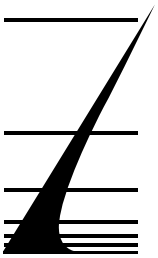
The Market for Aviation Turboshaft Engines

Product Code #F642

A Special Focused Market Segment Analysis by:



FORECAST INTERNATIONAL

Analysis 4
The Market for
Aviation Turboshaft Engines
2010-2019

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Introduction

This analysis discusses those trends influencing turboshaft engine design and production. The current and future competitive environment is also explored, in order to gain an understanding of the relationship between the market environment and engine production.

The aerospace industry tends to be cyclical, and production peaks and valleys are usually tied to world economic conditions. The current global economic slowdown has interrupted the normal cycle, creating a lower low that has pushed the recovery timeline to the right. Military engine programs are typically an exception to this up-and-down cycle; procurement normally happens over a period of several years. At the present time, military spending is accounting for a large percentage of current and future engine production.

Looking at the broader market, past performance is no guarantee of future production. However, it does show that the aircraft and engine ordering process tends to be cyclical, a fact that makes the task of predicting future events a bit less problematic.

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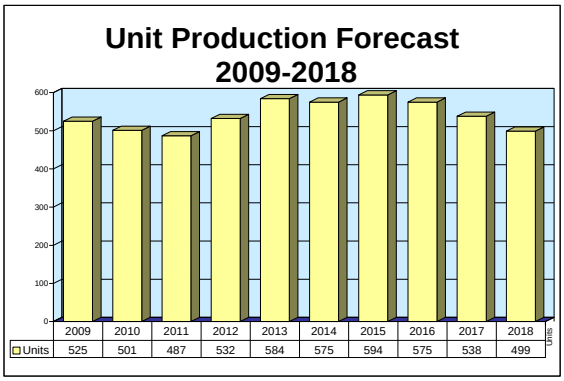
General Electric T700/CT7

Outlook

- 1,200+ Black Hawk procurement drives T700 production
- Korean Utility Helicopter is new application for T700



Orientation

Description. Twin-shaft, axial-centrifugal-flow, free-turbine aviation turboshaft engine.

Note: *This report covers the GE Aircraft Engines T700/CT7 turboshaft version only. The GE CT7 turboprop is covered in a separate report in Tab C.*

Sponsor. The GE T700 military turboshaft engine is sponsored by the U.S. Department of Defense through the U.S. Army, Aviation Systems Command, St. Louis, Missouri, USA.

Power Class. 1,690-2,600 shp (1260-1,937 kW). Growth to 3,000 shp (2,237 kW) possible.

Status. In production for several medium commercial transport helicopters, as well as military transport and attack helicopters.

Total Produced. As of the start of 2009, over 14,500 T700/CT7 aviation turboshaft engines of all variants had been produced by GE and its licensees.

Application. Medium-weight to heavyweight commercial and military helicopters. Applications include the following:

Model Variant	T-O Power Rating	Application	Units per Airframe
T700-GE-401	1,690 shp (1,260 kW)	Sikorsky SH-60B/F	2
		Kaman SH-2G Super Seasprite	2
		Bell AH-1W; Bell UH-1Y	2
T700-IHI-401	1,690 shp (1,266 kW)	Mitsubishi SH-60	2
T700-GE-401C	1,890 shp (1,409 kW)	Sikorsky HH-60J, MH-60R/S	2
		Sikorsky S-70B-2 (Australia)	2
T700-GE-700	1,622 shp (1,209 kW)	Sikorsky UH-60A	2
T700-IHI-700	1,622 shp (1,209 kW)	Mitsubishi HH-60J, UH-60J	2
T700-GE-701	1,698 shp (1,266 kW)	Boeing AH-64A	2
T700-GE-701C	1,890 shp (1,409 kW)	Boeing AH-64A/D	2
		Sikorsky UH-60L, MH-60G, MH-60K	2
T700-GE-701D	2,000 shp (1,491 kW)	Sikorsky UH-60M	2
T700/T6A; 6A1	2,200 shp (1,640 kW)	AgustaWestland EH101 MMI	3
		AgustaWestland EH101 Comorant	3
T700/T6E; 6E1	2,520 shp (1,879 kW)	NH Industries NH90	2
CT7-2	1,725 shp (1,286 kW)	Bell 214ST	2
CT7-2C	1,625 shp (1,211 kW)	Sikorsky S-70C	2
CT7-6/6A	2,000 shp (1,491 kW)	EH Industries EH101	3

General Electric T700/CT7

Model Variant	T-O Power Rating	Application	Units per Airframe
CT7-8	2,520 shp (1,879 kW)	Sikorsky S-92/H-92 Cyclone (Canada)	2
CT7 Series	2,700-3,000 shp (2,013-2,237 kW)	Sikorsky H-92	2
		AgustaWestland EH101	3
		NH Industries NH90	2

Price Range. The prices of the various GE T700/CT7 aviation turboshaft engine series, not including license-produced engines, are estimated as follows (in 2006 U.S. dollars):

- CT7-6: $700,000
- CT7-8A/E: $740,000
- CT7-8C: $760,000
- T700-401: $640,000
- T700-401C: $660,000
- T700-701C: $675,000
- T700-701D: $677,500
- T700-T6A: $700,000
- T700-T6E: $725,000

Competition. Apart from engines manufactured in the Russian Federation, Ukraine, and the People's Republic of China, GE's competition for its T700/CT7 aviation turboshaft engine series includes the Rolls-Royce Turbomeca RTM322, the Turbomeca Makila, and the Pratt & Whitney Canada PT6C/PT6T. The T700/CT7 turboshaft has growth to 3,000 shp for all applications.

Contractors

Prime

GE - Aviation	http://www.geae.com, 1000 Western Ave, Lynn, MA 01910-0001 United States, Tel: + 1 (617) 594-0100, Fax: + 1 (617) 594-4729, Prime

Subcontractor

Aerospace Industrial Development Corp (AIDC)	http://www.aidc.com.tw, No 111-X60, Lane 68, Fu-Hsing N Rd, Taichung, 40722 Taiwan, Tel: + 886 4 270 70001, Fax: + 886 4 228 42849 (Cooling Plate)
Aircraft Parts Corp	http://www.apcmfg.com, 100 Corporate Dr, Holtsville, NY 11742 United States, Tel: + 1 (631) 289-0077, Email: esandler@apcmfg.com (Starter-Generator)
Hamilton Sundstrand	http://www.hamiltonsundstrand.com, One Hamilton Rd, Windsor Locks, CT 06096-1010 United States, Tel: + 1 (860) 654-6000, Fax: + 1 (860) 654-2621, Email: hs.general@hsd.utc.com (Hydro-Mechanical Fuel Control)
Hamilton Sundstrand	http://www.hamiltonsundstrand.com, 4747 Harrison Ave, PO Box 7002, Rockford, IL 61125-7002 United States, Tel: + 1 (815) 226-6000 (Engine Air Particle Separation System)
IHI Corporation	http://www.ihi.co.jp, 2-1, Ohtemachi 2-chome, Chiyoda-ku, Tokyo, 100-8182 Japan, Tel: + 81 3 3244 5111, Fax: + 81 3 3244 5131 (Gearbox)
MRC Bearings Inc	http://www.mrcbearings.com, 402 Chandler St, Jamestown, NY 14701-3802 United States, Tel: + 1 (716) 661-2600, Fax: + 1 (716) 661-2740 (Main Shaft & Accessory Ball & Roller Bearings)
Woodward Governor Co	http://www.woodward.com, 5001 N Second St, PO Box 7001, Rockford, IL 61125-7001 United States, Tel: + 1 (815) 877-7441, Fax: + 1 (815) 639-6033 (Main Engine Control)

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General Electric T700/CT7

Technical Data

Design Features

Intake. Annular intake equipped with a fully integrated particle separator, reported to be 95 percent efficient. The separator is anti-iced, and particles are removed using a blower driven from the accessory gearbox.

Compressor. A five-stage, axial-flow compressor composed of integral forged/machined blisks (AM355 stainless) is followed by a single centrifugal compressor stage machined from an IN718 forging. Inlet guide vanes and the first two axial compressor stators are variable. Pressure ratio is 18:1 with an air mass flow of 10.0 lb/sec (4.53 kg/sec). Design speed is 43,000 rpm. Axial blade complements are as follows: 20, 22, 28, 28, and 32. Compressor case of Ti-6Al-4V. Compressor diffuser case of IN718.

Combustor. Short annular combustor. Central fuel injection facilitates use of contaminated fuel and minimizes smoke generation. Flame tube ring is machined Hastelloy X.

Gas Generator Turbine. Compressor is driven by a two-stage, air-cooled, high-pressure turbine with operating inlet temperatures in excess of 2,000°F (1,093°C). First HP turbine nozzle is cast of X-40 alloy. Stages 1 and 2 blades of Rene 125; Stage 2 vane segment of Rene 80; Stage 4 nozzle of Rene 77.

Power Turbine. Two-stage with tip-shrouded blades. Segmented power turbine nozzles. Maximum rotational output speed of 20,900 rpm. Stage 3 vane segments of Rene 77; Stage 3 and 4 blades of Rene 80.

Accessories. The free-power turbine drives a forward-mounted gearbox via the inner coaxial shaft. Controls and accessories are clustered around the gearbox and are top-mounted for accessibility and reduced vulnerability. Control functions include torque matching (within 5 percent), speed matching (within 2 percent), and over-temperature protection for the dual-engine installation. Condition monitoring and diagnostic devices. Self-contained alternator supplies electrical power. Self-contained lube tank and oil cooler, plus an additional get-home oil system to provide mist lubrication for six additional minutes of flight.

Dimensions. The GE T700/CT7 aviation turboshaft engine series has the following dimensions and weights:

	Metric Units	English Units
Length		
Basic Engine	1,193 mm	47 in
CT7-6/6A	1,224 mm	48.2 in
CT7-8	1,239 mm	48.8 in
Diameter, max	635 mm	25 in
Weight, dry		
T700-401	197.0 kg	434 lb
T700-401C	207.7 kg	458 lb
T700-700	198.0 kg	437 lb
T700-701C/D	206.8 kg	456 lb
T700-T6A	220.0 kg	485 lb
T700-T6A1	223.6 kg	493 lb
T700-T6E	240.1 kg	531 lb
T700-T6E1	260.0 kg	573 lb
CT7-2A	194.6 kg	429 lb
CT7-2D	200.5 kg	442 lb
CT7-2D1	211.4 kg	466 lb
CT7-6/6A	223.6 kg	493 lb
CT7-8	243.6 kg(a)	537 lb(a)
CT7-8A/8A5/8B/8B5/8E/8E5/8F/8F5	245.8 kg(a)	542 lb(a)

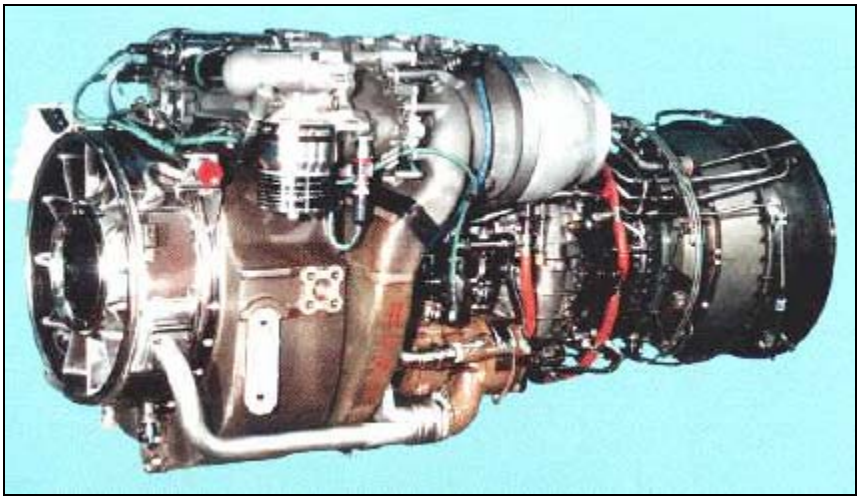
(a) Does not include cables from engine to FADEC (U.S. FAA).

General Electric T700/CT7

Performance. The following are the performance parameters of the GE T700/CT7 aviation turboshaft series, as well as U.S. FAA certification data (as of July 12, 2004):

	GE DOCUMENTATION		U.S. FAA DATA	
	Max Power at S/L	SFC @ Max Power	Normal T-O (5 min) Rating	Normal T-O (5 min) Output
T700-GE-401	1,690 shp (1,260 kW)	0.464	n/a	n/a
T700-GE-401C	1,800 shp (1,342 kW)	0.460	n/a	n/a
T700-GE-700	1,622 shp (1,209 kW)	0.465	n/a	n/a
T700-GE-701	1,698 shp (1,266 kW)	0.464	n/a	n/a
T700-GE-701A/A-1	1,723 shp (1,284 kW)	0.465	n/a	n/a
T700-GE-701C	1,890 shp (1,409 kW)	0.462	n/a	n/a
T700/T6A	2,000 shp (1,491 kW)	0.450	n/a	n/a
T700/T6A1	2,145 shp (1,599 kW)	0.445	n/a	n/a
T700/T6E	2,380 shp (1,774 kW)	0.433	n/a	n/a
T700/T6E1	2,269 shp (1,692 kW)	0.439	n/a	n/a
CT7-2A/2D/2D1	1,725 shp (1,286 kW)	0.481	1,625 shp (1,211 kW)	21,000 rpm
CT7-6/6A	2,000 shp (1,491 kW)	0.457	2,000 shp (1,491 kW)	20,463 rpm
CT7-8/8A	2,520 shp (1,879 kW)	0.450	2,520 shp (1,897 kW)	21,945 rpm
CT7-8A5	N/A	N/A	2,634 shp (1,964 kW)	21,945 rpm
CT7-8B	N/A	N/A	2,489 shp (1,856 kW)	20,900 rpm
CT7-8B5	N/A	N/A	2,609 shp (1,945 kW)	20,900 rpm
CT7-8E	N/A	N/A	2,527 shp (1,884 kW)	20,872 rpm
CT7-8E5	N/A	N/A	2,608 shp (1,944 kW)	20,872 rpm
CT7-8F	N/A	N/A	2,474 shp (1,844 kW)	20,841 rpm
CT7-8F5	N/A	N/A	2,603 shp (1,941 kW)	20,841 rpm

n/a = not applicable
N/A = Not Available.



T700

Source: GE

Variants/Upgrades

The GE Aircraft Engines T700/CT7 turboshafts are essentially the same engine; the designations refer to differences in design incorporated to meet the specific needs of each service or export customer. Variants of the T700/CT7 include the following:

T700-GE-700. The T700-GE-700 powers the U.S. Army's UH-60A and AH-64A prototype helicopters, and has a rating of 1,622 shp (1,209 kW) (intermediate). Specific fuel consumption at this

standard is 0.469 lb/shp/hr (285.3 kg/kWh). Engine weight is 437 pounds (198.2 kg).

T700-GE-701. The T700-GE-701 began flight-testing aboard an AH-64 helicopter prototype in 1982. The 1,690 shp (1,266 kW) (intermediate) version replaced the T700-700 engines. Production AH-64s incorporating this new variant demonstrate better high-altitude, hot-temperature performance than the T700-700-powered craft. The first production engine was delivered in 1983. Engine weight is 437 pounds (198 kg).

T700-GE-401. The T700-GE-401 is the U.S. Navy's engine for the SH-60B Seahawk, incorporating modifications and changes to adapt it to an ocean-operating environment. Some gas-path components are fabricated from corrosion-resistant materials, and seals and cooling systems are different from those used on the land-based version. The power increase to 1,690 shp (1,260 kW) (intermediate) comes from the higher turbine inlet temperature, improved centrifugal compressor impeller, and tighter overall clearances. While the turbine inlet temperature is notably higher, metal temperatures remain the same as for the T700-GE-700 by virtue of a new cooling scheme for the combustor and turbine sections. The first production engine was delivered in 1982. The T700-401 is used on the following: the AH-1W, the AH-1T being converted to the AH-1W standard, and the SH-2 being modified to the SH-2G standard. The engine weighs 434 pounds (198.6 kg).

T700-GE-701C/401C. The T700-GE-701C/401C models have an intermediate rating of 1,798 shp (1,340 kW); max power is 1,890 shp (1,409 kW) for the T700-701C and 1,940 shp (1,446 kW) for the T700-401C. The -701C/-401C models weigh 444 pounds (201.4 kg).

These variants are considered part of the Step 2 Growth Series (see CT7-6 entry) of the T700 for the U.S. government and for export. The T700-401C model is on contract, and initial deliveries were made to the U.S. Navy in 1988. These two engine models incorporate aerodynamic materials, and improved cooling technology has been applied to the centrifugal compressor and the HP turbine. The Royal Australian Navy was the first export customer for the T700-401C engine, having selected the engine for its S-70B-2 Seahawk. It received its first engines in 1988. Helicopters having the C variant include the Bell AH-1W, the Sikorsky SH-60B/F Seahawk and HH-60H (401C), and more recently, the Sikorsky UH-60L Black Hawk (-01C). The first T700-701Cs were shipped for the Army's Black Hawk program in 1989.

The T700-700 and -701 models are no longer in production.

T700-GE-701D. The 701D incorporates design improvements from both military and commercial technologies, including those gleaned from development of the 3,000-shp Common Engine Program engine. The engine powers the Sikorsky UH-60M, and may re-engine the Boeing AH-64D Longbow Apache. The 701D provides improved hot-section durability as well as increased shaft horsepower (1,994 shp, maximum). New higher temperature materials are incorporated in the turbine blades and nozzles, and a thermal barrier coating is added to the combustor liner. As of November 2007, GE was reportedly developing a Full Authority Digital Engine Control (FADEC) variant to be designated the T700-GE-701E to eventually power the upgraded UH-60M.

T700/T6A. The T700/T6A is an Avio (Italy) licensed-produced military variant of the CT7-6 baseline engine for the EH101 helicopter. It powers Italy's naval EH101 MMI helicopter that entered service in 2000.

In 1998, the T700/T6A1, a military version of the CT7-6, was selected to power the Canadian Search and Rescue Helicopter. The engine received final certification for use on the Canadian Comorant helicopter in 2001, replacing Canada's aging fleet of S-61 Labradors.

T700/T6E. The T700/T6E was developed by GE, Alfa-Romeo Avio (now Avio SpA), and Motoren und Turbinen Union. The engine produces up to 2,800 shp (2088 kW) emergency power for short periods. MTU left the program after the engine failed to be selected for German requirements.

The T700/T6E growth engine retains the rugged design features of its T700 predecessors, while delivering 2,500+ shp.

A FADEC system reduces pilot workload and enhances maintainability. The T6E, and the T700/T6E1 variant with an Integral Particle Separator system, power Europe's new NH90 helicopter.

The T700/T6E1 is being co-developed and will be co-produced by GE Aircraft Engines (GEAE) and Avio of Italy. Avio is responsible for 50 percent of the design and testing of the certification engines and will assemble and test the production engines for Italy's NH90 helicopters at its Brindisi plant.

In addition, production engine components will be manufactured at Avio's plants in Pomigliano d'Arco, Acerra, and Torino. Overall, Avio will produce 60 percent of the T700/T6E1 engines for the Italian

General Electric T700/CT7

NH90 and 40 percent for other T700/T6E1 markets worldwide.

The Italian Defense Administration began taking delivery of the NH90 helicopters in the fourth quarter of 2004.

CT7-2 Series. CT7 is the commercial designation for the basic T700 gas turbine. The CT7-2A incorporates fire-retarding and fireproof materials on external piping and lines, and uses other FAA-required hardware, including special fasteners and locking wires. The first CT7 was certificated by the FAA in 1977. The CT7 has also been certificated by the U.K. CAA and Italy's RAI.

The CT7-2A series provides 1,625 shp (1,211 kW) (intermediate) at a power turbine speed of 21,000 rpm. With the CT7-2A as a base model, the CT7-2D is similar to CT7-2A, but incorporates higher flow compressor and surface coatings to improve resistance to wear and corrosion.

The CT7-2D1 is similar to CT7-2D but incorporates the CT7-6/6A hot section.

CT7-6. As part of the Step 2 Growth Series, the CT7-6 is intended initially for European helicopters. This turboshaft model, rated at 2,000 shp (1,491 kW), uses the same improved centrifugal compressor and HP turbines as the T700-701C/401C. It adds the increased airflow from the CT7-9 turboprop axial compressor, as well as the improved CT7-9 LP turbine, to provide 28 percent more power than provided by the T700-700 model. The CT7-6 is fully interchangeable with existing CT7 models. The CT7-6C powers the civil EH101, and has been proposed for the civil S-92C. The former CT7-6D, now called the CT7-8 (see entry below), is proposed for the civil/military Sikorsky S-92I/U.

The CT7-6/6A is similar to CT7-9B/-9C except for the turboshaft CT7-2 family inlet and exhaust frames.

CT7-8. Civil variant of the T700/T6E (see T700/T6A/E entries above), although the CT7-8C has been named to power the military Sikorsky H-92 Superhawk. FAA and European JAA certification of the CT7-8 were granted in 2000.

The CT7-8 is similar to CT7-6 but has an increased airflow compressor, an improved durability turbine, and FADEC-based control.

The CT7-8A/8A5/8B/8B5/8E/8E5/8F/8F5 models are similar to CT7-8 but have an increased-durability turbine.

CT7-8C. The CT7-8C, currently undergoing maturation testing, is the newest and most powerful engine in the T700/CT7 family. Selected to power Sikorsky's new H-92 Superhawk helicopter, the 3,000-shp-class CT7-8C produces 20 percent more power than the CT7-8 but fits in the same installation bay. The CT7-8C incorporates upgraded materials in the turbine and an advanced three-stage power turbine (rather than the two-stage power turbine of earlier CT7-8 engines). The CT7-8C also features the advanced, fully redundant, dual-channel FADEC system with which the entire CT7-8 engine family is equipped. FAA certification of the CT7-8C was targeted for 2008, after flight testing of the H-92 had commenced. Certification is still pending.

CT7-8E. GE's more powerful CT7-8E engine is rated at 2,527 shp (1,884 kW), providing 12 percent more power than previous CT7 family engines, and will debut on the EH101 Merlin. GE is to begin production of the YT706 engine intended to power U.S. Army special operations MH-60M helicopters. As a growth version of the commercial CT7-8, the new engine will produce 2,600 shp, which represents a 600-shp increase over the current 701D engine. The YT706 has a 25 percent larger compressor, improved turbine cooling, and a FADEC controller. The new engine is designed to maintain power in the event both FADEC channels fail.

Program Review

Background. The first GE Aircraft Engines T700 turboshaft engine was delivered in 1978, 11 years after initiation of the U.S. Army's Advanced Technology Demonstrator Engine program. Under ATDE, a new powerplant was to be designed, engineered, and produced for a new generation of utility and transport helicopters for the U.S. Army. GE entered its GE12 against the Pratt & Whitney ST9 and won the competition in 1971.

Much of the design orientation of the GE T700 engine and the airframe it was initially designed to power was based on the experience of the Vietnam War, when the helicopter was subjected to ordeals never before seen in wartime. Operations in harsh environments contributed to very high rates of engine and aircraft failure. Furthermore, the inability of the helicopter to take small arms fire was well proven by the hundreds, even thousands, of helicopters downed during the Vietnam years.

The experience was instrumental in formulating the goals of the T700 program, including operation in severe combat, reliability, durability, ease of maintenance, survivability, and high excess power. Moreover, GE reports that it has succeeded in designing

and producing an engine that is literally maintenance-free, at least in comparison with its predecessors. The manufacturer states that less than a dozen tools are required to repair a T700, and accessories and line-replaceable units can be changed in minutes.

GE T700/CT7 Turboshaft Applications

Sikorsky UH-60/S-70 Black Hawk Series. The Sikorsky UH-60 is a twin-engine, single-main-rotor medium-lift transport helicopter. It is one of the most popular military helicopter series ever built, having been procured in the U.S. by the Army, Marine Corps, and Air Force, and by several countries outside the U.S.

Since its introduction in 1978, the Black Hawk had gained about 2,000 pounds in weight and had lost a great deal of its original performance capability, such as hover-out-of-ground effect at altitude, payload, etc. In addition, the U.S. Army's cargo lift and range requirements for its helicopters have grown. To meet these requirements cost-effectively, the Army wished to re-engine and retrofit a large portion of its nearly 1,400-strong Sikorsky UH-60 fleet.

The first upgrade to the original UH-60A design was the L, or interim Black Hawk. It incorporates a 3,400-horsepower main gearbox with improved reliability and durability, 1,890-shp GE T700-GE-701C engines, and since July 1991, an AlliedSignal (now Honeywell) auxiliary power unit. The UH-60L has more payload and is currently capable of sling-loading 9,000 pounds. The UH-60L entered the production cycle in 1989, with initial deliveries in November of that year.

The UH-60M is currently under development by Sikorsky. The Army intends to purchase over 1,200 new UH-60Ms, the first of which entered service in early 2007.

The UH-60M configuration includes a new cabin and transition section, T700-GE-701D engines, wide-chord graphite main rotor blades, a new stabilator system, and a number of changes in various gyros and accelerometers. The UH-60M will also have a new Rockwell Collins glass cockpit with four multifunction displays, two control display units, a new flight control computer, a new avionics suite, and a narrower instrument panel that will significantly improve chin window visibility.

Compared to the UH-60A/L, the UH-60M has increased payload capability and lower maintenance costs.

The UH-60M program has suffered a nine-month schedule slip, resulting from an underestimation of program cost as well as additional testing requirements.

In February 2004, Sikorsky received a $40 million contract to deliver four preproduction UH-60Ms to the Army. These four helicopters are to join the four M prototypes in the development program and were to be used for operational testing.

The MH-60M program for the U.S. Special Operations Command will be similar to the UH-60M effort. The UH-60M and the MH-60M will have a high degree of commonality, including use of the same main gearbox and active vibration control. Differences will include the use of composite materials in the MH-60M. The MH-60M will also be equipped with a higher powered engine, GE's CT7-8C, a version of the Black Hawk's existing T700 powerplant.

The MH-60M program may eventually cover more than 90 aircraft. A prototype is to be converted to the new configuration from an existing U.S. Army UH-60M. It was expected to be completed in FY07. The remaining aircraft to undergo modification may be a mix of UH-60Ms and MH-60K/Ls. The MH-60K/Ls would be re-engined with the selected new powerplant in advance of receiving the other MH-60M modifications.

Sikorsky has been developing a follow-on Black Hawk configuration called the UH-60X. Current U.S. Army plans call for the eventual remanufacture of 255 Black Hawks to the UH-60X configuration to meet a requirement for a Future Utility Rotorcraft. However, those plans are being re-evaluated. It is possible that the UH-60X will be dropped in favor of another alternative. Possible options include the Sikorsky S-92, the AgustaWestland EH101, or a tiltrotor aircraft.

The UH-60X would provide many of the same features as the UH-60M and would increase the lift of the Black Hawk by incorporating the drivetrain and rotor systems of the S-92 and a 3,000-shp class engine. Compared with the original UH-60A, the UH-60X would have double the payload-range capability and a 24-knot speed advantage, and would offer a 50 percent reduction in maintenance costs.

Sikorsky Seahawk Series. Sikorsky's SH-60 family of anti-ship and anti-submarine warfare helicopters is directly derived from the UH-60/S-70 Black Hawk. The first version was the shipborne SH-60B, also known as the LAMPS Mk III, designed to extend the Navy's anti-submarine warfare (ASW) capabilities and complement existing land- and sea-based fixed-wing ASW aircraft. The SH-60B was to equip all FFG-7 Oliver H. Perry, DD-963 Spruance, CG-47 Ticonderoga, DDG-51 Burke, and Belknap class ships.

The SH-60 program dates back to 1969, when the Navy issued informal Requests for Quotations based on a

General Electric T700/CT7

6,000-pound-gross-weight vehicle. Closer studies of this requirement resulted in a weight increase to 9,500 pounds in 1970. The service then extrapolated a need for a minimum force of 369 LAMPS helicopters for deployment aboard more than 100 ships. However, FY71 and FY72 funding requests were denied by Congress, and the planned inventory objective was cut to 204 units. The requirement was then revised upward to 265 before the Navy elected to halt Seahawk procurements with the FY94 purchases.

In 1974, the U.S. Navy awarded IBM's Federal Systems Division $13.8 million to develop the advanced Mk III ASW suite. Included in this package were the Control Data AYK-14 airborne computer (similar to that of the F/A-18 fighter), the Texas Instruments APS-124 search radar, Raytheon's ALQ-142 electronic stores management system, the IBM UYS-1 Proteus acoustic processor, the Teledyne APN-205 Doppler radar, and several multipurpose displays derived from systems incorporated into the Grumman F-14 fighter.

The total technology integration effort led by IBM was unique for its time, and caused significant cost increases and schedule slippages. Those were finally overcome during the late 1980s, and the system exceeded performance requirements.

The SH-60B basically is a UH-60A airframe, with differences dictated by mission capability and shipboard compatibility. The Navy variant incorporates an electric power-fold hinge on the main rotor blades for mechanized rotor folding prior to stowage of the aircraft, whereas the UH-60A's rotor folding is performed manually. The SH-60B's tail boom folds to the left rather than to the right as on the Army model, and the tailwheel is relocated forward to just aft of the cabin. The aircraft also has two pylons for carrying the Mk 46 homing torpedo. Other changes from the Black Hawk are corrosion-preventive coatings and more powerful GE T700 turboshafts.

Introduced on production machines for delivery from October 1991, the upgrade was also retrofitted to 95 inventory Seahawks at a program cost of $200 million. Block I includes a GPS system, a 99-channel sonobuoy system, the ARC-182 VHF/UHF radio, and provision for Penguin anti-ship missiles and Mk 50 lightweight torpedoes. The upgrade was completed in FY00.

Mitsubishi has produced 102 SH-60Js for the Japan Maritime Self-Defense Force under license from Sikorsky. Sikorsky has also delivered Seahawks off its own production line to the air arms of Australia, Greece, Spain, Taiwan, Thailand, and Turkey.

The advent of the CH-60 variant provided the Seahawk program with a new lease on life. That variant is intended for VERTREP (external cargo transfer), VOD (internal transport of mail, personnel, and cargo), amphibious search-and-rescue, combat search-and-rescue, special warfare support, and minehunting missions. The first CH-60-configured helicopter, a modified UH-60L, flew in October 1997. The U.S. Navy received the first of a planned 237 aircraft – since redesignated MH-60S – at the end of 1999.

Tied in with the FY94 cutoff in SH-60 procurements, the Navy wanted to remanufacture 200+ B, F, and HH-60H model Seahawks to the improved R standard. In late 2000, the service began a cost analysis comparing new-production SH-60Rs to the remanufacturing option, and determined that new-build R models would offer a better configuration than upgraded Seahawks. In late 2001, the Navy was authorized to proceed with new production of the redesignated MH-60R model in lieu of the upgrade option.

Boeing AH-64. In 1976, (then) Hughes won the competition for the Advanced Attack Helicopter (AAH) project with the AH-64A design; the AH-64A is a twin-engine, tandem-seat heavy attack helicopter with a maximum primary-mission gross weight of 14,445 pounds (6,552 kg). More than 800 helicopters were produced for the U.S. Army.

Production of the AH-64A was completed in 1996. In April of that year, McDonnell Douglas delivered to the U.S. Army the service's final AH-64A helicopter, marking the completion of a production run of 821 aircraft (not including prototypes and preproduction models). Production of the A version continued, with all remaining aircraft destined for non-U.S. customers. The last AH-64A was delivered by the end of 1996.

Initial AH-64D delivery to the U.S. Army occurred in March 1997. The Army is remanufacturing 501 AH-64A Apaches in its fleet to the AH-64D configuration.

The Army awarded McDonnell Douglas initial funding in late 1995 for the first 18 remanufactured AH-64Ds. This contract included provisions for a five-year agreement for at least 232 aircraft. In August 1996, the Army and McDonnell Douglas signed a five-year contract worth $1.9 billion for the remanufacture of 232 Apaches.

In 2000, the Army awarded Boeing a second five-year contract, worth more than $2.3 billion, for the remanufacture of 269 AH-64As to the AH-64D configuration. This brought the total number of U.S. Army AH-64As to be converted to the new standard to 501. The first helicopter remanufactured under the new contract was redelivered to the Army in April 2002.

In April 1995, the Dutch Cabinet selected the AH-64D for the Royal Netherlands Air Force. Parliamentary approval of the decision was received in May 1995 and was soon followed by the signing of a Letter of Offer and Acceptance. The Netherlands purchased 30 AH-64Ds under a NLG1.3 billion program. Deliveries began in May 1998 and were completed in June 2002. The Dutch leased 12 U.S. Army AH-64As (at a cost of $1.00 each) to provide an early operational capability; all of these have since been returned.

The AH-64D was selected for the Dutch purchase over the Bell AH-1W Cobra, the Eurocopter Tiger, and the Agusta A129. Originally, none of the Dutch Apaches were to be equipped with the Longbow fire control radar. However, in November 1999, the Pentagon announced that the Dutch government had requested a possible sale of 30 Longbow radars. The radars would be installed on the AH-64Ds.

In June 2003, the Dutch Ministry of Defense announced plans to withdraw six of the AH-64Ds from service and sell them.

In July 1995, the British Ministry of Defence selected the AH-64D to meet the U.K.'s requirement for a new attack helicopter. In a program worth approximately GBP2.5 billion, the U.K. is acquiring a total of 67 Apaches. Other competitors for the British procurement had included the Bell/GEC-Marconi Cobra Venom (based on the AH-1W) and the Tiger.

Boeing was teamed with AgustaWestland on the U.K. program. The initial eight British Apaches were produced by Boeing in the U.S., while AgustaWestland assembled the remaining 59 in the U.K. using Boeing-supplied kits. The U.K. Apaches are designated WAH-64Ds.

The U.K. decision to procure the Apache was particularly notable in that only 67 rotorcraft were purchased. The government had set aside funding for 91 Apaches but could only afford 67, as it chose to make an up-front investment in the Longbow fire control radar. All 67 helicopters are equipped with the Longbow radar.

Another noteworthy feature of the U.K. announcement was the decision to power the Apaches with the Rolls-Royce Turbomeca RTM322 engine. The powerplant for U.S. Army and all other Apaches is the General Electric T700. The first flight of an RTM322-powered Apache occurred in May 1998. That helicopter was a re-engined AH-64D on loan from the U.S. Army.

The initial delivery of a WAH-64D to the British Army occurred in March 2000. That helicopter was one of the eight WAH-64Ds that had been produced by Boeing in Mesa, Arizona. The first of the 59 WAH-64Ds built by AgustaWestland made its initial flight in July 2000. It was delivered to the British Army later that month. Deliveries of the 67 WAH-64Ds to the service were completed in July 2004.

AgustaWestland EH101. The AgustaWestland EH101 is a three-engine medium-lift military and commercial helicopter, having a maximum takeoff weight of 31,500 pounds (14,289 kg); it is a product of joint efforts by Westland Helicopters of the U.K. and Agusta of Italy. The two firms formed a new company, EH Industries, and designated the design accordingly. Though slightly smaller than the Sea King, the EH101 has greater payload-lifting potential and incorporates a three-engine configuration.

In 1979, the T700 was selected for prototype propulsion, and 11 engines were ordered for three ships. General Electric later agreed to a licensed-production arrangement with Alfa-Romeo. Alfa will produce all engines, and Avio SpA will provide the major components.

The competing engine on the EH101 is the Rolls-Royce Turbomeca RTM322. In 1988, it was announced that the RTM322 engine had been chosen over the T700/CT7 offer for the U.K. Navy and Air Force EH101 purchases.

Civil certification of the EH101 was received simultaneously in 1994 from the U.S. Federal Aviation Administration, the U.K.'s Civil Aviation Authority, and Italy's Registro Aeronautico Italiano. Both civil models, the passenger transport and the rear-ramp-equipped version, were certificated. Westland sees a potential world market for over 700 EH101s, including 250 in the civil sector.

Sikorsky S-92. Sikorsky unveiled a full-scale mockup of its proposed S-92 medium civil helicopter in 1992. Formally launched in 1994, the aircraft is in full-scale development. First flight occurred in 1999. Certification was planned for December 2001, followed by deliveries in 2002.

The S-92 is derived from the manufacturer's UH-60 Black Hawk. The new model features a redesigned transmission; the H-60's three-stage gearbox has been upgraded with a fourth stage, giving it a 4,170-shp (3,109-kW) capability for one-engine-out situations.

The commercial S-92C version is intended primarily for the offshore oil/gas market segment. Its maximum takeoff weight is 26,150 pounds (11,861 kg). The aircraft has a 168-cubic-foot aft baggage compartment. Maximum range is 444 nautical miles (822 km).

General Electric T700/CT7

The aircraft is powered by a pair of 2,043-shp (1,523-kW) CT7-8A engines. Any variant could also be equipped with Rolls-Royce Turbomeca RTM322 turboshafts.

Sikorsky H-92 Superhawk. Sikorsky originally proposed the military variant of S-92 as a low-cost, low-risk alternative to the Bell/Boeing V-22 as a replacement for the U.S. Navy and Marine Corps CH-46 medium-lift helos. As the V-22 program has since moved forward, Sikorsky has shifted its H-92 marketing emphasis to the international market.

Originally to be powered by the 2,520-shp CT7-8A, Sikorsky switched to the CT7-8C in 2003 to offer higher performance in all operating conditions.

Initial technical specifications rate the H-92 at 28,300-pound (12,863-kg) maximum takeoff weight, with an external (cargo hook) lifting capacity of 10,000 pounds (4,535 kg).

The H-92 configured for the land assault mission would have a 200-nautical-mile radius of action while carrying 22 troops at 3,000 feet on a 91.5°F day (compared with 140 nautical miles for the CH-46E). While in the amphibious assault role, the Sikorsky aircraft would have a dual sortie radius of action of 65 nautical miles with 22 troops under 103°F conditions (versus 45 nautical miles for the CH-46E). In the vertical replenishment role, the H-92 would offer a three-hour endurance carrying a 2,500- to 4,000-pound payload.

Bell AH-1 Variants. During the cost controversy surrounding the (then) Hughes AH-64A helicopter program, Bell proposed a much improved version of its AH-1 Cobra gunship as an alternative to the AH-64.

The original AH-1T uses the Pratt & Whitney Canada T400-WV-402 engine. The Marines required an aircraft that could operate at high altitude with the new-generation anti-tank weapons such as HELLFIRE. The Pratt & Whitney T400, however, was designed optimally for the sea-level role and would have required significant redesign. The Marines needed an engine by August 1983 for evaluation purposes. Pratt & Whitney could not meet that date. GE, by virtue of the CT7-2's flight testing aboard a modified AH-1, was virtually assured of the Marines' AH-1 application. The T700-powered AH-1W flew late in 1983.

In addition to procuring new T700-GE-401-powered AH-1Ws, the Marine Corps re-engined 41 AH-1Ts with the GE powerplant. The last of these were delivered in 1994.

The USMC AH-1W fleet recently received composite hingeless and bearingless four-blade main rotors, 2,625-shp transmissions (continuous power), new tail rotors, and a 90° mounted gearbox as part of its AH-1Z upgrade (done in concert with the UH-1Y, see below).

The AH-1's fuel capacity rose to 2,766 gallons from 2,086 gallons, with bigger stub wings. No engine changes were required. Deliveries commenced in 2006. No export production is forecast.

NH Industries NH90. The NH90 is a medium-size multimission helicopter. This aircraft is smaller than the EH101 and slightly smaller than the SH-3D. Despite the withdrawal of the U.K. from the program, the NH90 program managed to continue.

The first NH90 prototype flew in 1995 with the Rolls-Royce Turbomeca RTM322 engine.

In 1996, France reduced its planned NH90 purchase to 160 RTM322-equipped helicopters, a sizable decrease from its previously planned buy of 220. Italy slightly increased its planned buy to 224 T700/T6E-powered NH90s from the originally planned 214.

Germany also cut its planned buy, reducing the total to 243 helicopters from 272. MTU joined the T700/T6E program in 1997 as a co-production and revenue-sharing partner. It would have produced engines for use by German Army NH90s, but Germany chose the RTM322 to power its aircraft instead. MTU can still promote the engine and manufacture it for international customers, however.

Civil NH90 variants will be offered with the CT7-6A or the more powerful civil CT7-8 variant of the T700/T6E, as well as the RTM322.

Kaman SH-2G. In the early 1980s, Kaman Aerospace Corp (Bloomfield, Connecticut) proposed to the Navy that the service's fleet of SH-2F aircraft be refitted with T700-GE-401 engines – the same engines powering the service's SH-60Bs. The manufacturer received a contract for one GE-powered aircraft; it made its first flight in 1985.

In 1987, the service awarded Kaman $55 million to convert six inventory SH-2Fs to the SH-2G configuration, with redeliveries beginning in 1991. Kaman then upgraded 24 more SH-2Fs to G standard, and these were delivered to the U.S. Navy in 1993-1994. In mid-1994, Egypt ordered 10 SH-2Gs, which are modified SH-2Fs from U.S. overstock. Australia ordered 11 SH-2G aircraft in 1997 for a Royal Australian Navy shipboard multipurpose helicopter requirement.

The Royal New Zealand Navy also selected the SH-2G (four aircraft) for its naval requirement. It, too, has a heavy missile load requirement in the Hughes AGM-65 Maverick.

Kamov Ka-62R. The Ka-62 is a twin-engine helicopter designed to carry 14 passengers up to 370 miles (595 km); it can be converted for VIP use or to a multipurpose utility aircraft.

In 1990, Rolls-Royce announced that it and (then) USSR helicopter design bureau Kamov had signed a protocol agreement for the RTM322 engine to power a new civil transport helicopter. Under the agreement, covering both development and certification, Rolls-Royce would supply Russia with five RTM322 engines for development flying on the Kamov Ka-62R. The engines were to be delivered in 1993, but Kamov had reached an agreement with General Electric to fly a T700-powered Ka-62 prior to flying the RTM322-powered prototype. General Electric received $1 million from the U.S. Trade and Development Agency to study installation and certification issues relative to the Ka-62G. GE agreed to supply engines for the demonstration program.

Two RTM322 engines could be fitted to versions of the Kamov aircraft for export outside the USSR if the deal with GE does not lead to production. The dynamic-system ground test rig is powered by two 1,300-horsepower (970-kW) Russian turboshaft engines. First flight of a GE-powered Ka-62M was to have occurred in the mid- to late 1990s. Kamov claims to be actively developing the aircraft.

Bell/USMC UH-1Y. The U.S. Marine Corps awarded Bell Helicopter Textron a $134 million contract in 1997 to modernize its UH-1N Huey utility helicopters to UH-1Y (4BW) configuration. This will include re-engining 100 of the Marines' UH-1s (which have two Pratt & Whitney Canada PT6T engines) with the T700-GE-401 or -401C engines equipped with infrared suppressors; composite hingeless and bearingless four-blade main rotors; 2,625-shp transmissions (continuous power); new tail rotors; and a 90° mounted gearbox. This will result in an 85 percent commonality with the Marines' AH-1Z. In addition, the UH-1Y's fuel capacity will rise to 2,584 gallons from 1,381 gallons. The tailboom itself will be improved, and the fuselage stretched 20.8 inches (53 cm).

Redeliveries commenced in 2004 and will run to 2012 for the UH-1Y. The EMD phase has been completed, and first flight occurred in 2000. Bell has approached the U.S. Air Force with a plan to remanufacture 63 of its UH-1Ns as well, while the U.S. Army National Guard considered the engine (among others) for possible re-engining of UH-1H aircraft. The Army/Guard has elected to replace all of its UH-1 aircraft, however.

In October 2003, the U.S. Department of Defense's Defense Acquisition Board approved the USMC's multibillion-dollar H-1 upgrade program, calling for the remanufacture of 180 AH-1Ws and 100 UH-1Ns to the AH-1Z and UH-1Y standard, respectively. The UH-1s will receive all-new engines, and the SuperCobra engines will be reconditioned.

Funding

Funding for the GE T700 is contained in U.S. Army, Navy/Marine Corps, and Air Force R-1 and P-1 documentation. In many instances, the T700 work/effort has been melded into that of other engines, not all of which are GE engines.

U.S. FUNDING

	FY07 QTY	FY07 AMT	FY08 QTY	FY08 AMT	FY09 QTY	FY09 AMT
PE#0205633N						
W1355 Aircraft CIP (H-1)	-	$40.7	-	$51.4	-	$56.4

All $ are in millions.

Contracts/Orders & Options

Contractor	Award ($ millions)	Date/Description
GEAE	22.7	Aug 2004 – $22,743,763 N-T-E modification to a previously awarded ID/IQ contract (Navy contract N00019-03-D-1103) to exercise an option for depot-level repair of the T700-401/401C for the USN's H-60 aircraft. At the time of the award, the completion date was listed as Aug 2005.
GEAE	61.2	Apr 2004 – $61,291,918 modification to an FFP contract for the overhaul and repair of T700 family of engines. (Army contract DAAH23-00-C-0347)

General Electric T700/CT7

Contractor	Award ($ millions)	Date/Description
GEAE	40.6	Feb 2004 – $40,680,120 as part of a $2,273,740,895 FFP contract for supply of various T700 spare parts (Army contract W58RGZ-04-D-0057). At the time of the award, the completion date was listed as Dec 2008.
GEAE	22.7	Jan 2004 – $22,749,198 as part of an $824,000,000 FFP contract for 74 T700-701C spare engines (engines without hydromechanical control units and DECUs) and 74 containers. Army contract W58RGZ-04-D-0037. At the time of the award, the completion date was listed as Dec 2009.
GEAE	121.5	Nov 2003 – $121,550,672 modification to an FFP contract (Army contract DAAH23-00-C-0347) for the overhaul and repair of the entire T700 family of engines. At the time of the award, the completion date was listed as Dec 2004.
GEAE	21.3	Oct 2003 – $21,317,898 as part of a $743,030,910 FFP contract for 15 T700-701C spare engines and 15 shipping and storage containers. Army contract DAAJ09-97-D-0196. Work was completed by Dec 2003.
GEAE	9.3	Oct 2003 – $9,333,120 as part of a $53,919,300 FFP contract for the conversion of 110 T700-700 and T700-701 engines to the T700-GE-701C configuration. Army contract DAAH23-03-D-0416. At the time of the award, the completion date was listed as Sep 2008.

Timetable

Month	Year	Major Development
Mid	1967	ATDE announced
Dec	1971	GE12 selected as UTTAS finalist
	1972	GE12/T700 funded for FSED
	1973	First T700 FETT
	1974	First T700 flight tested
	1976	First production contracts for the UH-60A UTTAS awarded
Mar	1977	First production T700 delivered to the U.S. Army
Jun	1978	First commercial CT7 certificated
Sep	1978	CT7-2 certificated by U.S. FAA
Jan	1983	First T700-GE-401 delivered for the Sikorsky/USN SH-60B
Mar	1983	First T700-GE-701 delivered to Hughes for the AH-64A
Oct	1983	First flight of the Westland 30-200 with the CT7
Jan	1985	GE/Alfa Romeo/Fiat announce development of higher powered CT7 for the EH101
Apr	1985	First flight of T700-powered SH-2F
Nov	1985	2,500th T700/CT7 delivered
Feb	1986	First Alfa engine delivered
Mar	1986	First of batch of AH-1W aircraft delivered to USMC
Oct	1987	4,000th T700/CT7 delivered
1Q	1988	Certification of CT7-6
Sep	1988	CT7-6 enters service
Jan	1989	Start of T700-701C production
Mid	1989	GE, Ruston sign agreement on T700 production in U.K.
Dec	1989	Prototype military utility version of EH101 makes first flight
Mar	1990	Standard Aero Ltd becomes potential licensee of T700 in Canada
	1992	Start of CT7-6 production
Late	1996	CT7-6D certificated
Mar	1998	First flight of T700/T6E-powered NH90
Dec	1998	S-92 flown with CT7-6A engines for the first time
Nov	1999	First flight of CT7-8-powered S-92
Oct	2000	CT7-8 receives FAA certification
Jun	2004	IHI delivers first two license-built T700-701C engines for the Fuji-assembled AH-64D

Month	Year	Major Development
Jul	2004	First set of three CT7-8E engines delivered to AgustaWestland for US101/EH101s
Sep	2004	First flight of GE-powered Italian production NH90 helicopter
May	2008	Honeywell and Pratt & Whitney awarded engine demonstrator contract
Thru	2017	Continued production/support of T700/CT7 turboshaft

Worldwide Distribution/Inventories

At the start of 2009, more than 14,500 T700 and CT7 turboshaft engines had been manufactured and installed in aircraft worldwide.

Forecast Rationale

The General Electric T700 and its derivatives constitute the bulk of GE turboshaft production. Since production started in 1978, the T700 has seen nine different variants enter production for civil and military aircraft.

Black Hawk Variants

The T700 was originally developed for the U.S. Army's Black Hawk helicopter, and has since been installed on the UH-1Y, AH-1W/Z, AH-64, S-92, NH90, and AW101 helicopters. By far, the biggest application has been the UH-60M, and the U.S. Army's ongoing replacement of the fleet will ultimately lead to over 2,400 engines being produced. An additional 72 UH-60M aircraft will be converted to the MH-60M standard for the Army's special operations group. The engine powering this new variant is the 2,600-shp YT706-GE-700 (formerly CT7-8B5).

The U.S. Navy is buying new MH-60R and MH-60S Seahawk helicopters; the budget request for both machines is close to 600 aircraft.

NH Industries' NH90 and AgustaWestland's AW101 are also available with the T700/CT7-8 engine, although the majority of those aircraft have been ordered with the Rolls-Royce Turbomeca RTM 322 engine.

Sikorsky's S-92 and the military's H-92 are only available with the CT7-8 and will account for an estimated 536 CT7-8 engines. The S-92 will get another shot at the USAF's CSAR-X program, since the original award to Boeing's HH-47 was overturned after protests from Sikorsky and Lockheed Martin/ AgustaWestland. Little news has been made public regarding this program, but it is expected to regain momentum in 2010.

Licensed Production Continues

The T700 remains in licensed production in Italy by Avio SpA for the Italian military's NH90 helicopters. Similarly, Japan's IHI is producing engines for its UH-60 and AH-64 helicopters.

Samsung Techwin is producing T700s for the Korean Utility Helicopter, due to make its first flight in early 2010. The KUH is intended to replace the South Korean Army's aging UH-1s and MD500s. Export sales are planned for the aircraft as Eurocopter has collaborated with Korea Aerospace Industries in marketing the KUH outside Korea. The first export slots are expected to become available in 2014.

T700 Replacement

In May 2008, the Advanced Turbine Engine Company (a Honeywell and Pratt & Whitney joint venture) was awarded a contract by the U.S. Army for the Advanced Affordable Turbine Engine (AATE) technology demonstrator program. The program's intent is to develop a next-generation AATE, and its goals are to produce a 3,000-shp engine with a 65 percent improvement in power-to-weight ratio and a 25 percent improvement in SFC over the baseline T700. Ultimately, this engine will replace the T700 now powering the UH-60 Blackhawk and AH-64 Apache helicopters.

We estimate T700/CT7 production will total 5,410 engines, including license-built versions during the 2009-2018 timeframe.

General Electric T700/CT7

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program	**High Confidence**					**Good Confidence**			**Speculative**			
	Thru 2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**Total**
Avio SpA												
T700 T6E Military <> Italy <> NH90 NFH												
	3	0	1	6	11	13	13	13	13	13	11	94
T700 T6E Military <> Italy <> NH90 TTH												
	19	10	14	24	23	24	27	27	27	27	27	230
Subtotal	22	10	15	30	34	37	40	40	40	40	38	324
GE - Aviation												
CT7 -8 A <> S-92												
	217	52	41	29	26	30	33	34	38	43	47	373
CT7 -8 B5 Military <> MH-60 M												
	2	8	18	26	32	36	0	0	0	0	0	120
CT7 -8 C Military <> H-92												
	9	1	7	18	21	18	21	17	18	21	21	163
Subtotal	228	61	66	73	79	84	54	51	56	64	68	656
GE - Aviation												
CT7 -8 E <> AW101												
	0	0	0	0	1	3	2	1	4	7	6	24
CT7 -8 E Military <> AW101 Military Utility												
	0	0	0	0	0	2	11	15	12	6	2	48
CT7 -8 E Military <> Italy <> AW101 Naval												
	0	0	0	0	0	0	0	0	1	4	7	12
CT7 -8 F5 Military <> Spain <> NH90												
	0	2	9	17	20	20	20	20	20	19	17	164
Subtotal	0	2	9	17	21	25	33	36	37	36	32	248
GE - Aviation												
T700 -GE-401 Military <> United States <> AH-1 Z												
	0	0	0	0	2	10	21	30	33	33	26	155
T700 -GE-401 Military <> United States <> UH-1 Y												
	26	25	28	32	34	33	30	26	17	0	0	225
T700 -GE-401C Military <> Singapore <> S-70 B												
	5	4	3	0	1	3	2	0	0	0	0	13
T700 -GE-401C Military <> Turkey <> S-70 B												
	7	12	7	0	2	9	9	7	0	0	0	46
T700 -GE-401C Military <> United States <> MH-60 R												
	111	60	74	73	74	69	63	60	52	26	0	551
T700 -GE-401C Military <> United States <> MH-60 S												
	274	52	48	47	43	40	38	23	0	0	0	291
T700 -GE-701C Military <> Export <> AH-64 D												
	215	1	10	26	32	27	27	30	32	25	20	230

ESTIMATED CALENDAR YEAR UNIT PRODUCTION

Designation or Program	High Confidence				Good Confidence			Speculative			
	Thru 2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
T700 -GE-701C Military <> United States <> AH-64 D												
	49	46	26	8	17	18	0	0	0	0	0	115
T700 -GE-701C/-GE-701D Military <> UH-60/S-70												
	1,017	25	30	29	39	43	40	40	40	38	40	364
T700 -GE-701D Military <> United States <> UH-60 M												
	266	201	164	124	112	127	149	177	194	199	199	1,646
T700/T6A Military <> Italy <> AW101 Naval												
	2	5	1	3	2	0	0	0	0	0	0	11
Subtotal	1,972	431	391	342	358	379	379	393	368	321	285	3,647
IHI Corporation												
T700 Military <> UH-60 JA												
	68	1	3	5	7	7	7	7	7	10	11	65
T700 -GE-401C Military <> Japan <> SH-60 K												
	58	14	10	11	10	7	0	0	0	0	0	52
T700 -GE-701C Military <> Japan <> <> AH-64 D												
	14	3	3	2	0	0	0	0	0	0	0	8
Subtotal	140	18	16	18	17	14	7	7	7	10	11	125
Samsung Techwin Co Ltd												
T700/701K Military <> KUH												
	1	3	4	7	23	45	62	67	67	67	65	410
Total	2,363	525	501	487	532	584	575	594	575	538	499	5,410

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Market Intelligence Group Libraries (Pages 28-29)		
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Binder	$360	$680
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Binder & DVD	$140	$265
Binder & RT	$90	$170
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