 2005, 3.

the geography in the "non-integrated gap" is not conducive to large-scale linear deployments where military forces must rely on development infrastructures to facilitate entry, shaping, and containment operations. Second, because opponents in these regions rely on protracted, irregular techniques, the U.S. Army's future force, while being organized in lighter, smaller force packages relying on new types of networked, fast, agile mobility platforms and more than capable of conducting decisive combat operations, may be insufficient for conducting concurrent and subsequent stability operations.

'Catastrophic Challenges' involve the acquisition, possession, and use of weapons of mass destruction and/or effect (WMD/E)."[49] This type of threat is paramount to the security of the United States because the events of 9/11 have proven that U.S. territory and the territory of our allies and strategic partners can no longer be thought of as impenetrable from attacks from hostile forces. *The National Security Strategy of the United States of America* places a new emphasis on the protection of the homeland and the territory of our friends. Specifically, the NSS outlines an offensive strategy for military forces by stating that forces will "defend the United States, the American people, and our interests at home and abroad by identifying and destroying the threat before it reaches our borders."[50] Although the primary role for military forces is clearly offensive in nature with a goal to prevent attacks on the homeland by fighting abroad, a defensive role for military forces is also outlined. Although *The National Strategy for Homeland Security* clearly identifies that local and state authorities are the first-responders should a WMD/E event occur, it highlights the need for federal level coordination. The United States Government reorganized itself and created the Department of Homeland Security as a major first step to meet this requirement. One mandate for the newly created department is to oversee federal, state, and local level coordination and be the "review authority for military assistance in domestic security."[51] Clearly the Department of Defense and the U.S. Army will play a critical role in national emergencies. *The National Strategy for Homeland Security* identifies three circumstances when the Department of Defense would be used to improve security at home.

> First, in extraordinary circumstances, the Department [of Defense] would conduct military missions such as air patrols or maritime defense operations. In these cases, it would take the lead in defending the people and the territory of our country, supported by other agencies. Second, The Department of Defense will be involved in

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[49] *The National Defense Strategy of the United States of America*, March 2005, 2.

[50] *The National Security Strategy of the United States of America*, September 2002, 6.

[51] *The National Strategy for Homeland Security*, July 2002, ix.

> responding to emergencies such as responding to an attack or to forest fires, floods, tornadoes or other catastrophes. In these circumstances The Department of Defense may be asked to act quickly to provide capabilities that other agencies do not have. Third, The Department of Defense would also take part in 'limited scope' missions where other agencies have the lead-for example, security at special events like the recent Olympics.[52]

The discussion about the offensive and defensive roles of the Department of Defense and the U.S. Army, as part of the joint, interagency, and multi-national force in countering "Catastrophic Challenges" is necessary because it provides some background for why many feel that new technologies and procedures should be based on key performance parameters that significantly speed up response time and help negate anti-access constraints. The dual nature of how U.S. Army equipment and formations could be used in the future security environment at home and abroad makes the various technologies discussed in this monograph very appealing…and perhaps, seductive. Nonetheless, *The Capstone Concept for Joint Operations, version 2.0* contends that, "the joint force, [when] responding to stability and homeland security requirements, will capitalize on the same agility, modularity, and distributed sustainment systems that support combat operations."[53]

According to the *National Defense Strategy,* "Disruptive challenges may come from adversaries who develop and use breakthrough technologies to negate current U.S. advantages in key operational demands."[54] Adversaries may choose to use these types of threats because they clearly understand that they are incapable of confronting U.S. military forces in a symmetrical manner. *The National Defense Strategy* also highlights that this type of threat can be brought forth by "disruptive breakthroughs in biotechnology, cyber operations, space, or directed-energy weapons, [and] could seriously endanger our security."[55] Hence, when the U.S. Army advocates certain future mobility platforms, it must balance risk to "reconcile expeditionary agility and responsiveness with the staying power, durability, and adaptability to carry a conflict to a victorious conclusion no matter what form it eventually takes."[56]

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[52] *The National Strategy for Homeland Security*, July 2002, 13.

[53] Department of Defense, *The Capstone Concept for Joint Operations, version 2.0* , 6.

[54] Department of Defense, The National Defense Strategy of the United States of America, March 2005, 2.

[55] *Ibid,* 3.

[56] *Serving a Nation at War*, 7.

An example of how the Department of Defense and the U.S. Army are attempting to look more critically at "Disruptive Challenges" and balance risk can be seen in the concept development and experimentation (CD&E) of the Joint Tactical Radio System (JTRS). This program to develop "a family of revolutionary software-programmable tactical radios that will provide the warfighter with voice, data, and video communications, as well as interoperability across the battlespace" is tied heavily to one of the U.S. Army's five "transformational initiatives;" developing and fielding the future combat system (FCS)."[57] Although FCS will be analyzed in detail later, it is important to point out that the FCS and other mobility platforms across the Department of Defense will rely heavily on the JTRS for "network centric" operations in future "full spectrum" scenarios. If the goal is to "leverage new technological capabilities [like JRTS] to gain an enhanced common operational picture," then planners need to be cognizant of possible proliferation of separate "disruptive" technologies that may provide our opponents the ability to negate the U.S. advantages that the JTRS provides. If potential adversaries could develop and use cyber technologies, for example, to disable or destroy satellite coverage over a future battlespace, then the use of JTRS and ultimately the U.S. Army's reliance on networked FCS and related mobility platforms would place military forces at a tremendous disadvantage.

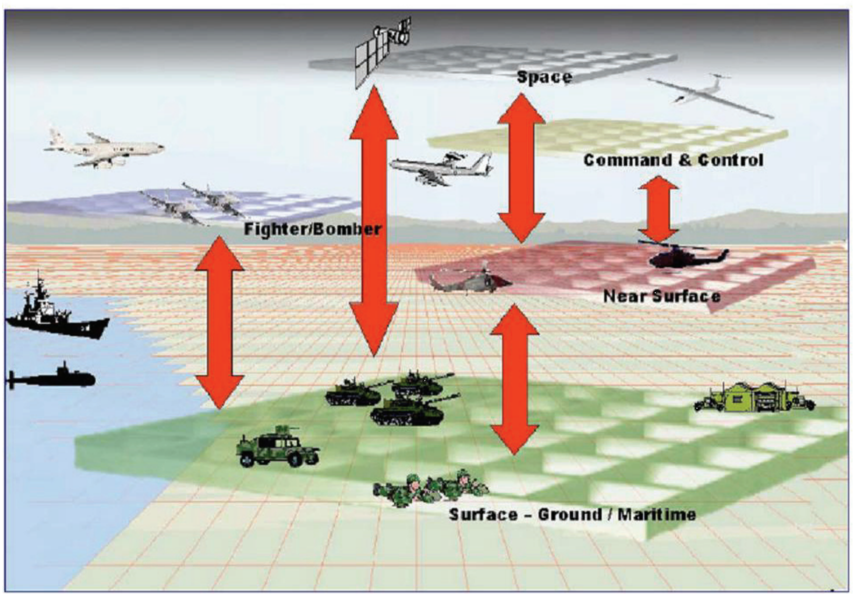

Figure 3: Joint Tactical Radio System Architecture[58]

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[57] JRTS Program website (accessed 19 January 2006); available from <http://www.jtrs.army.mil/sections/overview/fset_overview.html>

[58] JTRS Joint Program Office, 15 January 2003. (accessed 19 January 2006); available from <http://www. spacecom.grc.nasa.gov/isnsconf/docs/2003/11_d2/d2-06a-harrison.pdf>

Now that a discussion of the emerging challenges has been conducted, it is imperative to look at some key aspects of the security environment. *The National Military Strategy,* states that "a wider range of adversaries, a more complex and distributed battlespace, and technology access and diffusion all play a role and drive the development of concepts and capabilities that ensure success in future operations."[59] A specific discussion of each of these aspects is warranted since key performance parameters for future mobility platforms are drawn from them.

The source of conflict has widened since the bi-polar structure of international relations ceased with the collapse of the Soviet Union at the end of the twentieth century. The United States no longer has the comfort of knowing precisely who potential opponents will be. Adversaries now have a broad range in classification: state-actors, non-state actors, individuals, terrorist networks, and international criminal organizations are only a few. These actors can threaten the Unites States through a variety of means; traditional militaries, asymmetric technologies, weapons of mass destruction and/or effect, or simply access to dangerous capabilities. Some states act out of their own aggression and others are either unwilling or incapable of stopping other sub-national groups in their attempts at aggression. Whatever the case, the U.S. military needs to attain capabilities that account for all these uncertainties. Since opponents could potentially be any where in the world, the U.S. Army has introduced ten strategic imperatives in the *Army Strategic Planning Guidance 2005*.[60] Specifically, as it relates to mobility platforms, the U.S. Army has a tendency to focus on the criteria of speed, agility, and negating anti-access constraints. Although these criteria apply to all the strategic imperatives, it appears that they are more focused on the following five: "implementing transformation initiatives, achieving Army force capabilities to dominate in complex terrain, increasing Army capabilities for strategic response, improving global force posturing, improving capabilities for battle command, and improving capabilities for joint logistics."[61]

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[59] *The National Military Strategy of the United States of America*, 4-6.

[60] The Army Strategic Planning Guidance (ASPG) is the Army's institutional strategy and serves as its principal long-range planning document. The 2004 ASPG provided a new direction for the Army in the context of a security environment fundamentally changed by the Global War on Terrorism. The 2005 document does not alter the specified direction of its predecessor, but highlights emphasis on transformation and change. To provide focus, the Army introduced ten strategic imperatives. They are: Implement Transformation Initiatives, Improve Capabilities for Homeland Defense , Improve Proficiencies Against Irregular Challenges, Improve Capabilities for Stability Operations, Achieve Army Force Capabilities to Dominate in Complex Terrain, Improve Army Capabilities for Strategic Responsiveness, Improve Global Force Posture, Improve Capabilities for Battle Command, Improve Joint Fires Capability, and Improve Capabilities for Joint Logisitics.

[61] Department of the Army, *Army Strategic Planning Guidance*, 2005, 8-15.

In addition to the uncertainty the United States may face from potential adversaries, the U.S. military may also find itself operating in "widely diverse locations – from urban areas to littoral regions to remote, inhospitable and austere locations."[62] Again, because of this key aspect regarding the nature of future conflict, the U.S. Army has emphasized the parameters of speed, precision, lethality and the ability to overcome anti-access constraints for potential mobility platforms. Additionally, the U.S. Army has highlighted the duel use of technology with these capabilities for other scenarios like defending the homeland or responding to humanitarian crisis or natural disasters.

Finally, the proliferation of various technologies and the relative ease of gaining access to "low cost, commercially available technologies" will improve any adversary's ability to threaten the United States in the near term. The implication this has for the procurement of new mobility platforms is that the U.S. Army, as part of a joint, interagency, and multinational force, must balance near-term readiness, using currently available, off-the-shelf technologies with more long-term goals, where we may use entirely new capabilities not readily available and even "skip a generation of technologies" in order to attain more sophisticated capabilities.

MECHANICAL CHARACTERISTS OF MOBILITY-ENHANCING TECHNOLOGIES

GROUND-BASED TECHNOLOGIES: FCS, MODULAR FORCES

Bearing the brunt of the military's transformation is the U.S. Army. Most contemporary literature contends that today's full spectrum of conflict dictates that the U.S. Army must shed some of its heavy combat equipment for lighter, newer technology capable of overcoming anti-access challenges. The Army's primary challenge is that it must become "more of a rapidly deployable land expeditionary force," thus the emphasis on an "expeditionary mindset."[63] The goal is to reduce the weight and logistical requirements of battle tanks and armored fighting vehicles while continuing to enhance the lethality of the equipment, while simultaneously providing force protection for the soldiers operating them in any conflict scenario. As one senior Army official stated, "in future

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[62] *The National Military Strategy of the United States of America*, 5.

[63] Steven Koziak, Andrew Krepinevich, Michael Vickers, *A Strategy for a Long Peace* (Washington, DC: Center for Strategic and Budgetary Assessment, Janaury 2001), 29.

conflict scenarios, you are not relevant unless you can get to the fight."[64] The development of FCS and modular forces structure is the U.S. Army's "high risk venture" to get to the fight, wherever that might be, with a hybrid mix of capabilities that offers the most relevant use of land-power assets to the joint, interagency, and multinational force.[65]

Accordingly, the U.S. Army, under the then Chief of Staff of the Army General Erik Shinseki, developed in the late 1990s a near-term and long-range strategy to address its challenges in twenty-first century conflict. For the near-term, the army would procure off-the-shelf, light model vehicles, knows as Strykers, to serve in what was called the "Interim Brigade Combat Team." Additionally, the U.S. Army would adopt a long-range strategy for its "Objective Force" to develop "lighter, more modular, ground and air vehicles – manned and unmanned, and robotic-, and employ advanced offensive, defensive, and communications/information systems to outsmart and outmaneuver heavier enemy forces on the battlefield."[66] Hence, the concept development for the Future Combat System (FCS), as it is known today, was initiated. This plan, adopted in the absence of conflict, created the ultimate goal of merging the Interim Force and Legacy Force into the Objective Force within the next two decades. The GWOT and involvement in OEF and OIF changed the context of how this transformation would occur. Subsequently, the current Chief of Staff of the Army, General Peter Schoomaker, removed the name "interim" and placed the Stryker Brigade Combat Teams in the current force and renamed the objective force as the "Future Force." The revised goal, without the luxury of having an "interim force," remains similar to the original: to "redesign the current ten active duty division force with 43 to 48 brigade-sized units known as "Brigade Combat Teams," and to "use spiraling technology to create a networked system of 18 manned and unmanned advanced technologies, tied together by an extensive communications network to more appropriately deal with challenges of twenty-first century conflict."[67]

In order to conduct an analysis of the salient features of the FCS against the likely future conflict scenarios, or phases of conflict, where that equipment will be most useful and relevant, it is necessary to outline the specific mechanical characteristics that the U.S. Army has asked the

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[64] Army Public Affairs Homepage, "Army Announces Vision of the Future," *News Release #99-095* (accessed on 4 December 2005), available at <http://www.dtic.mil/armylink>

[65] Andrew Feickert, "The Army's Future Combat System (FCS): Background and Issues for Congress, *CRS Report for Congress RL32888,* CRS-1.

[66] Frank Tiboni, "Army's Future Combat Systems at the Heart of Transformation," *Federal Computer Week,* Feb. 9, 2004.

[67] Andrew Feickert, "The Army's Future Combat System (FCS): Background and Issues for Congress, *CRS Report for Congress RL32888,*2-5.

defense industry to design. In a Congressional Research Service's Report to Congress titled, *The Army's Future Combat System: Background and Issues for Congress,* FCS is outlined in the following manner:

> The Future Combat System (FCS) is the Army's multi-year, multi-billion dollar program which is considered to be at the heart of the Army's transformation efforts. It is to be the Army's major research, development, and acquisition program to consist of 18 manned and unmanned air and ground systems tied together by an extensive communications network, and the soldier (18+1+1). [The] FCS is intended to replace such current systems as the M-1 Abrams tank and the M-2 Bradley infantry fighting vehicle with advanced networked combat systems.[68]

The U.S. Army describes the following variants of FCS as "optimized for offensive operations, [but will also] have the ability to execute a full spectrum of operations." Army officials contend that [the FCS-equipped BCT] "will improve the strategic deployability and operational maneuver capability of ground combat formations without sacrificing lethality or survivability and is the fastest and surest way to modernize the army." Future Combat Systems include 18 individual systems.[69]

All of the component systems on the FCS have certain characteristics, or KPPs, that are considered absolutes in system design and are, therefore, rarely modified or disregarded. With the goal of "improving strategic deployability and operational maneuver capabilities without sacrificing lethality or survivability," the U.S. Army has focused on certain mechanical characteristics that aid in speed of deployment and help in overcoming anti-access constraints.[70] Because the seven specific KPPs are classified, this monograph will focus on the open source information.

Transportability is one such characteristic. Although there is debate about the exact nature of the requirement of transportability, original design criteria stated that the largest components of FCS, the eight

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[68] Feickert, 1.

[69] The *18+1+1 Future Combat Systems Overview* outlines the 18 component parts of the FCS program into these categories: "unattended ground sensors; two unattended munitions, the Non-Line of Sight – Launch System and Intelligent Munitions System; four classes of unmanned aerial vehicles organic to platoon, company, battalion, and Brigade Combat Teams echelons; three classes of unmanned ground vehicles, the Armed Robotic Vehicle, Small Unmanned Ground Vehicle, and Multifunctional Utility/Logisitcs and Equipment Vehicle; and eight manned ground vehicles, the Mounted Combat System, the Infantry Carrier Vehicle, the Non-Line-of-Sight Cannon, Non-Line-of-Sight Mortar, Reconnaissance and Surveillance Vehicle, the Command and Control Vehicle, the Medical Vehicle-Treatment and Evacuation, and the FCS Recovery and Maintenance Vehicle; plus the network, Joint Tactical Radio System, and the Warfighter Tactical Information Network-Tactical; plus the soldier."

[70] TRADOC Pamphlet 525-3-0, 18.

Manned Ground Vehicles (MGVs), must be air transportable by the Air Force's C-130 aircraft. This weight restriction originally placed about a 20 ton weight limit on all FCS components. However, in November, 2005 the army removed the C-130 transportability requirement and, instead, stipulated that three FCS MGVs must now fit inside a C-17.[71] Despite efforts to downplay this requirement and designate this characteristic instead as a lesser stringent "Critical Operational Issue and Criteria" (COIC), the MGVs must adhere to weight limitations in the 20 to 24 ton range. Weight restriction placed on design of the FCS fall within the current capabilities of the Air Force's fleet of C-130 and C-17 aircraft.

If weight restrictions have been imposed on FCS variants from design inception in order to achieve expeditionary agility and to create a more strategically responsive, campaign quality force, one must wonder why the U.S. Army chose a 20 to 24 ton weight threshold similar to the current capabilities of the C-130 and C-17. Some contend that the weight range was due to the inability of the defense industry to create a viable FCS that would meet the "survivability" requirements with anything less than 24 tons.[72] Others advocate that the weight restrictions were nothing more than a "design template," used to force engineers to think light. Furthermore, weight limitations were not meant to be taken literally, but to serve as guidelines for operating conditions in austere environments where a lighter MGV would be "able to move through narrow streets in urban areas as well as move across most bridges."[73] However, since transportability of FCS is tied to other joint systems, the weight restrictions placed on MGVs might also be related to maximum lift capabilities or carrying capacity of various sea-basing concepts and Joint Heavy Lift (JHL) aircraft concepts (to be addressed in subsequent portions of this paper). Interestingly, in today's military budgeting environment, money is allocated based off of joint agreement on specific concepts. The more a particular concept adheres to joint requirements, the more likely it is to receive an allocation of resources.

Another characteristic required for FCS variants is that it must be "converted to its combat configuration no more than 30 minutes after rolling off a C-130."[74] Specifically, each FCS, with all its armor, ammunition, fuel, weapons systems, required sustainment materials, and personnel, must be readily configurable upon arrival in a potentially austere theater of operations in order to engage almost immediately in combat operations.

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[71] Sandra Erwin, "For Army's Future Combat Vehicles, Flying by C-130 No Longer Required," *National Defense,* November 2005,

[72] Megan Scully, "U.S. Army May Tinker with FCS C-130 Need," *Defense News,* 15 November, 2004.

[73] Scully.

[74] Scully.

Because FCS will be configured using lightweight composite armor, and at 20 tons, weighs about a third of an M-1A1 Abrams tank, its ability to defend itself and maneuver for offensive operations is heavily reliant upon its ability to "network" with other FCS vehicles and the entire joint force. Therefore, a third characteristic for FCS development is that the communications technology used to create a networked "system of systems" must provide tactical forces with high situational understanding and information superiority.

Furthermore, since the fundamental mission of an armored vehicle is "to destroy the enemy while protecting its crew so they can safely serve the main gun and live to fight another day," FCS characteristics must continue to embrace the same standards in survivability and lethality of today's current fleet while simultaneously embracing the flexibility of greater mobility that a lighter platform provides.[75] Today's M1 Abrams Battle Tank, weighing 70 tons, has a proven track record for lethality and survivability. The troops that operate it and the general public who continue to be adverse to casualties in conflict have grown accustomed to the service it provides. Therefore, for many it is hard to conceive that a vehicle that weighs less than one-third of the weight of this vehicle could rival it as a modern main battle tank.

The Army's answer to this dilemma is the use of the *system of systems* concept. This concept defines the FCS not a single vehicle with a solitary role but a network of platforms working together to accomplish numerous functions. The Army's Training and Doctrine Command provides this summary of its System of Systems concept:

> The FCS force will be structured to exploit information dominance through a collection of fighting ensembles. This team achieves battlespace situational understanding by employing a common relevant operating picture. The result will be a synergistic interdependence in which the product of every sensor is tied to every shooter. The FCS force will consist of a combination of manned and unmanned air and ground elements. Each element depends on the other for protection as well as lethality. The net effect is an Abrams-like capability in a much lighter, more lethal and survivable platform. Its ability to engage targets is no longer constrained by the range of its own direct or indirect fire weapons. Its ability to sense the battlefield, process that information while understanding friendly and enemy situations, decide the best method of engagement, and act decisively within the enemy's decision cycle are key to its success.

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[75] Federation of American Scientists, "Direct Fire Weapons," (accessed on 3 January 2005), available at <http://www.fas.org/man/dod-101/sys/land/direct.htm>

One notices from this description that the U.S. Army has placed heavy emphasis on situational awareness and information dominance to help mitigate the drastically reduced armored protection that individual FCS vehicles offer. This holistic “system of systems” approach offers much insight to how military leaders envision the role of a networked system of FCS platforms in future scenarios across the full range of conflict. Now that ground-base technologies have been introduced, this monograph addresses the mechanical considerations of sea-based technologies.

SEA-BASED TECHNOLOGIES: JOINT MOBILE OFFSHORE BASE

Since US forces may gradually loose access to overseas basing facilities because of proliferation concerns, in cases where allies refuse to provide basing support, or because a particular geographic region does not have the infrastructure capable of sustaining US military equipment, policy makers are considering acquiring a man-made, movable, multipurpose, sea-based logistics facility called the Joint Mobile Offshore Base (JMOB). This mobility enhancing technology is part a “transformational concept, called ‘seabasing’ designed to revolutionize the projection, protection, and sustainment of U.S. warfighting capabilities.”[76] The JMOB is primarily designed to provide military units, such as Naval Expeditionary Forces (NEF) and Marine Air-Ground Task Forces (MAGTF) with the ability to operate forward and “maneuver in a theater complementary to or independent of allied or coalition support and infrastructure.”[77] This unique capability also augments current seabasing theater assets such as Carrier Strike Groups, Expeditionary Strike Groups, and Maritime Pre-positioning Groups associated with Marine Corps Expeditionary Brigades. In augmenting current capabilities, the JMOB further increases the ability of Naval and Marine Corps assets to form a joint base “more secure than a land base, [which is] not reliant on host nation support.”[78]

Specifically, this technology, being developed by three competing engineering firms, (Bechtel, Kvaerner ASA Lysaker, and McDermott Inc.) would be designed to operate “over the horizon” from a potential area of conflict and “provide the Navy and Marine Corps with a logistical transportation node for the inter- and intra-theater movement of supplies.”[79] This floating platform could allow tactical forces to operate by giving them freedom of maneuver without a heavy logistical footprint

[76] Department of the Navy, Headquarters, United States Marine Corps, *Marine Corps Concepts and Programs,* 2005.

[77] T.D. Kilvert-Jones, “The Key to Effective Presence,” *Sea Power*, vol. 42, no. 5, (May 1999): 40.

[78] Marine Corps Concepts and Programs.

[79] T.D. Kilvert-Jones, 40.

ashore while simultaneously providing logistical forces with the ability to support and sustain combat forces from a temporary off shore location.

Figure 4: Joint Mobile Offshore Platform[80]

What industry representatives, defense analysts, and some policy makers envision is creating the largest floating platform in the world by adapting the same proven technologies used today in many offshore oil platforms. "The primary design concept consists of five 1000-foot long independent semi-submersible modules that can be connected by innovative locking mechanisms to form a complete, fully functional, 5,000-foot JMOB."[81] This offshore seabase would essentially be large and sturdy enough to support a one-mile floating runway capable of handling up to C-17 sized aircraft. The five independent sections would be capable of traversing through the world's oceans at up to fifteen knots per hour, which would guarantee its arrival from the United States to any operational site in the world within thirty days. Once assembled, the platform would provide five million square feet of space, capable of surviving in all sea states. (50-foot seas with 100-knot winds) Since the platform would be modular, it could be configured to either accommodate up to 3.5 million square feet of storage space, 75 million gallons of fuel or potable water, 3500 vehicles, 5000 containers, or 150 small tactical fixed or rotary-wing aircraft. Additionally, the facility would have up to ten berths for ocean-going supply vessels such as the LMSR and combat ships to upload or offload cargo and equipment.[82]

At face value, it seems as though this technology will certainly enhance the capabilities of U.S. Joint Forces as they conduct "over the

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[80] Joint Mobile Offshore Base, (accessed on 27 February 2006), available at <http://www.popularmechanics.com/science/defense/1281531.html?page=3&c=y>

[81] Paul Nagy, "Setting the Record Straight On Mobile Offshore Bases," *National Defense*, vol.86, no.573, (Aug 2001): 62.

[82] The general discussion of JMOB capabilities, unless otherwise noted, comes from the BWX Technologies Homepage (accessed on 20 December 2005); available at <http://www.bwxt.com/Products/mob-bwx.html>

horizon" type operations in areas described in the "non integrated gap."[83] This specific technology, when used in combination with other mobility enhancing technologies like the U.S. Army's FCS and Joint Heavy Lift programs, increases expeditionary capabilities across all joint, interagency, and multinational forces. It allows forces to conduct "distributive operations." These types of operations are described as

> a form of maneuver warfare characterized by the capacity for coordinated actions by dispersed units throughout the breadth and depth of the battlespace, ordered and connected within an operational design [and] focused on a common aim. It is intended to create an advantage over an adversary through deliberate use of separated, coordinated, and interdependent tactical actions.[84]

Before turning to a more careful analysis for testing JMOB's transformational characteristics in a later section, an overview of the mechanical characteristics of air-based technologies is warrented.

AIR-BASED TECHNOLOGIES: JOINT HEAVY-LIFT AIRCRAFT CONCEPTS

The U.S. Air Force has recently reorganized its command and control structures into ten Aerospace Expeditionary Forces to more readily provide airlift assets to rapidly project power in the event of crisis or conflict. In addition to providing tactical aircraft for global reconnaissance and gaining air superiority, the Air Force must also provide strategic lift and some intra-theater airlift assets to its sister services.[85]

This strategy, coupled with a renewed effort to procure additional C-17 aircraft and efforts to develop global forward support location (FSL) options for storing war reserve material (WRM), provides a solid foundation for accounting for decreased warning times for conflict, increased deployment distances, and increased duration of potential conflict.[86] However, the major drawback to this plan is that the U.S. Air Force's planning figures must continue to account for limited

[83] Barnett, 122.

[84] Department of the Navy, Headquarters, U.S. Marine Corps, *A Concept for Distributed Operations,* 25 April, 2005.

[85] Mahyar A. Amouzegat, et al, "Supporting Air and Space Expeditionary Forces: Analysis of Combat Support Basing Options," (Santa Monica, CA: Rand, 2004), 3.

[86] *Ibid,* 16.

"infrastructure richness," such as air base access, storage, throughput, and transportation options in unknown forward operating locations (FOLs).[87]

Procuring additional C-17 aircraft provides an excellent example of how new technology has increased the capability to deploy forces around the world, however its shows how current aviation technology is limited in its intra-theater lift missions, especially in areas with infrastructure that cannot support large-type aircraft. To offset this deficiency, the Department of Defense must pursue the development of airlift assets capable of inserting and sustaining substantial land-based forces in an anti-access/area-denial environment.

Today the Air Force's C-130 aircraft, the Army's CH-47 helicopter, and the Marine Corps' CH-53 helicopter provide the bulk of the military's intra-theater airlift and "over the horizon" amphibious assault capabilities. These aging systems have the ability to offset the anti-access/area-denial environment, but are limited in their ability to fly at long ranges and in carrying large payloads. The Joint Heavy Lift Program (JHL), established by the Department of Defense, has embraced the concept of "vertical envelopment" and is seeking an "air vehicle capable of bringing [to a theater of operations] the heaviest equipment, and thus giving light forces a stronger punch."[88] Various heavy lift rotorcraft and aviation technologies are being studied as the U.S. Army is seeking an air delivery vehicle, capable of handling approximately a 20 to 24 ton payload capacity for its family of Future Combat System (FCS) vehicles.

Several new technologies are being developed by the defense industry and with the cooperation of the U.S. Army's Applied Aviation Technology Directorate (AATD) to enhance US military power projection capabilities and to effectively counter the new range of contemporary threats to US national security. In September of 2005, "AATD awarded the defense aviation industry with five $3.5 million contracts to examine potential [air delivery] concepts in an 18 month definition phase."[89] The five distinct technologies for concept design and analysis are the Quad Tilt Rotor (QTR), a super Chinook or Advanced Tandem Rotor Helicopter (ATRH), the SkyCrane based on earlier models of Sikorsky's CH-53 using co-axial rotors, a compound co-axial rotorcraft incorporating turboprop jets for transporting internal loads, and the Optimum Speed Tilt Rotor (OSTR).[90] The use of these new logistical technologies is envisioned to simultaneously reduce the U.S. Army's reliance on forward basing while increasing flight range and payload capabilities for FCS

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[87] *Ibid,* 15.

[88] Tim Robinson, "Tests of Strength," *Aerospace International,* December, 2005, 14.

[89] Robinson.

[90] Steven Trimble, "Army Plays it Safe on Heavylift," *Flight International,* April 2005, 6.

vehicles. The U.S. Army realizes that the advantages of FCS can only be fully realized if there is the capability to insert them anywhere on the battlefield –rather than the enemy knowing that the axis of advance will always come from large air and sea bases.

Although usually associated with the Marine Corps V-22 Osprey, Quad Tilt Rotor (QTR) hybrid technology can provide the military with unprecedented capabilities in twenty-first century battlefields. Bell-Boeing was awarded one contract by AATD to develop the Quad Tilt Rotor technology. This technology incorporates characteristics of both rotor-wing aircraft and fixed-wing aircraft, allowing vertical take off and landings with the capability of flying at faster speeds like traditional airplanes. This technology has broader applications than simply the V-22. Various plans for this technology are already under development in the U.S. Army and in the U.S. Marine Corps. The Army's focus is to create the Future Transport Rotorcraft (FTR) for vertical delivery of its FCS. In essence, the army wants the defense industry to build an aircraft capable of carrying the FCS. The Marine Corps, on the other hand, has created the Joint Transport Rotorcraft (JTR). This aircraft is to serve as a replacement for the aging CH-53 Heavy Lift helicopter and has design criteria similar to the V-22 with lower weight-carrying thresholds.

Figure 5: Quad Tilt Rotor[91]

What is interesting about these two programs is the opposite approach each service is using to create a series of "expeditionary"

[91] Quad Tilt Rotor Picture from *Popular* Mechanics Website; (accessed 27 February 2006), available at <http://images.google.com/imgres?imgurl=http://media.popularmechanics.com/images/tb_0009STAVC.jpg&imgrefurl=http://www.popularmechanics.com/science/defense/1281266.html&h=159&w=283&sz=15&tbnid=JgnoLgdyS7sFM:&tbnh=61&tbnw=110&hl=en&start=3&prev=/images%3Fq%3Dquad%2Btilt%2Brotor%26svnum%3D10%26hl%3Den%26lr%3D%26sa%3DN>

technologies to use in future conflict scenarios. The Army has first set parameters for its combat vehicles (FCS) and then has translated design characteristics required in the aircraft needed for transport. The Marine Corps already has the V-22 and can update its aging fleet with newer, more readily available aviation technologies with lower carrying thresholds. The approximate carrying capacity of the V-22 is about 10,000 pounds (2,450 pounds per axle) and the dimensions of the cargo compartment is five feet tall, five feet wide, and 17 feet long.[92] Since the Marines already have the V-22, their focus is to use design parameters of its aircraft and then establish characteristics for its ground vehicles, dubbed the "Internally Transportable Vehicle" (ITV). The goal is to use V-22s in combination with ITVs as an overarching "expeditionary fire support system," which allows Marine units to "fly deep into hostile territory and engage in combat autonomously, without the backing of rear echelons."[93] For this vehicle the Marines have chosen an off-the-shelf, American Growler off-road truck. "This truck is an updated version of the M151 Jeep that the U.S. Army military retired in the 1980s [and] is narrow and light enough to fit inside the V-22."[94] Although there is concern about the ability of this relatively small vehicle to provide adequate protection for Marines, the Marine Corps is moving ahead with research in "blast-mitigating" and "fragmentation protection" technologies.[95] Although they have some significant differences, these programs have the common goal of designing new types of aircraft capable of carrying larger payloads for longer distances than the military's current fleet of CH-47s and CH-53s while requiring smaller take-off and landing areas than the C-130. This technology may improve the mobility of US forces in future conflict scenarios where potential opponents may deny access to forward bases.

Figure 6: V-22 and American Growler M151 Jeep

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[92] V-22 Performance standards come from the Global Security. Org Homepage; (accessed 25 January 2006), available at <http://www.globalsecurity.org/military/systems/aircraft/v-22-performance.htm>

[93] Sandra I. Erwin, "Osprey's Cargo Capacity Driving Weapons Designs," *National Defense Magazine,* December 2005, 12.

[94] Ibid, 12.

[95] Erwin, 12.

While many policy makers are excited about the capabilities that Quad Tilt Rotor technology would provide the U.S. military, they worry about whether it is flawed and too costly to begin full-scale production.[96] Despite its many successes, the Marine Corp's V-22 Osprey Program has cast some doubt on the viability of this technology. In order to understand the issues related to testing and developing future technologies similar to the Osprey, a synopsis of the problems encountered with the V-22 is warranted.

The V-22 program, initiated in 1986 under President Reagan, began its first prototype test flights in 1989.[97] During the first Bush administration, especially with then Secretary of Defense Cheney, the program encountered intense opposition because of its high cost and technical complexity. However, Congress continued to fund it, allocating $1.5 billion. In 1992, during the Clinton administration, after the program had been cut then again was revived, it experienced setbacks because of two test- flight crashes and numerous cost overruns. In 1997, the government's General Accounting Office (GAO) after finding over 23 major flaws, warned that "the V-22 had not yet achieved program stability in terms of cost or aircraft design."[98] In the late 1990s and early 2000s, once the Navy began its test flight program, the program experienced additional setbacks because of two separate crashes, that killed twenty-three Marines, and accusations that the Marine Corps falsified maintenance records. With these events, the subsequent Secretary of Defense, William Cohen, indefinitely postponed further test flights and ordered a comprehensive review of the V-22. At the completion of the review in 2001 the panel reported to the current Secretary of Defense, Donald Rumsfeld, that "the tilt rotor had no flaws that could not be overcome with time, money, and good engineering practices."[99]

Department of Defense reviews of the fatal crashes determined that the V-22 experienced a technical problem known as "vortex ring state." This phenomenon occurs when the aircraft's "high-tech rotors pivot from the forward-facing mode that makes it fly like an airplane to the upward-facing mode that converts it to a helicopter enabling it to take-off and land vertically."[100] At this point in time, when the aircraft was descending, "the air flowing up through the rotors was moving as fast as the air being

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[96] Trimble, 27.

[97] The general discussion of the history of the V-22 program, unless otherwise noted, comes from Christopher Hellman, "Is the V-22 Osprey Aircraft a Must-buy for the United States," *Insight on the News*, (26 February 2001): 41.

[98] Adam J. Hebert, "The Osprey Factor," *Air Force Magazine*, (August 2001): 66.

[99] *Ibid,* 66.

[100] Richard J. Newman, "A Dream Machine's Mysterious Moment," *US News and World Report*, vol. 128, no. 24, (19 June 2000): 25.

pushed down."[101] The ensuing result was a loss of lift forcing the aircraft to plummet nose first to the ground.

Recently, the Department of Defense agreed to resume "limited" testing of the Osprey since all design defects had been corrected. Since the review panel's observation that the "risks associated with the V-22 do not appear to be insurmountable nor outweigh the performance enhancements that the tilt-rotor design offers," future plans on testing and producing this technology can proceed.[102] However, using the past as a guide, the development of the Osprey and any additional future tilt-rotor aircraft may also face delays and higher per unit costs. Currently, full-scale production has begun and the U.S. Marine Corps, Navy, and Special Operations Command plan to purchase a combined 458 V-22 Ospreys at a total cost of $37.2 billion.[103]

What industry representatives, defense analysts, and some policy makers envision for the Quad Tilt Rotor is creating a larger version of the V-22 with some of the same tilt-rotor technologies used today. The primary design concept consists of building a quad tilt-rotor aircraft about the size of a C-130 that would have two to three times the load capacity of the CH-47 and CH-53.[104] V-22 technical specifications outline that "this transport would be capable of carrying about 19 to 24 tons of equipment and supplies or about 90 troops at approximately 300 knots per hour for distances up to a 500 mile radius and then land vertically, without the need for runways or airports."[105] Another feature in many designs is an improved capability for self-loading cargo. This reduces the need for additional ground logistic equipment used to upload and offload these aircraft.

Advanced Tandem Rotor Technology is a second variant awarded for concept design and analysis by AATD. This concept updates current technologies used in the CH-47 Chinook helicopter and was awarded to Boeing. Boeing will exploit significant advances in technology for a Heavy Lift helicopter by enhancing "two equally-sized rotors that spin in opposite directions for lift."[106] This investment is considered much less

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[101] *Ibid*, 25.

[102] Hebert, 66.

[103] V-22 Production Rate and Costs are from Global Security Homepage; (accessed 25 January, 2006); available at < http://www.globalsecurity.org/military/systems/aircraft/v-22-cost.htm>

[104] The Boeing CH-47 has a max cargo capacity of 25,000 lbs and can fly at approximately 143 knots. The Sikorsky CH-53 has a max cargo capacity of 8,000 lbs and can fly at approximately 160 knots.

[105] Global Security Homepage (accessed 1 December 2005), available at <http://www.globalsecurity.org/miltary/systems/aircraft/qtr.htm>

[106] Global Security Homepage (accessed 25 January 2006), available at <http://www.globalsecurity.org/miltary/systems/aircraft/atrh.htm>

risky than tilt rotor technology, but the technology is also less innovative.[107]

Figure 7: Advanced Tandem Rotor Technology[108]

Sikorsky's X2 technology offers two concepts for design and analysis; a Skycrane that uses co-axial rotors to carry loads externally and a "compound co-axial" helicopter that incorporates turboprop jets along side the fuselage with an over-head rotor system for internal loads. AATD awarded Sikorsky Aircraft two separate concept design contracts for each of these technologies. Both the external lift and internal lift variants use co-axial twin rotors, which consist of "two sets of rotor blades spinning in opposite directions, but mounted on the same axis of rotation."[109] This design offers tremendous benefits to the Heavy Lift Program because the technology offsets the weight limitations of current "traditional" helicopter design. Specifically, mainstream rotorcraft must use a tail rotor to offset the tendency of the helicopter body to begin spinning in the opposite direction. This tendency, known as "angular momentum," is almost completely eliminated with co-axial rotors. Furthermore, the entire airframe [with a co-axial rotor system] can achieve increased payload capacity because it no longer requires a tail rotor, which typically wastes engine power that could otherwise be devoted to lift and thrust.[110] Additionally, the co-axial design tends to be more compact than traditional airframes and can be used in areas where space is at a premium.[111]

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[107] Robinson.

[108] Advanced Tandem Rotor Technology picture (accessed 27 February 2006); available at <http://www.globalsecurity.org/military/systems/aircraft/atrh.htm>

[109] Andrew Keith, 2005. Chief of Advanced Design for US Government Products, Sikorsky Aircraft, United Technologies Corporation. Interview. 18 December 2005.

[110] Keith.

[111] Sikorsky Homepage (accessed 26 January 2006); available at <http://www.sikorsky.com/details/0,3036,CLI1_DIV69_ETI2088,00.html>

Figure 8: Sikosky X2 Concept[112]

Finally, the Optimum Speed Tilt Rotor (OSTR), designed by Frontier Aircraft, was awarded the fifth concept design contract from AATD. This design is a carry-over concept from currently produced A-160 Hummingbird Warrior vertical take-off and landing Unmanned Aerial Vehicles (UAV). Considered one of the most sophisticated designs, the OSTR is based on innovative rotor designs incorporating "hingless" technology. "This 'hingless' rotorblade creates the ability to have a smooth acting, disk-like rotor system that creates a more ideal lifting thrust. This leads to the ability to create the necessary thrust at a lower rotating speed than in a conventional rotor. The 'hingeless' rotor, developed due to advances in composite materials, is able to use less power in a vertical lift situation than a comparable hinged rotor. In all it is a more efficient rotor design, capable of flying longer range missions and carrying a greater payload than systems currently in use."[113]

The Army's Applied Aviation Technology Directorate (AATD) has imposed certain required characteristics, or KPPs, in a similar fashion to those imposed for FCS. Again, these are considered absolutes in system design and are, therefore, rarely modified or disregarded. However, the five competing technologies have varying levels of complexity interwoven in their design. The requirements in the Joint Heavy Lift Program require the defense industry to make substantial leaps in current technology. Since this program is expected to be the most ambitious U.S. Military rotorcraft program since the Comanche program, certain expectations must be evaluated as specific technologies are developed and tested.[114]

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[112] Picture of X2 Concept Aircraft, (accessed 27 February 2006); available at <http://www.sikorsky.com/military/systems/aircraft/x2.htm>

[113] Karen A. Arnold, 2006, Curriculum Developer, Department of Logistics and Resource Management, Command and General Staff College, Ft. Leavenworth, KS, Interview, 26 January, 2006.

[114] Robinson,

The characteristics being sought for Concept Design and Analysis (CDA) for Joint Heavy Lift rotorcraft is the ability to carry and deliver an FCS/Stryker/LAV over a 250 to 500 nautical mile radius at speeds ranging from 160/200 knots per hour to 250/300 knots per hour, and to operate under a 4000 foot density altitude.[115] The purpose of the CDA is to define the "art of the possible, the science of the probable, and the design of the affordable" for JHL rotorcraft that enables future joint concepts and operations.[116] Key performance parameters focus on four major characteristics; "conducting mounted and dismounted vertical envelopment, executing operational maneuver and sustainment operations at extended ranges, operating in unprepared, complex terrain under extreme environmental conditions, and overcoming enemy anti-access strategies."[117]

The preceding mechanical descriptions for each of the mobility-enhancing technologies provides an understanding for an evaluation of the effectiveness of what the U.S. Army, as part of a joint, interagency, and multinational force, is seeking. Now that a basic description has been presented, a thorough analysis can proceed. The following chapter will attempt to illustrate if Key Performance Parameters provide suitable capabilities for all types of threats that are likely to emanate in future conflict scenarios.

ANALYSIS OF MOBILTY TECHNOLOGIES AND THEIR USE IN PHASES OF FUTURE CONFLICT

GROUND-BASED TECHNOLOGIES

Unlike past years when combat systems and equipment were procured with a focus on combat-specific capabilities and without a holistic understanding of their logistical constraints, today deployability and lift requirements have become as important as lethality and survivability for an "expeditionary" army. Because it is no longer feasible to design strategic lift assets around outsized, overweight combat vehicles, U.S. military forces must use the existing fleet of strategic aircraft and vessels as a guide for the size and weight of the military's next generation of equipment.

Since the C-130 and C-17 are the most versatile aircraft in today's military fleet, capable of delivering cargo into areas with little to no

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[115] Global Security Homepage (accessed on 25 January 2006); available at <http://www.globalsecurity.org/miltary/systems/aircraft/jhl-cda.htm>

[116] *Joint Operational Requirements Document (ORD) for the Joint Multi-Mission Vertical Lift Aircraft,* change 3, November 2004, 12-13.

[117] *Joint Operational Requirements Document (ORD) for the Joint Multi-Mission Vertical Lift Aircraft,* change 3, November 2004, 14.

infrastructure, they provide the maximum weight and size dimensions for newly acquired army combat equipment. More importantly, the cargo dimensions of these aircraft also serve as the baseline design parameters for the U.S. Army AATD Joint Heavy Lift concept where the defense aviation industry is attempting to design a future rotorcraft capable of delivering FCS. Although discussed in more detail in the air-based technologies section, it is important to note that the full expeditionary capabilities of FCS cannot be realized unless it is coupled with more robust aviation technologies that allow for vertical insertion anywhere in a theater of operation.

Does the technology reduce the amount of time for deployment?

By specifically designing the Future Combat System not to exceed the height, length, and width of the inside cargo bay of a C-130 aircraft and not to weigh more than 24 tons, the Army is attempting to increase its maneuverability on future battlefields. The concept of "vertical envelopment" is important in reducing deployment times because, inevitably, the Army will need to rely on some type of airlift assets to get initial and subsequent forces to the fight, and continue to rely on those same assets for missions in simultaneous or follow-on phases.

In theory, this increased maneuverability from a lighter, smaller combat vehicle will allow Army units to move continually, unpredictably, and in a more timely fashion around future battlefields. The U.S. Army, as part of a joint, interagency, and multinational force will no longer need to rely on a liner-type deployment process through large, predictable air and sea bases of debarkation. However, mobility of FCS does not in and of itself increase the speed in which Army forces can deploy because its maneuverability is tied to many other new technologies that are also still in developmental phases. FCS can, however, aid in achieving a higher level of throughput into even the most austere aerial ports of debarkation. Actual throughput into a theater of operations can be problematic because, in many instances, austere airfields cannot support large numbers of even the most versatile aircraft. If Army equipment, like FCS, is physically smaller, equally capable to today's standards, and less reliant on a logistical tail, it can be deployed, offloaded from aircraft, and marshaled at a more rapid rate, thus enabling a greater volume of aircraft to be made available for insertion into a theater of operations. This has the net effect of increasing the total amount of combat ground equipment inserted to a specific geographic region during any given period of time because of the decreased cargo requirement for aircraft.

Since the Future Combat System of lightweight armored vehicles is actually designed to decrease the footprint of Army equipment, it will inevitably reduce the net number of aircraft required to deploy a particular unit's organic equipment. The Army has recognized that it must compete with the Air Force and its sister services for strategic and intra-theater airlift during conflict. In theory, the net reduction of requested aircraft would increase the availability of additional assets in the Air Force's strategic and intra-theater airlift fleets.

Does the technology increase the likelihood of negating anti-access/area-denial constraints?

Since the Future Combat System of vehicles and equipment is being specifically designed with the maximum cargo bay dimensions of a C-130 in mind, the use of that aircraft in the near term would increase the number of airstrips around the world the U.S. Army could successfully operate from. In the long term, once a Heavy Lift aircraft replacement with C-130 like cargo dimensions is fielded, the U.S. Army would be free to insert its FCS virtually anywhere without the need to rely on any in-place infrastructure. Since many contemporary security strategists agree that future conflict may occur in areas with little to no infrastructure, the extensive weight of the Army's current armored vehicles would preclude timely deployments due to their reliance on larger aircraft. By reducing the overall size and weight of ground combat vehicles, the Army is improving its strategic mobility in future conflict and negating its reliance on a linear deployment process tied to large sea and air ports of debarkation. Nonetheless, the technology associated with the Future Combat System cannot alone guarantee successful deployments to conflict regions characterized by anti-access/area-denial environments. Although the FCS will certainly aid in improving the Army's maneuverability and deployability in future conflict scenarios, it is not clear what implications this lighter equipment will have on the Army's lethality and survivability, particularly in major combat operations.

Strengths and weaknesses of FCS in "Dominate Phases" vice "Stabilize and Enable Civil Authorities" Phases and KPP Focus.

Many argue that there is a direct correlation between the weight of a force and its resulting lethality and survivability, "with lighter forces being inherently less lethal and more vulnerable."[118] Even though the Army contends that the overall net reduction in each system's armored protection is offset by relying on a "system of systems" approach where all other FCS and joint systems are tied together within a network, the fact remains that each individual FCS offers less protection than current M1A1 Abrams Main Battle Tanks when engaging in close combat scenarios against opponents. To address this issue, weight performance parameters of the FCS become problematic because they must include technological improvements to armor and weapons systems while simultaneously reducing overall weight.

Limitations also exist with regard to the Key Performance Parameters of a lighter, more mobile ground vehicle and what it brings when conducting stability and reconstruction type operations. During

[118] Edward B. Atkeson, Major General, USA (RET), "Main Battle Tanks: To Be or Not To Be?" *Army Magazine*, (January 2000): 40.

stability operations, ground forces typically confront the mission of providing stability until a new government is elected and indigenous security forces can be trained.[119] In this environment, primary threats come from insurgent activity, not mounted armored formations. Insurgents prefer unconventional approaches like rocket propelled grenades and improvised explosive devices because they offer a capabilities mismatch to the conventional force. Insurgent ability to choose the time, place, and method of asymmetrical attacks affords protection similar to the protection offered by the ocean to a small fish. There, "the fish moves about unopposed drawing on the resources and support of the sea."[120] The connectivity provided by a networked system offers individual FCS platforms little in the way of situational awareness, the ability to rapidly focus combat power, or to provide for individual defense when a singular threat has the ability to appear, strike, and then swim away back into the murky depths of the population.

In Major Combat Operations, the Key Performance Parameters of speed and overcoming anti-access challenges help U.S. military forces achieve strategic preclusion. In this context, these KPPs offer military ground forces tremendous advantages over any potential opponent. Although speed and the ability to overcome anti-access constraints continue to offer advantages at the tactical level in Stability and Reconstruction Operations, it does little at the operational level. Theoretically, if combat forces across the joint force structure are already engaged in operations during the "dominate" phases, then there is no need, at the operational and strategic levels, for speed and the ability to overcome anti-access challenges for the "stabilize and enable civil authorities" phases since those same forces are already operating in the battlespace.[121]

In additional to analyzing various Key Performance Parameters, certain budgetary constraints for fielding FCS also play an important role in evaluating the overall effectiveness of fielding an entirely new system of mobility-enhancing ground equipment. Associated costs allows one to evaluate this technology using a cost-benefit ratio. According to the Congressional Budget Office (CBO) "the projected costs from 2006 through 2020 to develop and purchase the first increment, which would equip 15 – or about one-third – of the active Army's combat brigades, has grown 76 percent from approximately $90 billion to $160.7 billion."[122]

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[119] Andrew F. Krepinevich, "The Thin Green Line," *Center for Strategic and Budgetary Assessments,* 14 August, 2004, 2.

[120] Mao Tse-tung (Mao Zedong), *Aspects of China's Anti-Japanese Struggle* (Bombay, India: n.p. 1948), 48.

[121] Phases of combat operations are defined in Joint Publication 3-0, revised second draft, 29 April 2005, iv-30.

[122] United States Government Accountability Office, "Defense Acquisitions: Business Case and Business Arrangements Key for Future Combat System's Success,

The report goes on to estimate that FCS could easily reach $200 billion to reach fruition, making FCS the "largest and most expensive program in Army history."[123]

It is also important to note that this estimated cost does not include the associated costs of networking FCS with the joint force using the Joint Tactical Radio System (JTRS). The cost for developing these radios, which is key for the success of FCS, is estimated to be approximately $35 billion.[124] Additionally, since FCS is intended to be only a part of a joint, networked "system of systems," it must rely on new strategic and operational lift assets to reach its maximum potential. These systems, discussed in subsequent portions of this paper, have tremendous costs in and of themselves. To achieve the goals that the U.S. Army has envisioned for FCS and to gain maximum benefits in the emerging security environment, all these costs, even if they come from budgets of sister services and of the Department of Defense in general, must be accounted in conducting a cost-benefit analysis.

Additionally, the costs associated with research, development, testing, and evaluation (RDT&E) of FCS must now compete with other day-to-day expenses in the Department of the Army. Executing the GWOT and paying for rising operational and maintenance costs in Iraq and Afghanistan have altered the original context of developing FCS with "a few more years of relative tranquility."[125] Congressionally-mandated end-strength increases related to current operations will cost approximately $2.6 billion annually. Paying for the temporary increase of 30,000 additional service members by 2009 may offset what is earmarked for FCS since the U.S. Army will most likely need to reduce spending by $30 billion over the next six years as part of the deficit reduction campaign.[126] Although not addressed specifically in the *2006 Quadrennial Defense Review*, these budgetary constraints will inevitably impact the spiral development of FCS, possibly reducing the overall budgeted allocations or delaying further evaluation and testing of FCS

Testimony before the Subcommittee on Airland, Committee on Armed Services, U.S. Senate, 1 March, 2006, 8.

[123] Jon DiMascio, "McCain Questions FCS Commercial-Item Procurement Strategy," *Inside the Army*, Mar. 7, 2005.

[124] Government Accountability Office, *Future Combat Systems Challenges and Prospects for Success*, GAO-05-442T, Mar. 16, 2005, 22.

[125] Megan Scully, Christopher P Carvas, Laura M. Colarusso, Jason Sherman, "Top Defense Programs: How Secure are they as Pentagon Budgets Tighten?" *Armed Forces Journal,* Dec. 2004, 27.

[126] Megan Scully, "Analysts: U.S. Soldier Boost Could Cut Material," *Defense News,* June 28, 2005.

capabilities.[127] The following chart outlines specific dates, as of this monograph's publication date, for the projected FCS Program Schedule.

Event	Date (FY)	Event Description
Milestone B Update	May 2005	Milestone B approves entry into System Development and Demonstration Phase (SDD).
Preliminary Design Review	2008	A technical review to evaluate the progress and technical adequacy of each major program item. It also examines compatibility with performance and engineering requirements. (Part of SDD Phase)
Critical Design Review	2010	A technical review to determine if the detailed design satisfies performance and engineering requirements. Also determines compatibility between equipment, computers, and personnel. Assesses producibility and program risk areas. (Part of SDD Phase).
Design Readiness Review	2011	Evaluates design maturity, based on the number of successfully completed system and subsystem design reviews. (Part of SDD Phase).
Milestone C	2012	Milestone C approves the program's entry into the Production and Deployment (P&D) Phase. The P&D Phase consists of two efforts - Low Rate Initial Production (LRIP) and Full Rate Production and Deployment (FRP&D). The purpose of the P&D Phase is to achieve an operational capability that satisfies the mission need.
Initial Operational Capability (IOC)	2015	IOC is defined as the first attainment of the capability to employ the system as intended.(Part of the P&D Phase).
Full Operational Capability	2017	The full attainment of the capability to employ the system, including a fully manned, equipped, trained, and logistically supported force.(Part of the P&D Phase).

Figure 9: Restructured FCS Program Schedule[128]

The purpose of highlighting certain budgetary constraints with regard to fielding FCS, is to illustrate that there will be only be more intense scrutiny of where funds for the U.S. Army are allocated in coming years. It may become necessary to use a simple cost-benefit analysis when analyzing certain key performance parameters (KPPs) of FCS against the backdrop of where the most relevant use of land-power will be conducted in the next twenty to thirty years. Do KPPs accurately reflect the most relevant use of U.S. Army equipment and is the investment in developing and fielding FCS with certain specified capabilities worth the cost?

[127] Keith J. Costa, "Review Expected to Consider Unconventional Threats – Zakheim: QDR Could Alter Investment Patterns for Air, Land Forces," *Inside the Pentagon,* Dec. 9, 2004, 1.

[128] CRS Report for Congress, "The Army's Future Combat System: Background and Issues for Congress," 8.

The defense industry must make significant technological achievements, integrating new logistical and tactical characteristics, in their designs of the FCS within a twenty-year timeframe. Given the high risk associated with many of its technologies, the Army stakes its recognized dominance on the development of greater strategic mobility. Although this capability, given the appropriate level of research and development, can provide the Army with significant improvements not only in mobility, but also lethality and survivability, policy makers should not rush into full-scaled production of the FCS until adequate testing is conducted in realistic training and combat scenarios. If the FCS cannot provide the same type of confidence that current battle tanks provide, military leaders should be hesitant about its viability in twenty-first century conflict. If, however, the Army's *system of systems* concept proves successful, the FCS will revolutionize the way the US Army conducts warfare.

SEA-BASED TECHNOLOGIES

Does the technology reduce the amount of time for deployment?

At first glance, policy makers might concede that the JMOB will not reduce the amount of time it takes our forces to deploy. Its slow speed of fifteen knots per hour requires at least thirty days transit time to a potential conflict area plus the required time it takes to assemble the JMOB from its five independent sections.[129] This slow transit time does not seem to support the Army's stated goal of having five divisions in a theater of operations within 30 days. However, analyzing circumstances more closely can provide some different results.

When taking present preposition capabilities into consideration, it is possible to envision the individual JMOB sections located in areas away from the continental USA and within closer transit times to areas where conflict may emerge. Since the United States already has preposition afloat agreements in place in four regions: the Indian Ocean at Diego Garcia, near Guam and Saipan in the western Pacific, the Mediterranean Sea, and in the Persian Gulf, it would be possible to locate the JMOB platforms with other US prepositioned vessels and equipment. Production engineers and military planners should use this set of criteria to evaluate how fast the JMOB could deploy and be ready for use in conflict zones. Although the speeds of the JMOB would not be competitive with the speeds of the LMSR prepositioned vessels, it is possible to envision its arrival in theater in enough time to support stated US military deployment goals.

The last aspect that must be addressed with reference to deployment time is the JMOB's ability to provide almost immediate

[129] BWX Technologies Homepage (accessed on 12 January 2006); available at <http://www.bwxt.com/Products/mob-bwx.html>

availability of its resources once on station. Since the reception of equipment, along with its staging, onward movement and integration into combat operations (RSO&I) must be added to typical transit times when using present deployment capabilities, the time process of actually getting a piece of equipment into the forward edge of the battle area is often much longer than just its strategic movement from the United States or from prepositioned sites.[130] The JMOB, on the other hand, would streamline the "reception and staging" portions of the RSO&I process. Although "integration and onward movement" would still be a requirement, the JMOB would essentially cut out a significant portion of the deployment timeframe normally associated with the logistical preparations and processes.

Does the technology increase the likelihood of negating anti-access/area-denial constraints?

Since the assured availability of overseas bases can never be guaranteed, policy makers must hedge, with some degree of uncertainty, that obtaining certain technologies to negate anti-access/area-denial constraints is necessary. Above any other criteria, the JMOB is designed with this consideration in mind. Recently, the National Defense Panel (NDP) recognized the reality of the post Cold War era and predicted that "US forces' long-term access to forward bases, to include air bases, ports, and logistic facilities, cannot be assumed."[131] The Mission Need Statement (MNS) for the JMOB was developed to "support the US forward-presence strategy while denying the enemy an opportunity to disrupt a critical line of operations."[132] In this respect, once in place, the JMOB could provide the US military with the ability to operate at great distances from land, shorten logistics lines, and enhance combat readiness and operational mobility.

However, if strategies that address the deployment time of the five independent JMOB sections to a theater of operation are not developed, it may not offset problems U.S. Forces might encounter with an anti-access environment. Although this large facility could replace the traditional reliance of sea and airport facilities ashore, it would have to arrive on station in time to guarantee availability of its resources to combat and logistical forces. Initial combat operations during the "dominate" phase might have to be initiated without the logistical support of the JMOB. In this respect, the JMOB is better at guaranteeing availability of logistical support for ground forces in a theater of operations for follow-on stability, security, transition, and reconstruction operations in the "stabilize and enable civil authorities" phases. Therefore, the JMOB offers a tremendous

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[130] US Army, Field Manual 55-30: *Battlefield Transportation*, 1999, A6.

[131] T.D. Kilvert-Jones, "The Key to Effective Presence," *Sea Power*, vol. 42, no. 5, (May 1999): 42.

[132] *Ibid*, 42.

advantage for operations in the "non-integrated gap" when the United States wants to enhance its forward presence posture when local infrastructure is either insufficient or destroyed. However, the JMOB is much less valuable for denying the enemy, in major combat operations, the ability to disrupt critical lines of operation. Since the logistical footprint inevitably gets larger as more and more combat forces arrive in theater, having this capability for full-spectrum operations still makes sense when US forces encounter an anti-access environment.

Strengths and weaknesses of technology in "Dominate Phases" vice "Stabilize and Enable Civil Authorities" Phases and KPP Focus.

Since the acquisition of the JMOB is not designed to replace any current equipment in the US Navy or Marine Corps inventory, is does not reduce any current capabilities these forces may have. Therefore, concerns over current readiness are not a significant factor when deciding to invest in this technology. However, the acquisition of the JMOB represents the loss of certain opportunity costs for either updating or replacing some current naval combat equipment, used primarily during major combat operations. Consequently, policy makers must look for evidence that this new logistical technology provides the military with enough of an advantage for full-spectrum operations to offset the specific risks associated with combat operations.

The office of Naval Research (ONR) estimates that it will cost between $5 billion and $10 billion to build the JMOB.[133] Comparing costs by analogy, policy makers must weigh the cost of pursuing the development of this technology with the associated costs of building an additional aircraft carrier – specifically CVN-21 – which is estimated to cost approximately $5 billion. Therefore, the risk associated with producing the JMOB is that the Navy could essentially have one less aircraft carrier for twenty-first century conflict. Policy makers must then address this issue by asking whether the key performance parameters of the JMOB, which seem to be more useful in permissive environments where U.S. Forces are conducting military support to civil authorities, humanitarian assistance, and disaster relief, provide enough of a benefit to offset the loss of an aircraft carrier.

Using a cost-benefit analysis of the JMOB by comparing its characteristics to an aircraft carrier provides mixed results in advocating its procurement into military service. On the positive side, the JMOB provides the military with the nearly certain availability of a forward staging base for supporting a full range of conflict scenarios. On the negative side, the JMOB's sheer size and lack of defensive characteristics make it a vulnerable target in non-permissive environments ususally associated with major combat operations. If opponent's forces have

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[133] Paul Nagy, "Setting the Record Straight On Mobile Offshore Bases," *National Defense*, vol.86, no.573, (Aug 2001): 62.

offensive and defensive equipment such as diesel submarines or ballistic missiles and are willing to use them to attack, the JMOB is as vulnerable as large air or sea ports of debarkation ashore. Additionally, damage control for such a large vessel could be problematic at best and catastrophic at worse. However, the end result shows that investing in this technology will help improve forward presence and negate the anti-access/area-denial environment that may be characteristic of all future conflict, but more specifically associated with the Stability and Reconstruction environment without losing any significant current combat capabilities.

AIR-BASED TECHNOLOGIES

Does the technology reduce the amount of time for deployment?

Initially, when analyzing the capabilities that Joint Heavy Lift aircraft provide the military, one may casually conclude that they will overwhelmingly reduce the amount of time during the deployment process. This attitude becomes evident when policy makers compare the design specifications of these newer aircraft to those in the US military's current fleet. They can fly farther, faster, with a greater cargo carrying capacity and take-off and land without many of the constraints current aircraft encounter. However, what isn't clearly evident is that the use of this new technology will change military doctrine and logistic practices.

A more detailed analysis of these technologies highlights that they not only reduce time in a deployment, they change the entire deployment process. These new aviation technologies, coupled with a JMOB or staging bases outside the area of conflict and with lighter combat vehicles to transport, will enable U.S. military forces to conduct "operational maneuver from strategic distances."[134] This concept is explained in TRADOC Pamphlet 525-3-0 as

> a key operation idea…that will enable the force to deter or promptly engage an enemy from positions of advantage. Employing advanced joint lift platforms not dependent on improved ports, the Future Force will deploy modular, scaleable, combined arms formations in mission-tailored force capability packages, along simultaneous force flows, to increase deployment momentum and close the gap between early entry and follow-on campaign forces.[135]

The use of future Heavy Lift aviation technologies and their subsequent application to this concept will ultimately change the linear deployment process enabling the joint force commander to conduct "simultaneous, distributed operations" where the deployment and

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[134] "The Army in Joint Operations: The Army Future Force Capstone Concept,"TRADOC Pamphlet 525-3-0, i.

[135] TRADOC Pamphlet 525-3-0, i.

employment of combat forces will no longer be heavily tied to logistics forces in rear areas under friendly control and supply trains during conflict will be less of a burden for combat forces because supplies will be readily available.[136] Additionally, these aviation technologies will enable logistics forces to support small, mobile combat forces as they move around the battlespace.

Does the technology increase the likelihood of negating anti-access/area-denial constraints?

This technology has the ability to drastically reduce the effects of an anti-access/area-denial environment. Since these aircraft do not rely on airports or runways, their versatility will enhance military operations in various terrain features in future combat and stability and reconstruction scenarios. However, greater lethality and accuracy of ground-to-air and air-to-air systems will subject these aircraft to potential danger as they fly into hazardous areas of the battlespace. Since design plans do not include equipping these "logistical-type" aircraft with any significant armaments, crews will have to rely on evasive maneuvers and machine gun suppression to counter threats from potential opponents once operating in forward battlefield areas. To further compound problems with defending this aircraft, once positioned in the vertical mode, the downward thrust of the engines interferes with the effective fields of fire for standard door-mounted machine guns.[137] This problem can be corrected, but doing so will create the need for a more sophisticated machine gun, making the per-unit cost of this aircraft even higher. Nonetheless, since future warfare will be more fluid and lethal, VTOL aircraft will be needed more than ever to provide precise, rapid, non-terrain restrictive mobility to military forces engaged in combat operations.

Strengths and weaknesses of technology in "Dominate Phases" vice "Stabilize and Enable Civil authorities" Phases and KPP Focus.

From the discussion thus far, it would seem that the five technologies for concept design awarded to defense aviation contractors by AATD would be a panacea for the military's mobility concerns in future combat. It is true that if present designs of these various aircraft could be brought into full-scale production, this technology, coupled with FCS and JMOB technology, could provide the joint force with an extraordinary capability. There are, however, certain risks and costs associated with the development of this tilt-rotor technology.

First, from early testing of the V-22 it is clear that tilt-rotor technology is not without some significant flaws. More testing and evaluation must be conducted on the complex "tilting mechanism" that

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[136] *Ibid*, i.

[137] Andrew Keith, 2005. Chief of Advanced Design for US Government Products, Sikorsky Aircraft, United Technologies Corporation. Interview. 10 December 2006.

supports the aircraft's sophisticated engines. Designers must work out the critical problems stemming from "vortex ring state" which can cause a catastrophic loss of lift. Furthermore, when designing tilt-rotor technology, engineers must use competing theories of flight dynamics to create both forward thrust and vertical lift.[138] The efficiency of typical forward flight propeller blades only need to offset a ten-to-one ratio between the weight of an aircraft an its ability to fly forward, but those same rotor blades on the tilt-rotor aircraft need a one hundred percent efficiency ratio to hold the weight of the vehicle in the air during vertical operations. Thus, tilt-rotor aircraft cannot be efficient both at forward flight and vertical take-off and landing.[139] To compensate for these competing dynamics, engineers must create a heavier aircraft with more moving parts. These conditions lead to higher costs not only in the procurement process, but also in operating, support, and maintenance costs throughout the lifespan of the aircraft. Lastly, since this technology has only been tested in very controlled environments, it has yet to be determined if tilt-rotor aircraft can be operated safely and maintained in a realistic combat environment.

Second, the per-unit costs of the V-22 have tripled, from an estimated $30 million to more than $120 million per aircraft.[140] Currently the Pentagon is paying about $1.3 billion for full-scaled production of 11 Ospreys.[141] This steep price is largely due to re-tooling major components of the aircraft, which delayed the initial start of full-scale production. These two facts provide a strong indication that similar future technologies will be very expensive and their production could be problematic. One thing that must be considered is the reluctance to use such an expensive aircraft in potentially dangerous conditions. If each future Heavy Lift Aircraft becomes so expensive, political leaders and military commanders may consider it unwise and counterproductive to expose these aircraft to unnecessary risk by placing them in dangerous situations. Furthermore, weighing the benefits that currently available aviation technologies can provide at a fraction of the cost to new derivative designs, causes some to consider settling on an eighty percent solution for future lift requirements. Theoretically, the Department of Defense could use a fraction of the money to pay for service-life extensions and significant enhancements to current CH-47s and CH-53s which are reaching the end of their useful lives. It is estimated that improving the fleet of CH-53s with new, highly efficient JTAG engines and improved rotor blades, for example, could

[138] The technical discussion of tilt-rotor flight dynamics comes from Andrew Keith, 2005. Chief of Advanced Design for US Government Products, Sikorsky Aircraft, United Technologies Corporation. Interview. Stratford, Connecticut, 10 December 2005.

[139] Andrew Keith.

[140] Hellman, 41.

[141] *Ibid*, 41.

provide the military with an eighteen-ton lift capacity helicopter for only about 33 million dollars per aircraft.[142] Also, since these aircraft are currently in the operational military fleet, they could be re-tooled and available for use in a much shorter timeframe than any tilt-rotor design. Policy makers must weigh the risk between having either a capability that meets exact lift requirements in about the twenty to twenty-five year timeframe or settling for a lesser, more inexpensive capability in a shorter timeframe.

Finally, this monograph concludes that Joint Heavy Lift aviation technology is better suited for operating in the semi-permissive and permissive environments normally associated with the "stabilize and enable civil authorities" phases than the non-permissive environment of "major combat operations."[143] These aircraft are more than capable of negating anti-access challenges associated with peacekeeping operations, disaster and humanitarian relief efforts, and military support to civilian authorities both at home and abroad, but may have difficulty, because of their lack of defensive capabilities, in overcoming anti-access challenges associated with area denial from enemy forces. When analyzing their potential use in areas that correspond to Thomas Barnett's "non-integrated gap" one can conclude that although these aviation technologies can overcome anti-access constraints that are due to incomplete or destroyed infrastructure, they may continue to face the same challenges as current aviation technologies when anti-access challenges are a result of political or military area denial practices.

COST-EFFECTIVENESS OF ALL THREE TECHNOLOGIES

Now that the first three research questions have been presented along with a thorough analysis of strengths and weakness of each mobility-enhancing technology in the "seize initiative and dominate" phases vice the "stabilize and enable civil authorities" phases, the associated costs for all the technologies collectively will be compared against alternative uses for the funds allocated for these technologies. The figures used for comparison are only estimates, which reflect broad applications of current accounting projections, and are correct as of the publication of this monograph. Although it is virtually impossible to project precisely how each of these programs will evolve over the next 18 years, certain cost comparisons can be gleaned by measuring projections of what has been budgeted to alternative uses for portions of those funds.

The estimated costs associated with research, development, testing, evaluation, and the spiral implementation of the air, ground, and sea

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[142] Andrew Keith, 2005. Chief of Advanced Design for US Government Products, Sikorsky Aircraft, United Technologies Corporation. Interview. Stratford, Connecticut, 10 December 2005.

[143] Joint Publication 5-0, iv-30.

mobility-enhancing technologies presented in this monograph, covering the period between 2006 and 2024, is a staggering $324.4 billion, or approximately $18 billion annually for the next 18 years.[144] One might conclude that this annual figure is relatively insignificant when compared to the most recent average Department of Defense annual discretionary budget of $439.3 billion.[145] However, the FCS program alone accounts for almost 25 percent of the U.S. Army's total annual budget.[146]

Conversely, when measuring funding allocated to programs specifically related to irregular threats and increasing capabilities for stability and reconstruction operations, one notices that spending is much lower. As an example, expenditures for language and cultural training are currently estimated at only $181 million annually.[147] Furthermore, despite many calls to do so, there is a reluctance to permanently increase the size of the U.S. Army's ground forces. Secretary of Defense, Donald Rumsfeld, contends that the cost of increasing force structure would be approximately $1.2 billion annually for each increase of 10,000 troops.[148] In lieu of this, he argues that the U.S. Army must "rebalance" its force structure by taking certain military specialties no longer needed for major combat operations and retraining them with different skill sets needed for the full spectrum of conflict, to include stability and reconstruction operations. However, the retraining of certain soldiers is an audacious task that will also require large amounts of funding and time. To give the benefit of doubt, assume that "rebalancing" the force will cost $500 million per 10,000 soldiers or approximately half the amount of acquiring additional forces.

Assuming these particular soldiers would be used primarily for stability and reconstruction operations to provide security, to assist in rebuilding government institutions and infrastructure, and training indigenous security forces, one must calculate a baseline ratio of how many of these forces are needed. A senior mathematician at Rand

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[144] Total estimated funding figures come from The United States Government Accountability Office Testimony before the Committee on Armed Services, U.S. Senate on Wednesday, March 1, 2006 and from The Congressional Budget Office document, *The Long Term Implications of Current Defense Plans and Alternatives: Summary Update for Fiscal Year 2006*, October 2005. The total was arrived at by calculating $164 billion allocated for FCS, $65 billion allocated for JHL, $35 billion allocated for JTRS, $59.4 billion allocated for Amphibious and Maritime Prepositioning Ships (including JMOB).

[145] The Fiscal 2007 Department of Defense Budget, (accessed on 2 March, 2006), available at <http://www.dod.mil/comptroller/defbudget/fy2007/index.html>

[146] Congressional Budget Office, *The Long Term Implications of Current Defense Plans and Alternatives: Summary Update for Fiscal Year 2006*, October 2005, 21.

[147] Max Boot, "The Wrong Weapons for the Long War," *JWReview,* 9 February 2006.

[148] Edward F. Bruner, "Military Forces: What is the Appropriate Size for the United States?," *CRS Report to Congress RS21754,* CRS-3.

conducted a study where he estimated that "for cases that warrant outside intervention [like Bosnia, Haiti, Kosovo, Afghanistan, and Iraq] a force ratio of about twenty security personnel would be needed per 1000 inhabitants."[149]

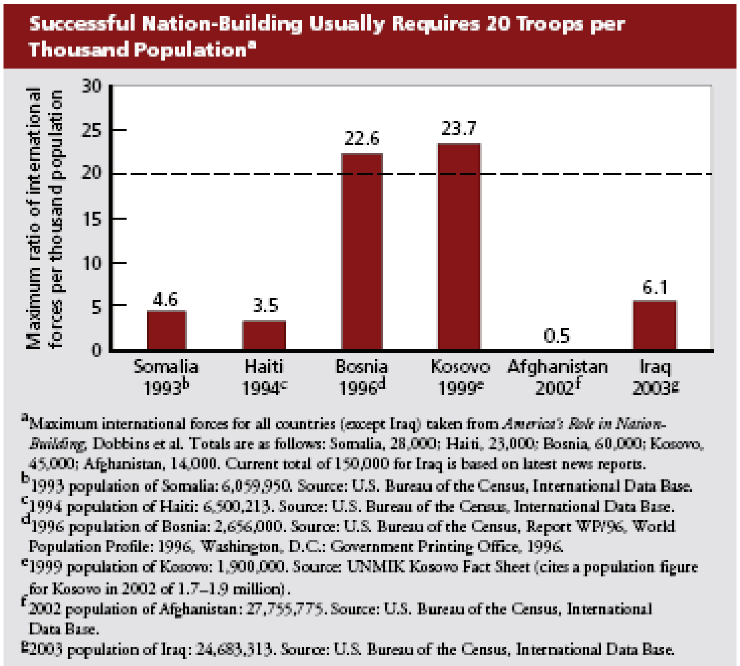

Figure 10: Force Ratios for SRO[150]

A population similar to Iraq today at about 25 million people would require 500,000 troops at any given time for conducting stability and reconstruction operations. Although this is a staggering amount, remember it is being shown for illustrative purposes related to funding.

Using this data as a planning figure to calculate the gross cost for producing this needed capability ($500 million per 10,000 troops times 50) the total allocated budget would be approximately $25 billion. Despite the enormity of the task of retraining 500,000 soldiers, the cost of $25 billion would only be about 13 percent of the $323.4 billion being spent on the three separate mobility-enhancing technologies discussed in this monograph.

This monograph is not suggesting that the U.S. Army begin efforts to create a force of 500,000 troops to conduct stability and reconstruction operations nor is it suggesting that the U.S. Army completely dismantle the three programs discussed in this paper. It does highlight, however, that the money being spent on mobility-enhancing technologies represents a largely disproportional percentage of the entire Department of Defense

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[149] James T. Quinlivan, "Burden of Victory: The Painful Arithmetic of Stability Operations," *Rand Review,* Summer 2003, vol. 27, no. 2, 28-29.

[150] Quinlivan, 29.

budget. When comparing the cost estimates presented in this paper, one notices that more funding is being devoted for capabilities to improve speed and the ability to overcome anti-access challenges in conventional settings rather than for capabilities that will strengthen areas related to counterterrorism, counterinsurgency, and stabilization and reconstruction operations.

CONCLUSION

Unlike the period of transition in the late 1990s, the U.S. Army now finds itself at a point in history where its strategic relevance is no longer questioned and where most informed individuals do not contest the notion that "boots on the ground" are required for a national strategic victory. However, after embarking on a radical journey to transform Army formations and to bring new joint technologies into play for expeditionary purposes, the U.S. Army continues to struggle to recognize what contribution, in the joint, interagency, and multinational environment, it must make not just to win the tactical fight, but to "attain a better peace."[151] In the years following the collapse of the Soviet Union and after the first Gulf War, the U.S. Army remained strongly wedded to the concepts of applying overwhelming force and seeking quick exit strategies upon completion of major combat operations. The Weinberger and Powell doctrines stressed avoiding protracted conflicts by steering clear of ambiguous "irregular" types of warfare because U.S. forces should intervene only if America's "vital interests" were at stake.[152] In effect, the Army wore blinders to potential contributions beyond applying its ground maneuver forces in a conventional setting. Today, the strategic environment has changed and has forced the Army to re-look its primary role in the "full-spectrum of conflict" to see at what point ground forces are most relevant.

The recently published *Department of Defense Directive 3000.05* points out that "stability operations are a core U.S. military mission [and] that the DoD shall be prepared to conduct and support [these types of operations]"[153] In effect, this document mandated that operations in phases three and four are as important as operations in phases one and two. Since the U.S. Army and the U.S. Marine Corps are the most relevant "boots on the ground" forces capable of conducting stability and reconstruction-type operations, they must now look at how their force structure contributes best in this category of conflict. With this in mind,

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[151] Basil Liddell-Hart, 202.

[152] For information about the very open and bitter public debate between the Chairman of the Joint Chiefs of Staff, Colin Powell, and Secretary of State, Madeline Albright, see, Michael Gordan, "Powell Delivers a Resounding No On Using Limited Force in Bosnia," *The New York Times*, 27 September 1992, A-1 and A-; Colin Powell, "Why Generals Get Nervous," *The New York Times,* 8 October 1992, 1-35.

[153] Department of Defense Directive 3000.05, 2.

Army efforts must now address how to properly design a force for both the worst case scenario of defeating a potential near peer competitor in a conventional setting and for the most likely scenario of performing stability and reconstruction operations in simultaneous and follow-on phases of protracted conflict.

The U.S. Army's efforts to transform have focused on using high-tech weaponry and equipment that can be used against all types of future challenges. The goal is to maximize the role each individual piece of equipment provides in various operations across the "full spectrum of conflict." To get the most "bang for the buck," the U.S Army has sought design parameters emphasizing speed and mobility and relying on net-centric capabilities in order to achieve a "one size fits all" function for all types of operations; from traditional combat to stability and reconstruction operations. The U.S. Army contends that FCS, along with seabasing concepts and the Joint Heavy Lift Program, will enable it to conduct "technology spinouts…that will significantly amplify capabilities to support [traditional challenges,] stability operations, and homeland defense."[154] However, these types of technologies, which stress speed and mobility in their key performance parameters, focus more on confronting traditional threats in major combat operations than threats that come from irregular sources in a series of protracted campaigns occurring in simultaneous and subsequent stability and reconstruction operations.

Designing an expeditionary force, based on speed, mobility, and net-centric capabilities is not, in and of itself, completely without merit. These types of technologies, when and if they come to fruition, can contribute to the future security environment in many immeasurable ways. One must ask, however, what the 'cost versus benefit' ratio is when attempting to achieve the capabilities promised by all these technologies. Using Iraq and Afghanistan as a benchmark for the U.S. Army's present combat effectiveness, many have argued that

> we deployed relatively small forces rapidly, and then won quickly and in very dominant fashion with minimal collateral damage. The result is, you end up in a theater with far fewer troops than in traditional wars, [and with] an enemy that is defeated but not exhausted. And suddenly you are in a postwar period without adequate forces or planning for the next phase of nation building[155]

If this is, in fact, true, why is it necessary to spend billions and billions of dollars on new equipment that provides U.S. Army forces with even more of the same capabilities while placing little emphasis on the things the

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[154] Department of the Army, Army Support to SSTR Operations, 7.

[155] *Transformation for Stabilization and Reconstruction Operations,* ed. Hans Binnendijk and Stuart Johnson, National Defense University, Center for Technology and National Security Policy, 12 November, 2003.

Army needs most? In light of the ground maneuver forces' newly recognized roles in operations other than combat, wouldn't it be wise to invest some of the money allocated to these new technologies in other programs that would aid the U.S. Army's contribution to possible protracted campaigns during stability and support operations?

This research does not recommend that the Department of Defense and U.S. Army completely give up on creating expeditionary capabilities. However, in lieu of designing an entire force structure with expeditionary equipment with "one size fits all" type capabilities, the U.S. Army should designate some equipment and programs for the most dangerous and some equipment and programs for the most likely scenarios. The 2006 *Quadrennial Defense Review Report* acknowledges that "although the U.S. military maintains considerable advantages in traditional forms of warfare, this realm is not the only, or even the most likely, one in which adversaries will challenge the United States during the period immediately ahead."[156] Furthermore, the 2006 *QDR* characterizes the future security environment as a "long duration, complex [set of] operations involving the U.S. military, other government agencies and international partners waged simultaneously in multiple countries around the world, relying on a combination of direct (visible) and indirect (clandestine) approaches."[157] With these two bold proclamations, it becomes necessary to look at the U.S. Army's most relevant role in the context of the entire Joint, Interagency, and Combined force structure. When confronting future challenges, each military service, as well as other government agencies, must provide their unique capabilities in an interdependent capacity, contributing to the overall effectiveness of the entire organization to achieve a national strategic end-state. The U.S. Army should, therefore, "leverage the [combat] capabilities of its sister services" and focus on equipping its force not necessarily for expeditionary purposes alone, but for an appropriate role for a nation engaged in a "long war."[158]

This "long war," or global war on terrorism, is likely to continue pressing great demands on United States' ground forces for the foreseeable future. Since the Joint, Interagency, and Combined force structure already possesses an immense combat capability and because ground forces now have an increased role in stability and reconstruction operations, the U.S. Army ought to reallocate some money currently invested in new mobility-enhancing technologies and fund programs to better build and train ground forces for the close fight during stability, support, transition, and reconstruction operations. Despite Congress mandating that the U.S. Army grow its force structure, the senior army

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[156] Department of Defense, *Quadrennial Defense Review Report,* 6 February, 2006, 19.

[157] *2006 Quadrennial Defense Review Report*, 23.

[158] Andrew F. Krepinevich, "The Thin Green Line," *Center for Strategic and Budgetary Assessments,* 14 August, 2004, 16.

leadership ought to embrace that the Army needs more than a temporary increase in troop strength and that funding a larger authorized force, with relevant skill sets, for a long duration requires consistent, dedicated dollars written in the defense budget. Since most believe that Congress will not increase spending, this money must come from some programs already budgeted. However, canceling current mobility-enhancing programs in their entirety, like the ill-fated Comanche program was, would be a serious mistake. Rather, shifting priorities and pushing "spiraling" dates back to later timeframes may allow the U.S. Army to continue seeking new technologies in a more reasonable fashion while paying for emerging requirements related to stability, support, transition, and reconstruction operations. This strategy makes sense given the fact that most of the technology associated enhancing mobility has not fully matured and is not expected to until 2009.[159]

"The most precious thing in the military is our talent and not our technology."[160] General (Retired) Barry McCaffrey's assertion rings load and clear in today's security setting. While ground forces become better and better at building lasting peace in places ravaged by conflict, senior leaders must aid our talent by helping Soldiers and Marines capitalize on initial combat successes. An investment in additional human intelligence, larger and more robust language training, Special Operations forces, and multi-purpose forces would increase current capabilities and allow future ground forces to "train, equip, and advise indigenous forces, conduct direct action, foreign internal defense, and counter terrorist operations, as well as support security, stability, transition, and reconstruction operations."[161] By doing this, we can help avoid the glory surrounding high-dollar procurement – the trap laid by the seductive effect of an expeditionary mindset.

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[159] Technology Readiness Assessment Update, Office of the Deputy Assistant Secretary of the Army for Research and Technology, April 2005.

[160] Barry McCaffrey's quote is from an article published by Mark Mazzetti, "Los Angeles Times, *Army's Rising Promotion Rate Called Ominous,* 30 January, 2006, A-1.

[161] *2006 Quadrennial Defense Review Report*, 23.

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