FROM THE PAST TO THE FUTURE OF HEAVY LIFT PART THREE: HEAVY LIFT HELICOPTERS

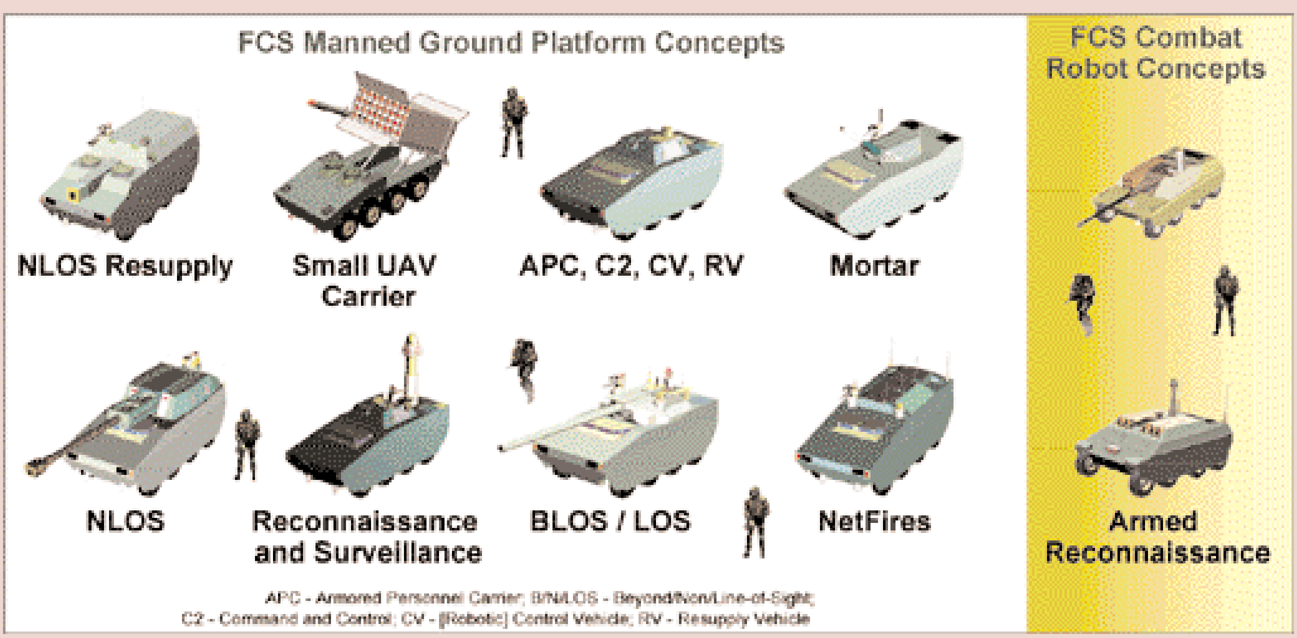
by Mike Hirschberg, Managing Editor

Introduction

As discussed in the previous two issues, the Department of Defense vision for heavy lift in the 21st Century is the Joint Common Lift (JCL) rotorcraft. The Army, expected to be the largest customer, had been pursuing this vision with a concept dubbed the Future Transport Rotorcraft (FTR). Recent announcements by the Army, however, indicate that they are no longer conducting any meaningful near-term effort toward their concept. Despite the overwhelming demonstrations in Afghanistan of the need for combining heavy lift with vertical capability, the Army (as well as the other services) is instead increasing funding for unmanned systems.

Nothing would be more "transformational" (the buzzword of the Rumsfeld Defense Department), however, than the heavy lift concepts being considered to meet the notional performance goals of the JCL mission. These include the Bell-Boeing Quad TiltRotor (QTR), the Boeing Advanced Theater Transport (ATT), and an enhanced version of the Sikorsky CH-53E. Other concepts, such as compound helicopters and stopped rotor designs, are also being evaluated.

One of the design drivers of the FTR is to deliver the Army's Future Combat Systems (FCS) vehicles – the medium ground forces with which the Army hopes to augment its 70 ton M1A2 Abrams tanks. The FCS vehicles are seen as being in the 16-20 ton range and capable of fitting in a C-130-sized fuselage. By distributing the sensors and weaponry onto smaller, FCS vehicles networked together, US forces could arrive in theater much more quickly with a dramatically smaller logistics tail. Boeing and Science Applications International Corporation (SAIC) were awarded a $154 million Army/Defense Advanced Research Projects Agency (DARPA) contract in March 2002 as the lead systems integrator to conduct the Concept and Technology Development for these vehicles. An FTR that could deliver the FCS vehicles vertically, or at least on extremely short, unprepared surfaces, would revolutionize future conflicts. The Vice Chief of Staff of the Army recently said that the need for vertical envelopment was critical in order to meet the Army's goal to move a brigade anywhere in the world in 96 hours. There are simply not enough large runways and airports



Boeing-SAIC FCS platform concepts

available to accommodate conventional fixed wing transports.

Although the general goals are not requirements, the following parameters are thought to be in the range for JCL/FTR: a payload of 10 – 20 tons (high altitude/hot day conditions), a range of 600 – 2100 nm, and a speed of 175 – 300 kt. Obviously, these are very broad, and don't include many important drivers such as cost (development, production, or operations and support). Each of the concepts currently under consideration has areas where they excel over the others.

In an effort to put these concepts into context, *Vertiflite* has been featuring a series of retrospective looks at the historical work on similar programs in the past. This final part of the series will focus on heavy lift helicopters – past, present and future. In a break from our tradition of avoiding company-written articles, we have included the latest information directly from the companies themselves. Once the impressive capability of each of the concepts becomes publicized, we hope this will help further the dialog on how best to fill the JCL requirements of the US and allied armed forces. The three main concepts under consideration are summarized below.

Bell-Boeing QTR

Boeing ATT

The Bell-Boeing QTR

The Bell-Boeing Quad TiltRotor concept seeks to capitalize on V-22 investments by using V-22 propulsion and support systems: engines, rotor systems, drive train, transmission, hydraulics, electronics, and generators, as well as much of the wing structure. The QTR fuselage would be the size of a C-130 Hercules transport, and could transport a wide assortment of loads: an FCS vehicle, eight 463L pallets, 90 passengers, 70 stretchers, a helicopter as large as an AH-64 Apache, a 155 mm howitzer, or three HMMWVs.

The QTR would be able to deliver cargo from airfields and port facilities directly to ground maneuver units and to ships at sea, needing as little as ½ acre to land. The QTR would allow a practical means to transport up to 30,000 lb externally or 40,000 lb internally far from shore bases. With twice the propulsion system of the V-22, the QTR could hover at over 100,000 lb and have a maximum weight of 140,000 lb; internal volume would be 6-8 times that of the V-22. Maximum unrefueled range would be 2,000 nm and it could cruise at 280 kt. However, in order to conduct the JCL mission – vertical take-off at high/hot conditions with a 20 ton FCS and deliver it 1000 km away with 20 minute reserves – increases in rotor lift, and transmission and engine power would be required.

The Boeing ATT

The Boeing Advanced Theater Transport (ATT) tiltwing concept being designed in response to the JCL/FTR mission has a payload capability of 80,000 lb operating from a 750 ft airfield in austere (sea level) conditions. This would permit the transportation of two of the nominally 20 ton FCS vehicles, a 25 ton Bradley Fighting Vehicle, or other similarly sized loads.

Although not capable of hover, vertical take-off, or vertical landing, the extremely short take-off and landing ATT is capable of high speed (350 kt) delivery of tremendous amounts of weapons, fuel, supplies, or other cargo, over great distances without refueling, directly to the theater. Although not a rotorcraft, it could be a strong contender for the Joint Common Lift/Future Transport Rotorcraft mission. Although not capable of vertical lift, it could fulfill many of the missions that are currently envisioned for vertical lift aircraft.

The Sikorsky Enhanced SLEP CH-53E

At the AHS-led International Powered Lift Conference in October 2000, Sikorsky's Jim Garman called their concept for the JCL, the CH-53X Future Stallion, "An Affordable Solution to Heavy Lift". Using the KC-130/V-22 engine, a modern (V-22 or UH-1Y) cockpit, improved main rotor blades and rotor head, and improved external cargo handling, it was seen as a way to capitalize on the inherent CH-53E platform, with a minimal investment; even the existing drivetrain could be used. A 25% reduction in operations and support costs was seen as possible through reliability improvements in the rotor head assembly, rotor blades, and the engines. A 200 nm radius with a 14 ton payload was seen as possible in high altitude/hot day conditions, tripling the radius over the CH-53E. A further doubling of the radius could be achieved by using advanced engine technologies – such as a being developed under the Joint Turbine Advanced Gas Generator (JTAGG) program – in a new purpose-designed engine.

In this issue's article by Mr. Garman, the same capabilities are advocated, but with a more conservative moniker: the enhanced Service Life Extension Program (SLEP) CH-53E.

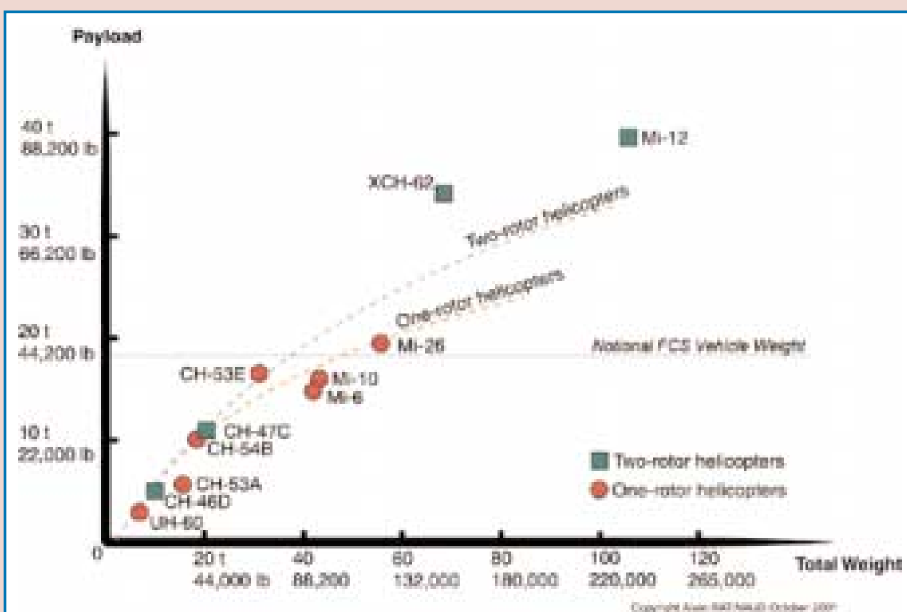
Mr. Garman's article is accompanied by historical discussions of the H-53, the Boeing XCH-62 Heavy Lift Helicopter, and Russian heavy lift helicopters. From the historical graph, we can see that vertical lift in the JCL payload range of 20,000-40,000 lb and higher has been shown to be achievable with pure helicopters, but achieving the desired JCL speed and range obviously has not. It should also be noted that these figures are for standard sea level conditions. The Army high/hot requirements significantly reduce the lift capabilities of any heavy lift aircraft (see, for example, Marat Tishchenko's article, "Could The Mi-26 Perform The JTR Functions?", Vertiflite, Summer 2000). Finally, it should be noted that these maximum payloads are typically accomplished as external loads due to the limited cabin volume. The larger, higher performance solutions to JCL would be able to carry the FCS payload, for instance, internally, with the speed and other advantages that this affords.

Sikorsky CH-53E

JCL vs. FTR

The US military services identified a need for heavy lift V/STOL capability, as detailed in two Joint Staff-led studies and approved by the Joint Requirements Oversight Council (JROC). These two studies, the 1998 Joint Advanced Rotorcraft Technology (JART) Study and the Overarching Rotorcraft Commonality Assessment (ORCA) concluded in 2000, determined that the prospects for a single-service new start in any rotorcraft, but particularly in the potentially more costly heavy lift category, was virtually nil.

The Army, having the potential requirement for the largest number of JCL rotorcraft, envisions a concept it has dubbed the Future Transport Rotorcraft. While not wholly endorsed by the other services, FTR may be (one of) the aircraft that fills the JCL mission. If the Army tried to go it alone with the FTR, the Marine Corps would



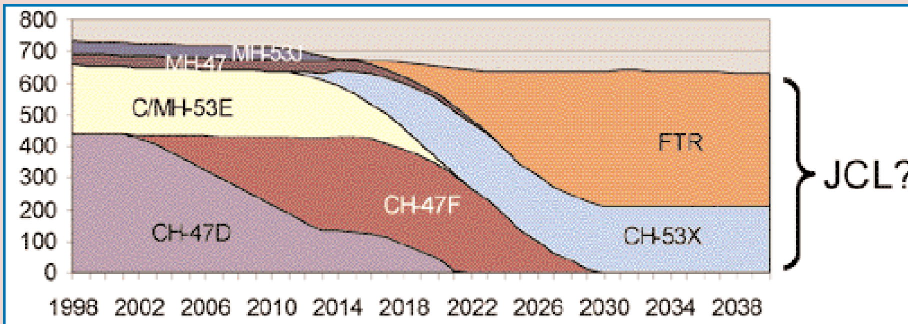
Comparison of historical heavy lift helicopters (H-46 and H-60 shown for reference) likely develop an upgrade, enhancement or replacement for the CH-53E. A Joint Common Lift solution, however, would satisfy the requirements of both of these platforms. It appears that the basic requirements within the Army and the Marine Corps will coalesce as the Army transitions to the interim armored vehicle and the Future Combat System.

The Army's chief scientist and deputy assistant secretary for research and technology has said that the FTR was an affordability issue for the Army. This has been one of the justifications for the Army's recent lack of support of the FTR. Looking at the cost spike shown in the graph, it is hard to disagree. The cost of individual service programs, such as FTR and a CH-53E replacement, would be untenable. The service rotorcraft modernization costs could spike to nearly $4B in 2024. What is often overlooked, however, is that the cost avoidance of a joint rotorcraft versus single service designs could be over $9B.

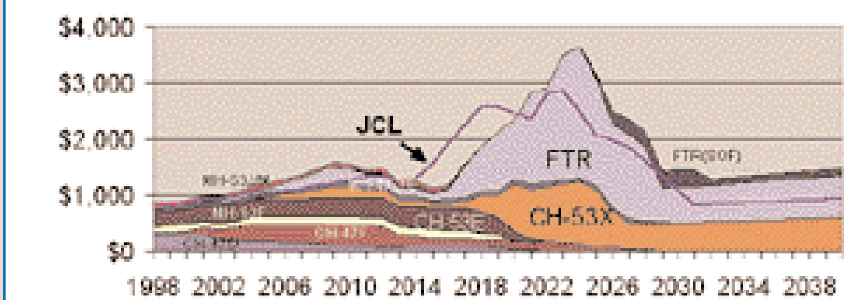
Summary

This series has explored the current configurations under consideration for the JCL/FTR mission needs, as well as review the relevant historical V/STOL development programs that may provide technical insights or lessons learned for these future concepts. Each of the JCL/FTR designs that has been highlighted in this series has a different approach, each with different performance and cost advantages. Looking at only the data that has been presented in this series, one could come up with a comparison as shown in the table.

It is easy to see how the capabilities discussed here could transform the way battles are fought in the 21st Century. Now the services must come together and pool their resources and decide the future of heavy lift. We hope this series will help to shape the dialog.



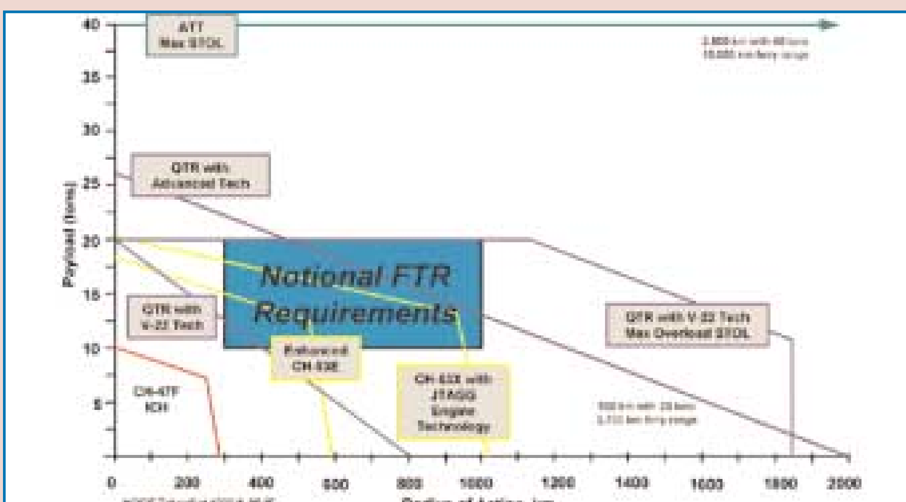
Projected DOD heavy lift inventory with FTR and CH-53X or JCL



Comparison of DOD costs (in millions) with a JCL or FTR and CH-53X

	ATT	QTR	Enhanced CH-53E
Max Speed	**High** 350 kt	**Medium** 280 kt+	**Low** 170 kt
Max Payload*	**High** 40 tons	**Medium** 20 tons	**Low** 18 tons
Max Range*	**High** 3000 nm	**Medium** 800 nm	**Low** 600 nm
Cost	**High**	**Medium**	**Low**
Hover	**No**	**Yes**	**Yes**

*Data shown are with existing technology engines for HOGE take-off (for QTR and CH-53) at high/hot conditions.



Performance comparison of candidate concepts to notional JCL requirements