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V-22: Osprey or Albatross?

by Charles V. Peña

Executive Summary

The V-22 Osprey is a tilt-rotor aircraft that takes off and lands vertically like a helicopter but flies like an airplane when its wing-mounted rotors are tilted to become propellers. Supporters of the V-22 argue that it has the operational flexibility of a helicopter but is twice as fast, can carry more troops, and has five times the range. And unlike helicopters, the V-22 can fly to its area of deployment and does not have to be transported, either by ship or by cargo aircraft. Critics contend that the Osprey is prohibitively expensive (which is why Secretary of Defense Richard Cheney tried to cancel the program in 1989) and unsafe (the V-22 program has experienced four crashes, two of which killed 23 Marines). Moreover, they argue that existing helicopters, which the services are already buying, can accomplish the same missions at considerably lower cost.

The reality is that the V-22 is only marginally more capable than helicopters in terms of speed, range, and payload but costs four to five times as much. And despite more than 15 years of development and $12 billion spent, the Osprey is still in a test phase and nowhere near ready for operational deployment. Instead of admitting that the V-22 program has failed and using the money to buy proven helicopters for the same missions, the Marine Corps, with considerable help from Congress, has kept the program alive—continually trying to fix various problems. But at least one problem—vortex ring state (VRS)—can never be fixed or eliminated. And "flying around" the VRS problem by slowing the descent rate of the V-22 makes the Osprey more vulnerable than helicopters (despite claims that it is more survivable).

In short, the V-22 Osprey is an albatross around the Pentagon's and taxpayers' necks. The program should be terminated.

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The V-22 does not provide any truly revolutionary operational military capability.

Introduction

The V-22 Osprey is a tilt-rotor aircraft that takes off and lands vertically like a helicopter but flies like an airplane when its wing-mounted rotors are tilted to become propellers. The V-22's vertical takeoff and landing (VTOL) capability allows it to operate without traditional runways (it can operate from the decks of amphibious ships). Its winged-aircraft configuration gives it the speed and range of a traditional turboprop airplane and permits aerial refueling and self-deployment (flying directly from its base to a theater of operations rather than being partially disassembled and transported via sealift or airlift) anywhere in the world.

Supporters of the V-22 argue that it has the operational flexibility of a helicopter but is twice as fast, can carry more troops, and has double the range. The V-22's multimission capabilities include troop and cargo transport, amphibious assault, transport for special operations, and search and rescue operations. According to an issue brief by the Lexington Institute, "It's hard to imagine an aircraft better suited to a period of uncertainty about the future because no matter what kinds of threats arise in the next century, the Osprey is nearly certain to be useful everyday."[1]

Critics contend that the Osprey is prohibitively expensive and unsafe (the V-22 program has experienced four crashes, two of which killed 23 Marines). The V-22 entered full-scale development in 1986, and its estimated per unit cost has more than tripled from $24 million to $85 million since the program started. Now—more than 15 years later and having survived an attempt to terminate it by then–secretary of defense Richard Cheney in the first Bush administration—the program is still essentially in a test phase with 40 preproduction V-22s built.

Although news reports have speculated that the V-22 Osprey might be on the Pentagon's chopping block,[2] the director of program analysis and evaluation, Stephen A. Cambone, recently announced that the V-22 would be allowed to proceed as a test program. Cambone says: "I think it would be fair to say that there isn't a desire to cut a major weapons system for the purposes of saving money. The question is whether the weapons system at issue is going to support the kind of joint operational capability that we are attempting to construct."[3]Cutting the V-22 would save money (which could then be used on other needed weapon systems) and would not undermine any important goal or reduce the military's capabilities. The V-22 does not provide any truly revolutionary operational military capability necessary for defense modernization. Therefore, to reduce an already bloated defense budget, the Pentagon should eliminate the V-22 tilt-rotor program.

The Tilt-Rotor Concept and the V-22

The idea of combining the vertical takeoff and landing capabilities of a helicopter with the winged flight of an airplane dates back to the mid-1940s. Wynn Laurence LePage (a pioneer in rotary wing design) and Haviland H. Platt (a mechanical engineer with a number of rotary wing patents) formed the Platt-LePage Aircraft Company in 1938. They proposed and patented the first tilt-rotor aircraft design in the United States. But Platt-LePage was forced to shut down in 1947 because of its small size, lack of capital, and lack of orders for military aircraft. Robert Lichten, an ex-Platt-LePage engineer, went to Bell Helicopter where he developed the XV-3—under contract with the National Aeronautical and Space Administration and the Army. The XV-3 was remarkably similar to the Platt-LePage in design.[4] The XV-3 was the first successful demonstration of tilt-rotor feasibility and, from 1953 to 1966, made 250 test flights, including 110 full conversions from helicopter mode to airplane mode and back.[5]

Beginning in 1972, Bell Helicopter developed the XV-15 tilt-rotor aircraft (again under contract with NASA and the Army)

and produced two aircraft in 1977. The XV-15 flew in helicopter mode in May 1978 and in airplane mode in July 1979. The prototype XV-15s accumulated more than 800 hours of testing, and they served as test beds for refining tilt-rotor concepts.[6]

History of the V-22 Program

In 1981 the Department of Defense began the Joint Services Advanced Vertical Lift Aircraft (JVX) Program—based in large part on demonstration of the XV-15—that was intended to meet the needs of all four military services for a vertical takeoff and landing aircraft. The Army lost interest in the program because of competing funding requirements for helicopters, perhaps portending the current affordability questions associated with the V-22. As a result of Army withdrawal, the Navy became the lead service for the JVX program in 1982. In 1984 the JVX was designated the V-22, and the secretary of the navy chose the name "Osprey" for the new aircraft.

The objective of the V-22 program was to develop and produce 913 tilt-rotor aircraft for the Army, Navy, Marine Corps, and Air Force. The plan was to achieve initial operating capability for the Marine Corps version in 1992. The following is a summary history that highlights some of the important events in the V-22 Osprey program.[7]

- 1986: The program entered full-scale development (FSD) after review by the Defense Systems Acquisition Review Council, the predecessor of the current Defense Acquisition Board (DAB). A fixed-price contract for a joint service V-22 was awarded to Bell/Boeing. Bell/Boeing began preliminary design studies on an anti-submarine warfare variant of the V-22, the SV-22.
- 1987: The Army withdrew from its commitment to procure the V-22. Bell/Boeing conducted budgetary cost estimates for the SV-22. Also, the company initiated a feasibility study for a variant to transport civilian executives (the VV-22). The U.S. Special Operations Command was formed and took over acquisition responsibility for the special operations variant—the CV-22—from the Air Force.
- 1989: A test flight of the first of six planned FSD prototype aircraft was conducted in March. Secretary of Defense Cheney canceled the V-22 program—citing cost—in the fiscal year 1990 amended budget. Production was terminated, but Congress disagreed with Cheney's decision and continued to fund the V-22.
- 1991: An FSD aircraft crashed in an accident on vertical takeoff due to miswiring of flight control system rate gyros. Prototype aircraft exceeded the specified weight, resulting in failure to meet several range and payload requirements for the aircraft as specified by the Joint Services Operational Requirement.
- 1992: A second FSD aircraft crashed due to a fire during landing approach, resulting in seven deaths. The V-22 program moved from FSD to engineering and manufacturing development (EMD).
- 1993: The new Clinton administration favored the V-22 and the program was funded in the Five Year Defense Plan for the first time in four years. The under secretary of defense for acquisition ordered the program to continue as a joint effort. Congress passed FY94 defense authorization and appropriation bills, both with funds identified for the continuation of the V-22 into production (the appropriations bill also added funds for restart of the CV-22).
- 1994: The V-22 passed a Joint Requirements Oversight Council review. The DAB formally approved the V-22 EMD program.
- 1997: The first EMD aircraft underwent a test flight. The DAB authorized the first lot of aircraft for low-rate initial production (LRIP). Authority for approval of further low-rate and full-rate production was delegated to the sec-

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retary of the navy.

- 2000: In April an EMD aircraft crashed when the pilot lost control during a high-rate descent, killing 19 Marines. In December an LRIP aircraft crashed during a routine night approach, killing all four Marines on board. V-22 aircraft were grounded pending a review of the program by a blue-ribbon panel. According to press reports, the V-22 maintenance records had been falsified for two years at the explicit direction of the squadron commander.
- 2001: In January the squadron commander admitted falsifying maintenance records. In April the Panel to Review the V-22 Program published its report and concluded:

> The need for a capability of the type the V-22 was designed to satisfy appears to be justified, and by its demonstrated performance, the V-22 has shown unique potential to meet that need. There is no evidence that the V-22 concept is fundamentally flawed; however, the aircraft is not ready for operational use in a number of key respects, chief among them system reliability and maintainability.
>
> At this point, the soundest management approach for the V-22 program is to restructure the program by temporarily reducing production to a minimum sustaining level while simultaneously initiating a Development Maturity Phase.[8]

In September three Marines were found guilty of misconduct and two were reprimanded in conjunction with the falsified V-22 maintenance records. In December the secretary of defense for acquisition announced that the V-22 Osprey would go through a new two-year flight test program.

- 2002: The V-22 was cleared for flight-testing. In May the Marines resumed flight-testing of the V-22 for the first time since the aircraft was grounded at the end of 2000. In September the first LRIP V-22 resumed flight test operations. The Air Force resumed flight tests of its version of the V-22.

Although the tilt-rotor concept is more than 50 years old and the V-22 program has now been in existence for more than 15 years, the program is still in a test phase. Forty preproduction models have been built, but no aircraft are operationally deployed. And despite claims that there is a global market for tilt-rotor capability, there are currently no civil or commercial tilt-rotor aircraft.[9] Development of the Bell Agusta BA609 civilian tilt-rotor aircraft is currently on hold—in large part due to the problems associated with the V-22 program.[10] This simply highlights the fact that tilt-rotor technology is still not proven to be sufficiently safe and reliable and remains largely experimental.

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Requirement for the V-22

The V-22 program is driven largely by a Marine Corps requirement to replace the aging CH-46 assault-transport helicopter.[11] The CH-46 provides all-weather, day or night assault transport of combat troops, supplies, and equipment for the Marine Corps. Its primary mission is troop transport; the movement of supplies and equipment is secondary. The CH-46 can carry up to 22 troops, plus 2 aerial gunners and a cargo payload of 5,000 pounds. It has a maximum speed of 145 knots (167 mph), and a maximum range of 132 nautical miles (152 statute miles) for a land assault mission.[12]

Based on a 10,000-hour service life established by the Navy in 1978,[13] the Marines claim that

> finding an aircraft to meet the Corps' medium lift needs is the most pressing issue for Marines this year. The aging CH-46 helicopter is entering its 26th year of service life. While it has served us well, we can no longer expect it to carry

> Marines in harm's way on the modern battlefield. Precision-guided munitions and hand-held surface-to-air missiles place the 30-year-old helicopters and the Marines they carry at risk.[14]

In addition to its age, other deficiencies of current medium lift[15] helicopter capability cited by the Marine Corps include

- inadequate payload, range, and speed;
- lack of ability to communicate, navigate, and operate in adverse weather conditions, day or night;
- lack of self-deployment or aerial refueling capability;
- inability to operate in a nuclear, biological, chemical (NBC) environment;
- insufficient threat detection and self-protection capabilities;
- unacceptably high maintenance and inspection rates; and
- limited communication capability for embarked troop commanders.[16]

Interestingly, the V-22 Osprey is not a direct replacement for the CH-46. Indeed, the helicopter that will replace the CH-46 is the CH-60 Seahawk, which is a variant of the Army's UH-60 Blackhawk. The CH-60 is a medium lift utility and assault helicopter that can carry 13 passengers or a total payload of 10,000 pounds.[17] It has a top speed of 180 knots and a range of 380 nautical miles (but range becomes unlimited with aerial refueling capability).[18] Clearly, the CH-60 addresses the CH-46's deficiencies related to payload, speed, range, and aerial refueling.

The requirement for the V-22 stems not so much from a need to replace the CH-46 helicopter's traditional vertical lift capability as from the Marine Corps' desire to have a new aircraft that supports its doctrine of expeditionary maneuver warfare, crisis response, and naval forward-presence operations. According to the Congressional Research Service:

> The U.S. Marine Corps considers the V-22 its highest priority. Lt. Gen. Frederick McCorkle, the Marine Corps Deputy Commandant for Aviation has written, "The Osprey's introduction to the Marine forces is of paramount importance to the Marine Corps as it epitomizes our philosophy of procuring and fielding leap-ahead technology systems to best employ our expeditionary forces." The Marine Corps believes that the Osprey will give them an unprecedented capability to quickly and decisively project power from well over the horizon. Indeed, the Marine Corps considers the V-22 Osprey more than just an aircraft. Instead, the Osprey is an important foundation upon which its vision for projecting naval power ashore (operational maneuver from the sea, or OMFTS) rests.[19]

Traditionally, the primary mission of the Marines Corps has been amphibious assault. However, there has not been a large-scale amphibious assault since Inchon during the Korean War. OMFTS is a departure from the traditional operation of launching a large amphibious assault from a fleet off the coast and then building up forces to establish a beachhead before advancing to the main objective or objectives further inland. Underpinning the concept of OMFTS is the ability "to move units from ships lying over the horizon to objectives lying far from the shore."[20] Even with this new concept, the Marine Corps nonetheless recognizes that "amphibious assaults are essential to the landward dominance of battlespace."[21]

Critics point out that "because the V-22 can carry only troops and light weapons, the Marines must still rely on much slower helicopters and hovercraft to carry heavy weapons into battle."[22] Thus, Marines would be conducting inland combat operations without the benefit of supporting weapons that could be critical to the success of such operations. In his book *Putting "Defense" Back into U.S. Defense Policy*, Ivan Eland asserts:

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> An unsupported assault inland by marines using V-22s is every bit as risky as an unsupported airborne assault by light army troops using parachutes. Since the end of World War II, large airborne assaults have been rare. . . . For equally compelling reasons, inherently risky amphibious assaults have also been rare. It seems unwise to add even more risk by landing unsupported marines inland, with only light equipment, against a reasonably capable foe.[23]

He concludes that "landing marines with heavy equipment and supplies on the beach from over the horizon (to reduce vulnerability of amphibious ships) may be a good idea, but risky, unsupported landings inland via V-22 are less attractive."[24]

The Marine Corps developed the doctrine of operational maneuver from the sea, which seems to conveniently justify the need for the V-22.

There is also the question of whether the V-22 supports the new Marine Corps doctrine of OMFTS or vice-versa. In April 1989 then–secretary of defense Cheney told the House Armed Services Committee that he "could not justify spending the amount of money . . . proposed . . . when we were just getting ready to move into procurement on the V-22 to perform a very narrow mission that I think can be performed . . . by using helicopters instead of the V-22."[25] In July 1990, testifying before the Senate Appropriations Defense Subcommittee, Assistant Secretary of Defense for Program Analysis and Evaluation David Chu said, "The driving factor underlying the V-22 cancellation decision was the comparative up-front investment cost of the V-22 versus an alternative force of helicopters . . . judged capable of performing [Marine Corps assault and Navy search and rescue missions] reasonably well."[26] In other words, the V-22 was deemed too expensive for traditional Marine Corps operations ferrying troops and equipment the relatively short distances from amphibious ships to shore.

But the Marine Corps (and Congress) resisted the recommendation to eliminate the V-22 and make do with lower-cost helicopters to accomplish the same missions. Instead, the Marine Corps developed the doctrine of operational maneuver from the sea, which—at least in part—seems to conveniently justify the need for the V-22.

Finally, there is the even larger policy issue assumed by OMFTS: "To influence events overseas, America requires a credible, forwardly deployable, power projection capability"[27] (which is a basis for needing the V-22). The requirement for forward deployment and power projection is primarily based on the premise that the United States must be the world's policeman because international disorder threatens American security. Indeed, one justification given for the V-22 is that "the world has changed. Expanding international trade and *humanitarian efforts* have more Americans living abroad. Protecting their lives . . . is an increasingly dangerous world is a serious challenge."[28] And according to the Congressional Budget Office: "Cutting V-22 purchases might decrease the Corps's ability to perform *peacekeeping missions* and other smaller-scale contingency operations, which have grown more frequent in recent years."[29]

Alternatively, the United States could adopt a strategy of noninterventionism—"described variously as minimalist realism, offshore balancer, and balancer of last resort"[30]—that avoids promiscuous military intervention. Such a strategy—by eliminating or reducing such missions—would reduce or obviate the need for the V-22.

V-22s vs. Helicopters

Advocates of the V-22 argue that the tiltrotor aircraft will combine the operational flexibility of a helicopter with the capabilities of an airplane.[31] They cite greater speed, range, payload capability, and the ability to self-deploy. And the Bell/Boeing contractor team claims the V-22 is up to 21 times less vulnerable to small arms fire than helicopters, is 75 percent quieter than helicopters, and has NBC warfare protection.

Speed

Supporters of the V-22 claim that it is twice as fast as a helicopter.[32] The maximum

speed of the V-22 is 275 knots. The maximum speed of the CH-46 that the V-22 is intended to replace is 145 knots. The CH-60 helicopter, which is a replacement for the CH-46, has a top speed of 180 knots, reducing the V-22's speed advantage (about 50 percent faster than the CH-60). And the CH-53—which is another helicopter slated to be replaced by the V-22—has a top speed of 160 knots (making the V-22 just over 70 percent faster than the CH-53). But if the V-22 has to carry cargo on an external hook, it must keep its rotors upright and fly in helicopter rather than airplane mode, thus eliminating most of its speed advantages over helicopters.[33]

Range

Osprey supporters claim that the V-22's range is five times that of a helicopter.[34] The V-22's range for amphibious assault missions is 515 nautical miles. This is slightly less than four times the range of the CH-46, which has a range of 132 nautical miles for the same mission. The V-22's range advantage over the CH-60 is less pronounced—515 nautical miles vs. 380 nautical miles, or about 1.4 times greater. And the V-22 has no advantage over the CH-53, which has a range of 578 nautical miles.

One advantage the V-22 does have over most helicopters is an in-flight aerial refueling capability that makes its range almost unlimited.[35] But the CH-60 helicopter can be fitted with auxiliary fuel tanks to extend its range[36] and also has aerial refueling for nearly unlimited range.

Payload

V-22 supporters claim that it can carry three times more payload than a helicopter.[37] Maximum internal load for the V-22 is 10,000 pounds.[38] The maximum cargo capability of the CH-46 is 5,000 pounds; that of the CH-60 is 4,000 pounds,[39] and that of the CH-53 is 8,000 pounds. At best, the V-22 can carry 2.5 times more than a comparable helicopter and, at worst, only 25 percent more.

The V-22 is supposed to be able to carry 24 combat-ready Marines.[40] The CH-46 can also carry 24 troops; the CH-60 carries fewer troops than either the V-22 or the CH-46 (13 troops);[41] and the CH-53 can carry more than all the others (37 troops). So this measure of payload capability does not substantiate the claim that the V-22 can carry three times more payload than a helicopter.

The one area in which the Osprey may have a payload advantage (but not quantifiable as three times greater) is its demonstrated ability to carry a 10,000-pound external load (using a single cargo hook) at 230 knots.[42] The CH-60 can carry a 9,000-pound external load, but at much slower speeds (40–45 knots).[43]

Survivability

Another area in which the V-22 supposedly outshines helicopters is survivability. Certainly, while flying as an airplane, the V-22 is faster and a harder target to hit than are slower helicopters. So at least while going to and from the landing zone, the V-22 should be less vulnerable. But the biggest danger is in the landing zone itself. Because the V-22 will use vertical flight mode (like a helicopter) to take off and land, it would be just as vulnerable as helicopters while in takeoff or landing modes.

The V-22 is supposed to be more resistant to small arms fire and thus more survivable. But that does not mean that helicopters can be easily shot down with small arms. Indeed, the CH-60 (one alternative to the V-22) will be fitted with self-sealing fuel tanks capable of withstanding 7.62 mm rounds.[44] And the real threat from the ground is not so much from small arms fire as from rockets—often fired from portable launchers that can be carried and fired by a single person—such as the one-shot disposable Light Anti-Tank Weapon, the AT4,[45] the RPG-18, or the reusable Shoulder Launched Multipurpose Assault Weapon or RPG-7.[46] While flying vertically in the landing zone, the V-22 and helicopters would be equally vulnerable to rockets.

Another claimed survivability advantage of the V-22 is that it is supposed to provide NBC protection. But it has been reported

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that the NBC protection unique to the V-22—overpressure and filtration systems—will be dropped because it is considered too difficult and expensive to accomplish.[47] Instead, troops aboard the V-22 will wear special suits for NBC protection, which they could presumably wear on helicopters as well.

Most important, if a helicopter loses engine power (e.g., the engine fails or is shot out by hostile fire), it can still safely land by using autorotation (analogous to "gliding" without engine power for a fixed-wing aircraft).[48] But this operational requirement for all other Navy helicopters was waived for the V-22, largely because it cannot autorotate. Elaine Grossman of *Inside Defense* reported of the V-22 that "should a pilot lose engine power and try to restart it, 'autorotation descent cannot be maintained,' [quotation from GAO report] which could ostensibly lead to a crash."[49] In this respect, the V-22 may actually be less survivable than helicopters.

Vortex Ring State

Related to the V-22's inability to autorotate is a phenomenon known as vortex ring state or VRS (sometimes also called "power settling"). When rotary aircraft hover or descend, the rotor exerts a downward force and flow of air. VRS occurs when a secondary vortex is created (usually brought on by low forward airspeeds and high rates of descent) that exerts an upward force and flow of air above the rotor. The result is an unsteady flow of turbulent air over the rotor that causes a loss of rotor efficiency even though it is still being powered by the engine.[50] An analogous situation for a conventional aircraft is when it stalls as a result of insufficient forward airspeed or too steep an angle of climb.

All rotary aircraft are subject to the effects of VRS, but the V-22's unique side-by-side rotor configuration appears to make it easier for this catastrophic condition to occur. The crash of a V-22 during a training mission on April 8, 2000, which killed the 4 crewmembers and 15 Marines on board, was attributed to VRS.

According to former director of operational test and evaluation for the Pentagon, Phillip Coyle:

> In the tilt-rotor V-22, the onset of VRS can occur in the proprotor on one side without the other side losing lift. In such a case, the aircraft tends to roll sharply into the side that first loses lift, resulting in large, unexpected bank angles, followed immediately by rapid dropping of the nose of the aircraft and a steep dive. At low altitudes, there may be no opportunity for recovery.[51]

VRS is a fundamental technical characteristic that cannot be remedied by design changes. The only real solution is to restrict V-22 operations to avoid VRS (that is, to descend at lower rates of speed). The specified descent rate for the V-22 to avoid VRS is 800 feet per minute (fpm) at 40 knots. Modern helicopters can descend at rates more than twice as fast. And as one V-22 critic points out, "While that [800 fpm] would be adequate for a commercial operation, it's far short of what the military needs—several thousand feet per minute—during tactical insertions."[52] In this respect, the V-22 might actually be more vulnerable to hostile fire than are traditional helicopters.

The problem, according to Coyle, is that "should a pilot inadvertently exceed published limitations, there may be no easily recognizable warning that the aircraft is nearing the danger zone."[53] Making the problem worse is the fact that normal pilot control inputs may not be able to counter the rolling brought on by entering the VRS region. Therefore, the roll will simply continue, and, at low altitude, the result will be a catastrophic crash.

By comparison, VRS occurrences with helicopters are extremely rare. And according to the Navy Judge Advocate General's report after the April 2000 V-22 crash that killed 19 soldiers:

> In traditional rotorcraft, power settling would cause uncommanded rates of descent and, depending on altitude, may result in a hard landing or quite possibly a controlled crash. In all likelihood, however, such an event

would result in the aircraft at least hitting the ground in an upright attitude. In this respect, with regard to Vortex Ring State and/or Blade Stall, the MV-22 appears to be less forgiving than conventional helicopters.[54]

The V-22 Is Only Marginally Better Than Helicopters

In the final analysis, the increased capabilities over helicopters promised by the V-22 are marginal. Performance differences in speed, range, and payload are, for the most part, unimportant if the Marine Corps' OMFTS requirement—operating from over the horizon and to inland points far from shore—is eliminated. More typical landing operations will have ship-to-shore distances considerably less than the V-22's combat radius of 250 nautical miles and well within the range capabilities of existing helicopters.[55] The V-22 might have greater in-transit survivability than helicopters, but it is likely to be just as vulnerable in vertical flight mode in landing zones. And although helicopters can recover from an engine failure via autorotation, the V-22 (flying in vertical helicopter mode) cannot—gravity simply takes over. Also, the V-22 appears to be more susceptible to VRS—a phenomenon common to all rotary aircraft—which, when combined with the V-22's inability to autorotate, could have catastrophic results. Another potential problem for the V-22 is that if the rotors become stuck in the forward position (that is, while flying horizontally like an airplane), the aircraft cannot land because the rotor blades extend well below the fuselage.[56]

Helicopter alternatives that could accomplish the same missions as the V-22 include

- the CH-60—a variant of the Army's UH-60 Blackhawk helicopter—that the Navy is procuring instead of the V-22 to replace the CH-46 for transport missions;
- the CH-53, which Marines already use for heavy lift missions during amphibious assault; and
- a military version of the Sikorsky S-92 commercial helicopter, which—like the V-22—has a capacity between that of the CH-60 and the CH-53 to carry troops and equipment.[57]

Cost

To date, $12 billion has been spent on the V-22 program.[58] When the program entered FSD in 1986, the armed forces planned to build 923 aircraft, at an average cost of $24 million per aircraft.[59] The current program plan calls for building 437 Ospreys at a total cost of $37.2 billion, or more than $85 million each.[60] So less than half the number of aircraft will cost more than 3.5 times as much per aircraft.

More important, comparable helicopter capability can be purchased at a considerably lower cost. For example, the FY98 program estimate for the CH-60 was $9.1 billion for 166 helicopters, or $19 million each.[61] The 1999 firm fixed-price contract for five CH-60 helicopters was $67.4 million, or about $13.5 million apiece.[62] A Sikorsky S-92 has an estimated civilian market price of $15 million.[63] And even though the S-92 is not built under military contract or with government subsidy, it is designed to be used by the military as an off-the-shelf acquisition alternative.[64]

Given the less than stellar success of the V-22 program to date, the marginal gains in speed, range, and payload do not seem worth the high costs and risks associated with the program—especially when there are lower-cost alternatives. Tilt-rotor technology may eventually prove viable, but it makes no sense to throw good money after bad. True, $12 billion in sunk costs has already been spent. But spending another $25 billion on a system that might not be needed (if the Marines scale back their risky OMFTS doctrine), that may never achieve suitable operational effectiveness and safety (VRS is an inherent problem and any potential fixes may become cost prohibitive), and that has lower-cost, proven alternatives readily available would be wasting money. And needless spending on the V-22 would mean

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lost opportunity costs to invest in other more badly needed defense programs. Indeed, the CBO has noted that canceling the V-22 program and buying conventional helicopters would save $9.6 billion over 10 years.[65]

Conclusion

That after more than 15 years and $12 billion the V-22 Osprey is still in a test mode should speak volumes about the efficacy of the program. If the V-22 was proven to be operationally effective and safe and cost only $24 million each, it might be a viable aircraft. Indeed, retired admiral Stephen Baker (who was the operational test and evaluation commander for the Navy from 1995 to 1999) has said, "If the program were not 10 years behind schedule due to developmental problems, the V-22 just might have been a major performer in Operation Enduring Freedom."[66] But tilt-rotor technology has yet to be operationally proven for either military or civilian use, and the cost of the V-22 has more than tripled. Moreover, while tilt-rotor technology itself might be "revolutionary," it doesn't offer any truly revolutionary operational capabilities for the military.

Instead of admitting that the V-22 program has failed and using the money to buy proven helicopters for the same missions, the Marine Corps (with considerable help from Congress) has kept the program alive—always trying to fix various problems. But at least one problem—VRS—can never really be fixed or eliminated. And "flying around" the VRS problem by slowing the descent rate of the V-22 makes the Osprey more vulnerable than helicopters in landing zones—despite claims that the Osprey is more survivable.

Also, Bell/Boeing is using the V-22 as a way to subsidize commercial tilt-rotor research and development at considerable taxpayer expense.[67] This subsidy was apparent when Bell Helicopter president John Murphey announced that the civilian BA609 would be put on indefinite hold and said, "The V-22 must lead tilt-rotor technology into the marketplace."[68] But it is not the government's responsibility to pay for research and development and assume risks so that companies can make a profit in the commercial marketplace. If Bell/Boeing (or other manufacturers) thinks there is a commercial market for tilt-rotor aircraft, then they need to make their own capital investment based on the risk and return on that investment.

Despite the considerable time and money invested, the V-22 Osprey is still nowhere near ready to be operationally deployed. Although the Marines claim that the V-22 is not a case of blind love,[69] they cannot close their eyes to the fact that the same missions can be accomplished with less-expensive helicopters. The hard truth is that the V-22 Osprey is an albatross around the necks of the Pentagon and taxpayers. It's time to cut it loose.

That after more than 15 years and $12 billion the V-22 Osprey is still in a test mode should speak volumes about the efficacy of the program.

Notes

1. Jim Courter and Loren Thompson, "V-22 Versatility Argues for Faster Production," Lexington Institute Issue Brief, December 14, 1998, www.lexingtoninstitute.org/defense/v22ib.htm.

2. "[T]he Osprey is among dozens of programs Defense Secretary Rumsfeld has ordered reviewed for possible cuts or cancellation as early as this fall." Richard Whittle, "Air Force Begins Flight Testing of Its Version of V-22," *Dallas Morning News*, September 17, 2002, p. 1D. See also Thom Shanker and James Dao, "Defense Secretary Wants Cuts in Weapons Systems to Pay for New Technologies," *New York Times*, April 16, 2002, www.nytimes.com/2002/04/16/national/16BUDG.html.

3. Thom Shanker, "Military Spending Proposals Envision Changing Battlefield," *New York Times*, November 22, 2002, www.nytimes.com/2002/11/22/politics/22DEFE.html.

4. Jay Hendrickson, "Platt-LePage Aircraft Co.," Helicopter History Site, www.helis.com/pioneers/f_plp.htm (accessed November 15, 2002).

5. "XV-3," GlobalSecurity.org, updated October 21, 2001, www.globalsecurity.org/military/systems/aircraft/xv-3.htm.

6. NASA Ames Research Center, "XV-15 Tilt-Rotor Research Aircraft," updated November 30, 2001, www.simlabs.arc.nasa.gov/library/tiltrotor/ctr20th.html#Background.

7. Primary sources for this history are Christopher Bolkcom, "V-22 Osprey Tilt-Rotor Aircraft," Congressional Research Service Issue Brief for Congress IB86103, updated November 5, 2001; and U.S. Department of Defense, *Report of the Panel to Review the V-22 Program*, April 2001.

8. Ibid., p. 75.

9. "The Osprey program was central to viability of a civil tilt-rotor commuter aircraft. The military program had to come first so that commercial operators had the confidence that a large tilt-rotor would be safe, reliable and efficient." David Godfrey, "Transitional Flight," Bell Helicopter website, www.bellhelicopter.textron.com/content/products/HelicopterMag/transFlight.html (accessed November 15, 2002); article originally appeared in *Helicopters Magazine Canada*.

10. Bill Wagstaff, "Bell Shelves Civilian Tilt-Rotor Indefinitely," April 2002, www.ainonline.com/issues/04_02/04_02_bellshelvespg1.html.

11. The CH-46 was first procured in 1964 to meet Marine Corps' requirements for medium lift capability in Vietnam.

12. "CH-46D/E Sea Knight," United States Navy Fact File, updated February 12, 2002, www.chinfo.navy.mil/navpalib/factfile/aircraft/air-ch46.html.

13. Note that the 10,000-hour service life was only for planning purposes and not based on a fatigue test of the airframe to determine exactly how many hours a CH-46 can be safely used for operational purposes. In all likelihood, the service life of a CH-46 exceeds the 10,000-hour specification. "Evaluation of the CH-46 airframe fatigue analysis, fatigue test results, and in-service experience data indicates the CH-46 airframe can be safely operated beyond 10,000 hours. . . . Some civilian operators have logged over 25,000 hours on the BV-107 [civilian version of CH-46]." Maj. Kenneth D. Bonner, USMC, "Use of and Future of the CH-46 Assault Helicopter in the United States Marine Corps," 1990, www.globalsecurity.org/military/library/report/1990/BKD.htm.

14. Gen. Alfred M. Gray, then-commandant of the Marine Corps, Testimony at hearing of the House Armed Services Committee, February 20, 1990, quoted in Bonner.

15. There is no exact specification for or definition of "medium lift," but it can best be described as the ability to carry troops and cargo with a total payload capability of approximately 10,000 pounds.

16. U.S. Department of Defense, *Report of the Panel to Review the V-22 Program*, p. 10.

17. "CH-60 Description," Naval Supply Systems Command: Naval Inventory Control Point, updated April 14, 2000, www.navicp.navy.mil/03/0320/ch60.htm; and "SH-60 Seahawk," United States Navy Fact File, updated November 10, 2002, www.chinfo.navy.mil/navpalib/factfile/aircraft/air-sh60.html.

18. Ibid.

19. Bolkcom, p. 1.

20. Gen. Charles C. Krulak, commandant of the Marine Corps, "Operational Maneuver from the Sea: A Concept Paper for the Projection of Naval Power Ashore," p. 12, www.dtic.mil/jv2010/usmc/omfts.pdf (accessed November 15, 2002).

21. U.S. Marine Corps, *Ground Combat Operations*, updated February 10, 1997, pp. 4–5, http://web.mit.edu/afs/zone/user/jlwfnord/Tactics/ed6ch4.pdf.

22. Sydney J. Freedberg Jr., "It's a Bird, It's a Plane. . . ," *National Journal*, March 25, 2000, p. 979.

23. Ivan Eland, *Putting "Defense" Back into U.S. Defense Policy* (Westport, Conn.: Praeger, 2001), p. 145.

24. Ibid.

25. Quoted in Bolkcom, p. 3.

26. Bert H. Cooper Jr., "V-22 Osprey Tilt-Rotor Aircraft," Congressional Research Service Issue Brief for Congress 86103, updated December 6, 1996, www.fas.org/man/crs/86-103.htm.

27. Krulak, p. 2.

28. Capt. Landon R. Hutchens II, USMC, "Marine Sounds Off on V-22 Osprey," editorial, *Osprey Facts* 12, no. 6 (July 2001), reprint of letter to the editor, *St. Louis Post-Dispatch*, June 4, 2001. Emphasis added.

29. Congressional Budget Office, *Budget Options 2001*, February 2001, p. 142, ftp://ftp.cbo.gov/27xx/doc2731/ENTIRE-REPORT.PDF. Emphasis added.

30. Ted Galen Carpenter, *Peace & Freedom: Foreign Policy for a Constitutional Republic* (Washington: Cato Institute, 2002), p. 11.

31. Unless otherwise noted, data for comparing the V-22 with helicopters are drawn from the following sources: "V-22 Osprey," Boeing, www.boeing.com/rotorcraft/military/v22/flash.html (accessed November 15, 2002); "V22 Osprey Web," U.S. Navy NavAir, http://pma275.navair.navy.mil (accessed November 15, 2002); "CH-46D/E Sea Knight," United States

Navy Fact File, updated February 12, 2002, www.chinfo.navy.mil.navpalib/factfile/aircraft/air-ch46.html; "CH-53D Sea Stallion," United States Navy Fact File, updated May 17, 1999, www.chinfo.navy.mil.navpalib/factfile/aircraft/air-ch53d.html; and "SH-60 Seahawk," United States Navy Fact File, updated November 12, 2002, www.chinfo.navy.mil.navpalib/factfile/aircraft/air-sh-60.html.

32. See for example, "V-22 Osprey: Missions/Requirements," GlobalSecurity.org, updated November 8, 2001, www.globalsecurity.org/military/systems/aircraft/v-22-mission_req.htm; "Osprey or Albatross? Should the V-22 Tiltrotor Aircraft Fly or Die?" Cato Institute Policy Forum, May 11, 2002, p. 6, www.cato.org/events/transcripts/010511et.pdf; Hutchens; and Bolkcom, p. 8.

33. The V-22's speed in helicopter mode is 185 knots; see "Bell/Boeing V-22 Osprey," Helicopter History Site, www.helis.com/Since80s/h_v22.htm (accessed November 15, 2002).

34. See "V-22 Osprey: Missions/Requirements"; and Bolkcom, p. 8.

35. Specified maximum range for the V-22 is 2,100 nautical miles. "V-22 Osprey."

36. The UH-60 Blackhawk, which is the basis for the CH-60, "can carry external fuel tanks that can extend the Blackhawk range up to 1,150 nautical miles." "UH-60 Blackhawk," FAS Military Analysis Network, updated April 23, 2000, www.fas.org/man/dod-101/sys/ac/uh-60.htm.

37. See "V-22 Osprey: Missions/Requirements"; and Bolkcom, p. 8.

38. "V-22 Osprey," U.S. Naval Institute Military Database, updated January 1, 1998, www.periscope1.com/demo/weapons/aircraft/rotary/w0004388.html.

39. "CH-60 Description." Note that "SH-60 Seahawk" states that "the Army's UH-60L Black Hawk can carry . . . 2,600 pounds (1,170 kg) of cargo."

40. The U.S. General Accounting Office, however, has raised concerns about the V-22's ability to carry 24 combat Marines and their equipment. U.S. General Accounting Office, "Presentation to the V-22 Blue Ribbon Panel," January 12, 2001, p. 18, www.gao.gov/new.items/d01369r.pdf. One critic claims that the V-22's cargo compartment is almost four feet shorter than the CH-46's. Carlton Meyer, "The V-22 Fiasco," G2mil.com, www.g2mil.com/v-22.htm (accessed November 15, 2002).

41. "CH-60 Description."

42. Bolkcom, p. 4. Note that, using dual cargo hooks, the V-22 can carry a 15,000-pound external load.

43. "CH-60 Description."

44. "CH-60S/MH-60S Knighthawk," GlobalSecurity.org, updated April 10, 2002, www.globalsecurity.org/military/systems/aircraft/ch-60.htm.

45. At least one fully functional example of this weapon was for sale on the Internet at www.gunsamerica.com/guns/976239627.htm (accessed November 15, 2002).

46. During the fighting in Mogadishu, Somalia, in October 1994, the two U.S. Army Blackhawk helicopters that were shot down were reached with RPG rocket launchers. Lester W. Grau, "A Weapon for All Seasons: The Old but Effective RPG-7 Promises to Haunt the Battlefields of Tomorrow," http://fmso.leavenworth.army.mil/fmsopubs/issues/weapon.htm (accessed November 15, 2002), originally appeared as "The RPG-7 on the Battlefields of Today and Tomorrow," *Infantry*, May–August 1998. Grau wrote for the Foreign Military Studies Office, which provides direct support to the senior U.S. Army and Department of Defense leadership and general support to the U.S. Army Combined Arms Center: "It [the RPG-7] is relatively cheap, quite effective and found everywhere. The RPG-7 was adopted by the Soviet Armed Forces in 1961. Today, it is part of the TO&E [table of organization and equipment, which prescribes the organizational structure and equipment of military units] of over 40 different countries' armies and several of these countries, besides Russia, are licensed to build their own. Other manufacturers include Bulgaria, China, Iran, Iraq, Romania and Pakistan."

47. Christopher J. Castelli, "V-22 Program Cancels Plans for Two Chem-Bio Protective Features," *InsideDefense.com*, October 22, 2001, www.insidedefense.com/public/special.asp.

48. For a more complete explanation of helicopter autorotation, see Rey Madrid, "Helicopter Aerodynamics for the Layperson," Vertical Reference, www.verticalreference.com/vertical_reference_helo_aero_by_Rey3.htm (accessed November 15, 2002); and Mick Spiers, "What Happens When a Helicopter's Engine Fails?" Helicopter History Site, www.helis.com/howflies/autorot.htm (accessed November 15, 2002).

49. Elaine M. Grossman, "GAO Sounds Alarm on Osprey Waiver for 'Autorotation,' Other Tests," *InsideDefense.com*, February 1, 2001, www.insidedefense.com/public/special15.asp.

50. For a more detailed explanation of vortex ring state, see Paul Cantrell, "Settling with Power,"

Helicopter Aviation Home Page, www.copters.com/aero/settling.html (accessed November 15, 2002); and "V-22 Osprey: Vortex Ring State (VRS)," GlobalSecurity.org, updated August 9, 2002, www.globalsecurity.org/military/systems/aircraft/v-22-vrs.htm.

51. Quoted in U.S. General Accounting Office, p. 31.

52. Carlton Meyer, "Keeping the V-22 Alive," G2mil, www.g2mil.com/v-22alive.htm (accessed November 15, 2002), quoting an article in *Armed Forces Journal*, February 2002. Meyer also points out that to avoid the VRS region, "the V-22's NATOPS (operating manual) used by ALL pilots of the V-22 clearly states on Page 1-4-13, WARNING 'Air Combat Maneuvering and Aerobatics are PROHIBITED.' This is a simple and direct mandate." It would seem obvious, however, that a combat aircraft such as the V-22 should be able to perform air combat maneuvers in order to perform its missions and ensure the survivability of the aircraft and crew.

53. Ibid.

54. Ibid., p. 28.

55. A more typical ferry distance for a Marine amphibious assault from ship to shore is 50 nautical miles.

56. Presumably, the V-22 could crash land on water in such a situation.

57. Congressional Budget Office, p. 142.

58. Council for a Livable World, "V-22 Osprey: Technical Flaws Should Call for Cancellation, Not Delay," press release, April 18, 2001, www.clw.org/milspend/ospreycancel.html; and Taxpayers for Common Sense, "Bailout Watch," June 7, 2002, www.bailoutwatch.org/defense.org.

59. Center for Defense Information, "U.S. Military Transformation: Not Just More Spending, But Better Spending," January 31, 2002, www.cdi.org/mrp/transformation.cfm.

60. U.S. Department of Defense, OUSD(AT&L) AR&A/AM, "Selected Acquisition Report (SAR) Summary Tables," November 14, 2001, p. 3, www.acq.osd.mil/ara/am/sar/SARST0901.pdf.

61. "CH-60 Fleet Combat Support Helicopter," GlobalSecurity.org, www.globalsecurity.org/military/library/budget/fy1998/dot-e/navy/98ch60combat.html (accessed November 15, 2002), excerpted from Director, Operational Test and Evaluation, *FY98 Annual Report*.

62. "Sikorsky Back in U.S. Navy Production with CH-60S," October 25, 1999, Helicopter History Site, www.helis.com/news/1999/h60cs.htm.

63. Ron Bower, "Flying the Friendly Giant," *Aviation Today: Rotor & Wing*, February 2001, www.aviationtoday.com/reports/rotorwing/previous/0201/0201s92.htm.

64. Ibid. For example, the S-92 meets military standards for electronics compatibility, making it easy to integrate military avionics into the S-92 without incurring the added costs of built-in special avionics and electronics packages.

65. Congressional Budget Office, p. 142.

66. Rear Adm. (ret.) Stephen H. Baker, "The V-22 Osprey: It's Time for Realistic Testing," *Defense Week*, April 29, 2002.

67. "All threw up their hands in frustration when their military R&D money dried up." "Bell Agusta: BA609," AINOnline.com, www.ainonline.com/Features/newrotorcraft02/ba609.html (accessed November 15, 2002).

68. Quoted in Wagstaff.

69. Linda de France, "Marine Commandant Insists Love of V-22 Is Not Blind," *Aerospace Daily*, March 15, 2001, p. 403.

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