COUNTERPOINT:

AIR-MECHANIZATION:
An Expensive and Fragile Concept

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FOR ROUGHLY A DECADE the Army has been examining a concept widely referred to as air-mechanization. According to the concept, some portion of future Army forces would be designed specifically for quick transport to a key location on the battlefield ("intra-theater aerial maneuver") using aircraft of roughly C-130 size. In theory, this capability would enable Army forces to conduct rapid aerial maneuver of medium-weight mechanized units over a distance of several hundred miles to place the units suddenly on an enemy's flank or in his rear areas. Recently, retired Army Major General Robert Scales publicly endorsed the theory, asserting that "the challenge of future warfare on land cannot be met without building modular FCS [Future Combat Systems]-equipped aero-mechanized brigades that form the aerial blitzkrieg force of the future."[1]

That this concept has already had considerable influence on the Army is apparent in the FCS program, a family of manned and unmanned vehicles whose weight has been constrained primarily by the design requirement for transport aboard relatively small (C-130-sized) cargo aircraft.

Our analysis suggests that the air-mechanization concept is flawed in a number of areas that make it untenable when more closely examined. More specifically, assumptions about the need for rapid deployment and optimism about the level of tactical situational awareness that will be available during a conflict are questionable, so much so that it is difficult to justify the massive investment of limited resources required to conduct such maneuver operations. It also disregards relevant history regarding past airmobile operations, ignores the realities of what can be accomplished within plausible defense budgets, and is too sanguine about what the U.S. aircraft industry can feasibly deliver. The concept's proponents also gloss over, if they don't ignore altogether, the cheap and easily obtained countermeasures that any adversary would likely employ to deal with air-mechanized assaults of the kind envisioned in the concept.

What Is Air-mechanization?

The concept of air-mech calls for medium-weight ground units to be lifted by C-130-class aircraft to key points on the operational battlefield. This means that the fighting vehicles transported must be of a size and weight that

will allow them to be moved in this type of aircraft. Theoretically, air-mech would enable joint force commanders to maneuver mechanized forces with much greater speed over several hundred miles in operations aimed at more quickly attacking enemy centers of gravity. Proponents of the concept have called for radii of action of up to 500 miles from point of take-off to prospective landing zones.

Questionable Assumptions

The success of air-mech rests on a number of suspect assumptions, two of which call into question the viability of the entire concept.

Rapid deployment, quick engagement. The first questionable assumption is that the Army will be able to deploy rapidly and engage quickly. During Operation Allied Force, NATO's operation against Yugoslavian forces in Kosovo from March to June 1999, the primary U.S. Army element was Task Force (TF) Hawk, a brigade-size force built around two Apache helicopter squadrons. Despite the relative lightness of the force, it still took roughly 20 days to deploy this 5,000-Soldier unit from Germany to Albania. Once it arrived in Albania, additional training was required to familiarize the pilots with flying conditions in the mountainous Balkan terrain. By the time the unit was declared ready for employment (on 26 April), fixed-wing air operations had already been ongoing for some time. Ultimately, senior U.S. political and military leaders decided not to commit the low-flying Apaches in Kosovo as they apparently determined that the risks outweighed the benefits. After 78 days of fixed-wing air attack, the Yugoslavian government in Belgrade agreed to evacuate its forces from Kosovo. NATO had won without the commitment of Army forces, including the attack helicopters of TF Hawk.

What did the U.S. Army learn from this experience? The Army, which thinks of itself as the "supported service" within the U.S. military, concluded that if it had only been able to deploy its forces faster to Albania, those forces would have been committed in an effort to drive the Serb forces from Kosovo, with NATO's airpower in support. Therefore, the lesson was "get lighter, and more deployable." As is true with most large organizations, events (and their possible meanings) are viewed through parochial institutional lenses. And such was the case with the U.S. Army in the aftermath of Allied Force. The

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Army Apache pilots familiarize themselves with the terrain at Rinas Airport, Tirana, Albania, on 23 April 1999 during Operation Sustain Hope and NATO Operation Allied Force.

fact that NATO's senior political leaders (with the possible exception of Britain's Tony Blair) were unwilling to commit ground forces was apparently not included in Army assessments of the event. Rather, the Army concluded that if its forces had been able to deploy faster, they would have been committed against the Serbs. This interpretation of the lessons of Kosovo merely reinforced thinking that had already been underway in the Army's Training and Doctrine Command (TRADOC) for several years before Allied Force.[2] TRADOC-sponsored "Army After Next" wargames had been ongoing since 1996. Those in control of the games concluded that high-speed intercontinental deployment and rapid intra-theater operational maneuver (by air) were the key capabilities the future Army had to acquire to remain relevant. The fact that high-speed deployment has rarely been needed—Korea in June 1950 and Saudi Arabia in 1990 are the only two significant post-World War II examples where such a capability was critically important—was apparently not included in the Army's internal assessment.[3]

After Allied Force, some of the authors of the air-mech concept argued that if the Army had had such a capability, it would have conducted a fundamentally different operation against the Serbs.[4]

When General Eric Shinseki became the Chief of Staff of the Army in the summer of 1999, one of his first actions was to initiate the Stryker wheeled combat vehicle program to create a "medium-weight" combat-unit capability in the Army.[5] Citing the Kosovo experience, Shinseki declared that to preserve its relevance, the Army had to become more deployable.[6]

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Undoubtedly, the Army's plans to introduce medium units into its force structure, first the Stryker and in the future an appropriate number of FCSs, are moves in the right direction toward greater flexibility and speed of deployment. Fundamentally, the introduction of medium units means that the Army can provide joint force commanders more options. However, the acquisition of a fleet of medium combat vehicles should not be justified in terms of aerial maneuver. The Army has already paid some price in vehicular capability by mandating that the FCS be able to fit into aircraft of roughly C-130 size. (Later, this article will highlight the significant problems associated with the aerial maneuver concept.)

Situational awareness. The second major assumption that air-mech relies heavily on is the idea that future commanders will have a far greater level of situational awareness than today's commanders have. This assumption about situational awareness is critical for two reasons. First, air-mech calls for flying slow, cargo-type aircraft at low altitude up to several hundred miles into enemy territory. This means that the success of any air-mech scheme of maneuver basically depends on avoiding or neutralizing enemy air defenses. Second, once the lighter vehicles that the aircraft will carry (Stryker or FCS) are on the ground, they will be highly vulnerable if they suddenly encounter well-armed or heavier enemy forces. Because air maneuver necessitates lighter vehicle weights, the vehicles' ballistic armor will be limited. Therefore, without what by today's standards would be phenomenal knowledge of the enemy at the lower tactical levels (brigade and lower), the aircraft and the lighter ground units that are fundamental to air-mech will be at much greater risk than if employed in a more methodical, mutually supporting, though somewhat slower, combined arms manner.

If the answer to the vulnerable light-vehicle quandary is air-mechanized units armed with 20-ton or larger combat vehicles, problems remain. Moving such vehicles will still require large and relatively slow, and hence vulnerable, cargo planes. Moreover, heavily loaded aircraft of this kind will lack maneuverability and range.

In response, some proponents see the solution in quad tilt-rotor aircraft. These are faster than helicopters (roughly 250 knots compared to about 170 to 180 knots for most helicopters). However, even the theoretical speed of 250 knots is quite slow by modern aircraft standards. As a point of comparison, 240 to 250 knots puts a quad tilt-rotor in the same speed class as the biplane fighters many air forces still used at the start of World War II. In addition, despite various on-board countermeasures that could help reduce certain threats, this type of aircraft will remain extremely vulnerable to many types of ground fire. Such aircraft are also extremely expensive and difficult to replace compared to conventional cargo aircraft. Even the loss of a few could adversely affect any operational plan that depended on them.

Aircraft conducting air assaults into enemy territory will, by definition, be exposed to low-altitude defenses. The threat includes antiaircraft guns, shoulder-fired infrared missiles, beam riders (such as the Swedish-made RBS-90), small arms fire, and RPGs.[7] Low-altitude defenses do not typically use emitting radars to locate and track targets; they are passive, optically directed systems. The lack of telltale electronic emissions means that when concealed, these weapons are very difficult to locate—until they fire on an aircraft.

Today, locating and suppressing non-emitting low-altitude defenses is very difficult. The problem is so challenging that since Operation Desert Storm in 1991, the Air Force and Navy have generally kept their strike aircraft well above 10,000 feet. Given

the accuracy of the precision munitions that arm today's aircraft, there is little need for the Navy and Air Force to descend into the lethal envelope of low-altitude defenses to engage targets. Both services recognize the difficulty of locating this class of weapon on the ground, and they simply fly above the threat. Air-assault aircraft winding their way to a landing zone do not have that luxury.

Because it is difficult to defeat concealed low-altitude air defenses, an air-mech force would almost certainly have to fly only where the enemy is highly unlikely to be. The ground force, with its lightly protected vehicles, would then have to move what may be considerable distances to reach its objectives. Such conditions could obviate the entire purpose of an air-mech assault. Consequently, though the vehicles of an air-mech force would give it much greater ground mobility than today's generally foot-mobile light forces, the maneuvering ground force would need very high levels of situational awareness as it moves toward the enemy. Recent operations in Kosovo, Afghanistan, and Iraq, however, show that we continue to experience extreme difficulty consistently locating concealed enemy forces, especially in forests, jungles, suburbs, and urban areas.

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Ignoring Relevant History

At the end of the Vietnam War, the U.S. Army aviation community was in a difficult situation. The last two years of the war for U.S. forces, 1971–1972, saw some ominous developments. In February and March 1971, Operation Lam Son 719 (the incursion into southern Laos by the Army of the Republic of Vietnam, heavily supported by U.S. aircraft, artillery, and helicopters) took place. Roughly two divisions of South Vietnamese (ARVN) troops moved by helicopter or ground into blocking positions 10 to 30 miles into southern Laos to sit astride the Ho Chi Minh Trail. The North Vietnamese Army (NVA) response was rapid and violent. Using the jungle for concealment, the NVA surrounded many of the hilltop ARVN firebases. As the ARVN forces came under increasing pressure, large numbers of U.S. Army helicopters had to be committed for resupply, casualty evacuation, fire support, and finally, extraction of the surviving ARVN forces. U.S. Army aircraft had to fly over the NVA forces that were concealed in the jungles surrounding the South Vietnamese firebases.

Losses were heavy. In about seven weeks of operations, 106 helicopters were destroyed and another 600 damaged, many seriously.[8] Army personnel casualties were also high: 65 U.S. helicopter crewmen were killed in action, 818 wounded, and 42 went missing in action. These losses were inflicted by optically directed small arms, RPGs, heavy antiaircraft machine guns, as well as 23-mm and 37-mm antiaircraft guns. Importantly, in 1971 the NVA did not have shoulder-fired missiles.[9]

In the spring of 1972, the North Vietnamese launched a major offensive to topple the Saigon regime. Again, the NVA managed to seriously limit U.S. helicopter operations by deploying (for the first time) the SA-7 shoulder-fired missile. In the early 1970s, the SA-7 was state-of-the-art, especially since there were few countermeasures available to aircraft at that time. The SA-7's effect was immediate and profound. Combined with the large number of 12.7-mm and 14.5-mm heavy machine guns the NVA deployed, the SA-7s drove off low-altitude observation planes and helicopters. The clear result of these developments meant that overflight of enemy territory had become prohibitively dangerous for low-altitude aircraft. The kind of bold, sweeping vertical maneuvers executed during the middle years of the Vietnam War were over.[10]

In the mid-seventies, the Army aviation community struggled with the lessons of the war's final years. When the Army refocused on conventional war in Central Europe after Vietnam, it had to consider the low-altitude air defenses of the Soviet forces. The integrated and sophisticated air defenses of the Warsaw Pact made whatever the NVA could throw up look amateurish. Therefore, when the Apache attack helicopter was developed in the early 1980s, it was *not* intended to "go deep" into

the enemy array. Rather, the Apache was to move rapidly to a threatened point in the line, hover over and behind friendly ground forces, and then fire at approaching enemy units using Hellfire missiles, its long-range stand-off weapons.

These conclusions concerning low-altitude aircraft operations were developed with the lessons of Vietnam still fresh in the Army's memory. By the late 1980s, however, many of the important lessons had apparently been forgotten.[11] Operation Desert Storm in 1991 seemed to give advocates of deep, aggressive helicopter operations evidence to make their case. As they noted, the deep left hook by the 101st Airborne (Air Assault) Division was conducted with little difficulty. That maneuver, however, contributed relatively little to the overall campaign. In the end, history shows that Kuwait was not liberated by a deep vertical envelopment. It was freed by a direct armored assault that shattered Iraqi units already reeling from 38 days of intense air bombardment and that seized objectives in short order. While the 101st's move looked interesting, it was not essential to the accomplishment of the coalition's mission. In fact, the 24th Infantry Division (Mechanized) reached the Euphrates River roughly a day after the 101st did, putting heavy armor astride the Iraqis' supply line leading from Baghdad to Kuwait.[12]

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Task Force Hawk's experience in Kosovo underlines the problematic nature of the case for a deep aerial assault capability. As the task force was deploying, there were grave doubts about the Apaches' survivability. The mountains between Albania and Kosovo meant that a combat-loaded Apache could only enter Kosovo via some eight passes through the mountains. Additionally, the heavily forested and hilly terrain inside Kosovo afforded excellent concealment to the opposing Serb forces. Those forces were numerous. Before the bombing operations started, there were well over 25,000 Serb troops inside Kosovo, and they were protected by hundreds of antiaircraft guns and shoulder-fired missiles as well as several batteries of radar-guided surface-to-air missiles (SA-6).[13] Some air-mech proponents have claimed that had an air-mech force been available, NATO could have deployed it into Kosovo quickly, effectively precluding Serb offensive operations. The assertion does not stand up to scrutiny. First, there were the 25,000 Serb troops, plus paramilitaries, inside Kosovo before NATO initiated operations, so there was no possibility of precluding anything—the Serbs were already there in large numbers. Second, had a brigade of air-mech (or airborne) forces been deployed into Kosovo, it would have been totally alone: the closest NATO ground forces were U.S. and British troops in Macedonia, and they were few in number, with a very limited offensive capability. How likely is it that NATO and U.S. decision makers would have been willing to deploy an isolated ground force into the midst of more than 25,000 enemy troops, particularly when those troops had ample air defenses?[14]

The sheer magnitude of the low-altitude air-defense threat meant that, with the exception of General Wesley Clark, most senior leaders were unwilling to risk the Apaches in operations inside Kosovo, even at night.[15] Given the large numbers of civilian refugees inside Kosovo, senior leaders were also unwilling to use area fires to suppress air defenses. As previously mentioned, low-altitude defenses generally do not expose themselves via radar emissions. This was certainly the case in Kosovo, where NATO was having great difficulty locating even the medium- to high-altitude surface-to-air missiles due to clever Serb radar management.[16]

It should be noted that the proposed Army air missions into Kosovo were to have been conducted by small numbers of armored attack helicopters (four to eight at a time), not the dozens or scores of transport aircraft that an air-mech-type assault would have required. It is also noteworthy that the Serbs were well prepared for a possible air assault. Serb units were observed conducting anti-air-landing exercises in the vicinity of possible landing zones. There was no major landing zone in the province that was not within range of literally dozens of Serb mortars, cannon, and multiple rocket launchers. The

Serb brigades in Kosovo included scores of armored fighting vehicles, many of which were located close to prospective landing zones. Also, many of the possible landing zones were mined. The reception that the Serb Army could have provided to an air assault force would probably have made any Vietnam-era "hot" landing zone look mild.

Iraq in 2003 offers a final historical example. All the ground components—the U.S. Army, the Marine Corps, and the British Army—planned to conduct air assault operations out in front of their leading armored elements. Key objectives such as bridges or other important terrain were planned for seizure by helicopter-borne forces that would then be joined by the approaching armored units. Due to their lack of vehicular mobility, the air assault forces of 2003 would have consisted of light infantry units, thus requiring their transport aircraft to fly to landing zones relatively close to the objectives. However, the air defense threat in Iraq was assessed to be very low, which facilitated at least the planning of air assault operations. Nearly 10 years of Operations Northern and Southern Watch had crippled Iraq's integrated air defense system. The majority of the threat would be from small arms, RPGs, machine guns, plus an occasional antiaircraft gun and a few shoulder-fired missiles. Nevertheless, that relatively minimal threat was enough to place major constraints on coalition helicopter operations.

Despite their pre-war plans, coalition units conducted no air assault operations forward of the leading edge of armor in the major combat operations phase. In the words of a senior Marine Corps staff officer, "We considered the risks, and we considered the benefits, and there was always too much risk."[17] The U.S. Army and British Army said the same thing: it was simply too risky to send troop-carrying aircraft into enemy controlled territory, even at night.[18]

The now well-known deep attack by the U.S. 11th Attack Helicopter Regiment on 23 March 2003 further dampened the willingness of Army commanders to risk helicopters forward of the leading edge of their heavy ground forces. The 11th's attack was intended to severely damage the Republican Guard Medina Division near Karbala, south of Baghdad. In that operation, every attacking Apache in the regiment was hit by enemy fire. One aircraft was shot down, and many of the other 30 were seriously damaged. The next morning, only seven of the remaining aircraft were airworthy.

The good news was that compared to Vietnam-era aircraft the Apache proved to be a very survivable helicopter. The bad news was that intense small arms fire and RPGs—the same type of weapons used in Lam Son 719 three decades earlier—drove off an entire regiment of very expensive, sophisticated attack aircraft. Five nights later the 101st Airborne Division made another deep attack into generally the same area. Although no aircraft were lost to enemy fire (two were lost to mishaps), the attack inflicted very little damage on the enemy.[19] The Army attempted no more deep attacks against regular Iraqi Army formations.

The Marines had their own challenges with helicopters. Their Cobra attack helicopter force suffered considerable damage from enemy ground fire. Approximately 46 of the 58 AH-1W Cobras deployed with the 3d Marine Air Wing suffered battle damage. Initially, the Cobras performed useful close support and armed reconnaissance roles, the latter missions taking them 5 to 15 kilometers into enemy territory in front of the leading ground elements. The Cobras often gathered useful information and engaged targets of opportunity, but took very heavy fire from concealed enemy forces. By roughly 1 April, the accumulated battle damage forced the Marines to stop using Cobras for armed reconnaissance. Thereafter, the helicopters were limited to close support, hovering over or close to friendly ground forces.

By the time they made the final push on Baghdad, Army commanders had become very cautious in their use of rotary wing, low-altitude aircraft. The commander of the 3d Infantry Division, Major General Buford Blount, prohibited *all* helicopter missions from going north of the Euphrates River from about 1 April 2003 until Baghdad's fall roughly a week later. Even medical evacuation helicopters were only occasionally allowed to go north of the river, to pick up grievously wounded personnel.[20]

In southern Iraq, the British Army was equally cautious in its use of low-altitude aircraft. After helicopters transported elements of the Royal Marine's 3 Commando Brigade ashore at the start of operations, the British restricted their use near the enemy. For example, on several occasions the British Army's 16 Air Assault Brigade planned for helicopter movement

of troops to encircle Iraqi forces near Basra. Each time, the operation was cancelled. The hard-to-locate, non-emitting, low-altitude air defense threat was simply too pervasive.[21]

It is very significant that the U.S. Army, the USMC, and the British Army, all independently of each other, reached the same conclusion regarding vertical maneuver in front of the leading edge of armor: *the risks were simply too great*. Given the facts, this unwillingness to do vertical maneuver is even more striking because—

- OIF was supposedly a war of vital national interest.
- Coalition forces had complete command of the air.
- The enemy's integrated air defenses were largely destroyed before the start of the war.
- The residual air-defense threat consisted mostly of small arms, RPGs, and an occasional antiaircraft gun.

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If senior commanders were not willing to take the risks associated with deep vertical maneuver in those circumstances, when would they be?

The air movement of the Army's 173d Airborne Brigade (reinforced by a small task force of tanks and mechanized infantry) from Italy into northern Iraq is sometimes cited by proponents of air-mech as an example of what the future will look like. In reality, the 173d deployed into a safe area already controlled by Kurdish forces. Once it arrived, it needed time to accumulate sufficient supplies for sustained operations. Finally, the 173d's actual contribution to the campaign was negligible. This is no insult to the unit or its Soldiers. The fact is that the major combat operations phase in Iraq was won by heavy forces driving up the Tigris-Euphrates Valley, backed by considerable air support.

Compatibility Problems

History isn't the only thing militating against the air-mech concept. Now and for the foreseeable future, the available planes are not compatible with the available vehicles. To make air-mech work, the Air Force has only C-130 and C-17 transports. The Army has the Stryker. The Stryker will fit (barely) inside a C-130, but not without first removing its anti-RPG slat armor. This armor would have to be reinstalled upon arrival in the area of operations—hardly a selling point for a force meant to move out and fight on arrival. The 20-ton Stryker also significantly reduces the C-130's range because it forces the aircraft to operate at close to its maximum payload. The vehicle's weight, moreover, compels the C-130 to use improved, rather than field, landing strips, thereby limiting the possible areas into which the force can be air-landed. The larger C-17 can carry possibly three Strykers, but it requires an even more developed airfield than the loaded C-130 does. The end result is an even greater loss of deployability.

Nor will the arrival of the FCS solve the plane-vehicle problem. To retain some compatibility with the C-130, the Army intends to offset the FCS's weight (24 to 26 tons) by making the system modular, so that components can be removed to make the FCS transportable by C-130. But like the Stryker's slats, these components will have to be reinstalled upon arrival in the area of operations, and the C-130 will still require an improved runway.

Air-mech proponents hope that in the future a heavy vertical take-off and landing (VTOL) aircraft can be built to permit truly vertical maneuver and to reduce or negate the need for runways. Examples of this type of hypothetical aircraft include either a large helicopter (such as a very large CH-47 with a 20- to 25-ton payload) or a large tilt-rotor aircraft such as a four-engine version of the V-22 Osprey. But until—and unless—such an aircraft is designed, the air-mechanization concept will be hamstrung by the need for airports and improved airfields.

Fiscal Realities

Operational concerns and compatibility problems aside, air-mech faces issues of cost and technological feasibility. To put it simply, it would be hugely

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The CV-22 Osprey fires countermeasures during a safe-separation test over the precision impact range area at Edwards Air Force Base, California, in 2004.

expensive to create even one brigade of air-mech capability. The cost of the FCS itself is very high, at least $130 billion for the research and development plus production of 15 brigades of equipment (enough for roughly one-third of the active Army).[22] The cost of the aircraft would also be enormous.

A very large premium has to be paid for VTOL aircraft. Take, for example, the V-22 compared to the C-130. The C-130J can lift up to 20 tons of payload over short distances (although loads of 13 to 15 tons are much easier on the aircraft). That aircraft costs roughly $65 million. The VTOL V-22 tilt-rotor can do some things the C-130 cannot, most notably take off and land without an airstrip. This is why the proponents of air-mech see tilt-rotor aircraft as the key enabler of the concept. However, a major problem is that the aircraft they envision is prohibitively expensive. The V-22, which costs $70 million, can lift only six tons of payload, less than one-third the maximum payload of C-130J. It is easy to see the premium required for VTOL capability.

To lift a combat-equipped FCS, a large tilt-rotor would have to be sized for roughly 28 to 29 tons. Aircraft cannot be designed to habitually lift their theoretical maximum payload. Just as the C-130 has a theoretical maximum capacity of about 20 tons, but a planning factor of roughly 15 tons, so would a tilt-rotor intended to lift a 24- to 26-ton FCS have to be designed toward a higher threshold.[23] Recent analysis conducted for the U.S. Navy showed that a quad tilt-rotor sized to lift 20 tons would cost roughly $200 million per aircraft. With the recent weight increase of FCS to between 24 and 26 tons, the size—and cost—of the aircraft would have to grow. It is likely that a VTOL aircraft capable of lifting an FCS over any substantial distance would cost about $250 million each.[24]

At a cost of roughly $250 million per aircraft, a plausible research and development cost from $10 billion to $15 billion, plus a major investment in new infrastructure capable of handling this class of aircraft (which the Army lacks today), building the aircraft component of air-mech would be enormous. To have enough aircraft to move just one FCS-armed brigade, the Army would have to purchase a minimum of roughly 300 aircraft for operational units. That figure presumes two lifts (round trips) to move one brigade (at 25 tons per aircraft per lift, with the brigade weighing roughly 15,000 tons, comparable to a Stryker brigade). Additionally, the Army would have to purchase spares and training aircraft that would push the total buy up to at least 375. At $250 million per aircraft, plus research and development (R&D) costs, the program (not including new infrastructure) would cost between $130 and $135 billion. If the Army wanted sufficient aircraft to move one complete FCS-armed brigade in a single lift, the total cost would be well over $200 billion.

The great cost of the aircraft would also affect the rate at which the Army could acquire them. At a unit cost of $250 million per aircraft (more than the current cost of a new production C-17), very few large tilt-rotor aircraft could be purchased each year. The maximum annual production of the C-17 is 15 airplanes—and the Air Force is in the primary business of buying and operating large aircraft, whereas the Army is not. Producing 20 aircraft a year would cost the Army some $5 billion annually, or roughly 50 percent of its entire current procurement account. Even at this optimistic production rate, it would require 17 to 18 years to produce enough aircraft to give the Army the ability to lift one-half of one of its brigades. If the program were started next year (a virtual impossibility), the R&D period would last roughly a decade, followed by at least five years of low rate initial production, after which full rate production (20 per year for the sake of argument) could start. Therefore, it would be between 2038

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One way the Army might afford the aircraft would be by sharing the cost with another service. However, given the demands on their budgets, it is unlikely that the other services would be willing to commit substantial funds to such an Army-sponsored aircraft. That the Air Force will have no interest in such an aircraft goes almost without saying. It is already heavily committed to the F-22A, its version of the F-35; C-130J production is still underway; more C-17s may be built; a tanker replacement is on the horizon; and the service needs additional surveillance and reconnaissance platforms. The Air Force is, to put it nicely, already oversubscribed. Moreover, operationally, the USAF has no need for a heavy-lift VTOL aircraft. Realizing this, the Army has not seriously approached the Air Force for cooperation in the heavy vertical lift project.

On the other hand, the Army has held out considerable hope that the Navy and Marine Corps would support such a program. The Marines have vertical lift needs of their own, and the Army would welcome sea-service participation in a joint program, even if the Navy and Marines have to be forced to do so by Congress or the Office of the Secretary of Defense.

The problem is that the type of aircraft that the Army wants is simply not compatible with shipboard operations. To carry a 24- to 26-ton payload, the aircraft would have to be so large and heavy, with rotors that will produce hurricane-force winds on crowded flight decks, that it is problematic at best for shipboard use.

A recent Navy study of lift capability examined seven hypothetical aircraft. Significantly, that study was based on aircraft sized for 20-ton payloads. Since the Navy study was completed, the weight of the FCS has increased, resulting in a requirement for an even larger aircraft. Such an aircraft (whether helicopter or tilt rotor) would be so large that it could not use the ships' elevators, nor would it be able to enter hangar bays. Indeed, these aircraft would be so large that they would place major constraints on air operations by aircraft designed for normal shipboard use.[25]

Additionally, the Marines do not need a heavier aircraft than already contemplated. Whereas the Army's Stryker (20 tons) and FCS (24 to 26 tons) require an aircraft with roughly a 25-ton lift capability, there are important break points in the equipment weight of a Marine Expeditionary Brigade (MEB). The Marine's CH-53E can already lift all the equipment of a MEB except the 25-ton Amphibious Assault Vehicle-7 (AAV-7) and the 65-ton M-1A1 main battle tank. The AAV-7's replacement will be the 35-ton Expeditionary Fighting Vehicle (EFV). The Marines have no requirement for either the EFV or the M-1A1 to be airlifted. Their next heaviest piece of combat equipment is the 14-ton Light Armored Vehicle (LAV-I). With the CH-53 capable of airlifting the LAV-I, and with no expectation that its two heaviest pieces of combat gear be moved from ship-to-shore by air, the Marines have no need for an aircraft of the type the Army desires.

Susceptibility to Countermeasures

We have already discussed the survivability issue in terms of the optimistic assumptions about situational awareness regarding non-emitting, low-altitude air defense weapons. Of at least equal importance is the gross mismatch between the costs to the United States of this concept compared with the cost to an opponent to deploy countermeasures. By orders of magnitude, the cost calculation argues against the air-mech concept.

Whereas medium/high-altitude defenses are very expensive and require considerable training for the operators, low-altitude air defenses require neither. The state-of-the-art Russian SA-18 shoulder-fired surface-to-air missile costs roughly $50,000 per launcher. Each missile costs about the same. So, a launcher with six missiles represents an investment of some $350,000. When training aids and other extras are added, it may come to about $400,000.

Assuming the cost to the United States for *one* quad tilt-rotor is $200 million, an opponent could purchase 500 SA-18 launchers and 3,000 missiles for the same investment. Clearly, there is a tremendous disparity between the cost of air-mech and the countermeasures that can threaten or defeat it.

To hedge against U.S. development of counters to a single system, an opponent would almost certainly buy an assortment of air defenses. Antiaircraft guns ($150,000 to $5 million each depending on the model), anti-helicopter mines (roughly $30,000 each), beam-rider systems such as RBS-90, and quick-response, radar-guided, low-altitude missiles like the Russian SA-15 would probably be mixed and matched to create a multifaceted air defense system that would foil U.S. countermeasures. It may be beyond the ability of the United States to counter at all. Recall the Navy and Air Force's response to today's low-altitude threat: they usually fly above it unless there is some extreme operational reason not to do so. An air-mech force cannot do that. It could only fly around the air defense threat, landing where there is probably nothing that the enemy cares about anyway.

The main point is that compared to costly medium/high-altitude defenses, low-altitude defensive systems (not to mention small arms and RPGs that are also used against low-flying aircraft) are very cheap. They are also much easier to train operators on compared to the sophisticated systems required for medium/high-altitude defenses (such as SA-10/12 or Patriot). This fundamental reality means that the United States could find itself in the situation of having purchased a hugely expensive air-mech "system" (the expensive ground vehicles, a costly reconnaissance network in an attempt to gain situational awareness, and very expensive aircraft) only to find that commanders are not willing to use it—even when the opposition consists of cheap, low-tech countermeasures.

A Fragile Concept

In summary, the air-mech concept is hugely expensive, vulnerable to relatively cheap countermeasures, and would probably involve such risk that it would only rarely, if ever, be used in the manner advocated by its proponents. The chances of risk-averse senior U.S. decision makers deploying a brigade hundreds of miles from the nearest friendly ground force is remote (unless the deployment is into a safe area, such as the movement of the 173d Airborne Brigade into the Kurdish-controlled part of northern Iraq in 2003). There is little likelihood of an operation ever being conducted that remotely resembles the large-scale, deep penetrations envisioned by air-mech advocates.

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What should be done? Although this article has highlighted the multiple major problems with the air-mech concept, a case can be made for the purchase of a small number of new heavy-lift VTOL aircraft. During ground combat in Operation Iraqi Freedom, aircraft were used to supplement the traditional truck-based ground supply system. The farther the ground force moved from its supply base in Kuwait, the more the logistics system was strained. A judicious number of heavy-lift VTOL aircraft would have been very useful logistically. Given the effectiveness of Iraqi air defenses, the same cannot be said about using such aircraft in an offensive mode.

If the Army wants a joint program with the sea services in order to share costs, it will have to make major compromises on the aircraft's design. An aircraft intended to vertically lift the roughly 25-ton FCS will be way too large for reasonable use aboard ship. Even an aircraft built for a 20-ton payload would present major challenges for shipboard operations. The aircraft's size, the velocity of its rotor wash on the deck, and its large blades hanging over the ship's side while rotating at high speed would be major issues for naval aviation. If an airplane is too large to fit on a flight-deck elevator or too big to stow inside a ship's hangar bay, it will be of little use to the Navy and Marine Corps. Therefore, to attract joint sponsors from the sea

services, the Army would have to be willing to make major compromises to its requirements.

For nearly a decade the Army has been examining the utility of air-mechanized forces and associated aircraft. This article has highlighted the many problems that would challenge the creation and employment of a true air-mech capability. Perhaps the most telling point is that the air-mech concept, which would be hugely expensive by any standard, could be severely threatened, if not entirely negated, by cheap, low-tech countermeasures. It is becoming increasingly clear that in the coming decade the U.S. military will have to make some very hard, fundamental choices about the capabilities it truly needs in an era of fiscal constraints. Building a future capability that is based on a hugely expensive, very fragile concept is not an option that deserves further consideration, much less investment. ***MR***

NOTES

1. Robert Scales, "The Shape of Brigades to Come," *Armed Forces Journal* (October 2005): 32.

2. John Gordon and Jerry Sollinger, "The Army's Dilemma," *Parameters* (Summer 2004): 33-45; Dennis Steele, "The Wheels Start Turning," *Army* (February 2000), 36.

3. For a discussion of the historical need for rapid intercontinental deployment, see Alan Vick, et al., *The Stryker Brigade Combat Team: Rethinking Strategic Responsiveness and Assessing Deployment Options* (Santa Monica, CA: RAND, 2002).

4. See Huba Wass de Czege, "The Continuing Necessity of Ground Combat in Modern War," *Army* (September 2000), 8-12, for perhaps the most extreme postulation of what the Army could have accomplished in Kosovo if it had air-mechanized forces. According to Wass de Czege, "*the incursion of the Serb Army into Kosovo could have been preempted before the genocide began*. . . . One or two [U.S. Army] objective force divisions could have been flown into Kosovo to block the entry of most of the Serbian forces. They would have used organic aircraft with enough range to fly into Kosovo from at least beyond the Adriatic Sea" (page 11). Emphasis in the original.

5. The term "medium forces" generally refers to combat units armed with tracked or wheeled fighting vehicles in the 15 to 26 ton weight class.

6. "Highlights of AUSA's Annual Meeting," *Army* (December 1999), 45-52.

7. A beam-rider missile is controlled by a gunner on the ground who keeps his sight fixed on the target. Control commands are transmitted to the missile based on the gunner's sight picture. Currently, beam riders are immune to countermeasures.

8. As a point of comparison, the entire buy of the UH-60 helicopter was 1,463 aircraft. The aircraft lost and damaged during Lam Son 719 would have accounted for about half of the fleet in less than two months.

9. <www.a101avn.org/LamSon719.html>. Lam Son 719 was known to U.S. troops as Operation Dewey Canyon II. It lasted from 30 January to 24 March 1971.

10. Peter Wilson, "Defense of Hue and Quang Tri City—the 1972 NVA Invasion of MR-1" (Washington: Center for Naval Analysis, 1974).

11. See the following web site for a discussion of the evolution of U.S. Army thinking on attack helicopter development, particularly the 1972 decision to cancel the Cheyenne attack helicopter and the early post-Vietnam development of the AH-64 Apache: <www.centennialofflight.gov/essay/Rotary/Assault_heli/HE17.htm>.

12. Frank Schubert, et al., *The Whirlwind War* (Washington: Center of Military History, 1995), 174-190.

13. Bruce R. Nardulli, et al., *Disjointed War, Military Operations in Kosovo, 1999* (Santa Monica, CA: RAND, 2002), 94.

14. Robert H. Scales, *Yellow Smoke: The Future of Land Warfare for America's Military* (Rowan & Littlefield, 2003). See also John Gordon IV, David Johnson, Walter L. Perry, and Bruce R. Pirnie, "Letter to the Editor: Kosovo and Landpower," *Army* (April 2001), 4-8, for a discussion of the insurmountable obstacles air-mech forces would have faced during Operation Allied Force.

15. Nardulli, 94-95.

16. Unlike the Iraqis in 1991 who turned their air-defense radars on and left them operating for long periods, thus making them ideal targets, the Serbs in Kosovo frequently moved their mobile radars and only operated them for brief periods from a given location. This greatly complicated NATO's ability to locate and target them. Indeed, NATO could never be sure how much damage it had inflicted on the Serb air-defense system.

17. Interviews with members of the 1st Marine Division, Camp Pendleton, California, October 2003.

18. Interviews with British Army Doctrine and Development Command, Upavon, United Kingdom, August 2003; interviews with members of the 3d Infantry Division (Mech), Fort Stewart, Georgia, October 2003.

19. Gregory P. Gass, "The Road Ahead," *Rotor and Wing* (October 2003): 26.

20. Interviews with MG Buford Blount, February 2004; interviews with members of the 3d Infantry Division (Mech), Fort Stewart, Georgia, October 2003.

21. Interview with UK Ministry of Defense, London, July 2003.

22. For information on FCS cost growth, see the August 2006 Congressional Budget Office report, "The Army's Future Combat Systems Program and Alternatives," xvi. The report cites an estimate by the Pentagon's Cost Analysis Improvement Group that placed FCS R&D and production of 15 brigades at $160–173 billion.

23. FCS is being designed in a modular fashion so that components can be removed to lower vehicle weight, possibly allowing for C-130 transport. The reassembly of the vehicles upon arrival at their destination could, however, be time-consuming and certainly not conducive to immediate employment.

24. John Gordon, et al., *Assessment of Navy Heavy-Lift Aircraft Options* (Santa Monica, CA: RAND, 2005).

25. Of the aircraft options examined for the Navy, only the CH-53X (now known as the CH-53K), an improved model of the existing CH-53E, was determined to be readily shipboard compatible. That aircraft is, however, limited to roughly 15-ton payloads. Some of the helicopter variants (sized for a 20-ton payload) might be able to enter a ship's hangar bay, but several important technical challenges would have to be resolved first. Of the helicopter variants, a large tandem (i.e., a large CH-46 or 47) was most compatible with shipboard operations in terms of its shape and rotor wash.