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NORTHROP GRUMMAN

Achieving Partnership and GROWTH

Commodore (Retd) Gyanu Sharma

Also interview with William J Schaefer, Sector Vice President, Northrop Grumman Aerospace Systems

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Achieving Partnership and Growth

Commodore (Retd) Gyanu Sharma

WHEN LEROY GRUMMAN FOUNDED THE GRUMMAN AIRCRAFT ENGINEERING Corporation on Long Island, New York, in 1929, little did he realize that the company would still be going strong more than 80 years later.

Jack Northrop was an innovator with a skill for designing aircraft. He founded his first company in 1928 where he conducted research for the first all-metal aircraft and the "flying wing." This research and innovation would eventually lead to the revolutionary development of a flying wing bomber.

The innovation and determination that launched these early companies so many years ago, led to the world-class enterprise that became known as Northrop Grumman Corporation in 1994. Covering the full-range of defence and security hardware, software and services from under the water to outer space to cyberspace, Northrop Grumman's historic accomplishments range from transporting Charles Lindbergh across the Atlantic to carrying astronauts to the moon's surface and back to earth.

Through the years, Northrop Grumman has made series of successful, strategic business acquisitions, transforming itself into a leader in technology and innovation in the United States aerospace and defence industry. The combined, historical achievements of all of these companies is the foundation on which the Northrop Grumman of today is built.

Today's Northrop Grumman Corporation is a leading global security company whose 120,000 employees provide innovative systems, products, and solutions in aerospace, electronics, information systems, shipbuilding and technical services to government and commercial customers worldwide. With five operating sectors - Aerospace Systems, Electronic Systems, Information Systems, Technical Services and Shipbuilding - Northrop Grumman is well positioned to provide near- and long-term solutions that meet a nation's needs.

LEGACY

Northrop Grumman and US Naval Aviation share a long, and rich, history. Northrop Grumman is the longest running provider of aircraft to the US Navy, having manufactured its first fighter, the FF-1, for the Navy in 1932. That first successful aircraft design progressed through various improvements, resulting in the F4F, Grumman's first fighter with folding wings. This folding wing design allowed the Navy to store twice as many aircraft on its carrier decks than previously and began a proud legacy of the company, which began with the FF1, that has continued through the decades to include a multitude of fixed-wing aircraft - F6F Hellcat, A-6 Intruder, E-2C Hawkeye, F-14 Tomcat, C-2A Greyhound - for a multitude of missions.

FROM THE AIR

Northrop Grumman has a presence in every military domain and an in-depth knowledge of specific platforms and customers requirements and tactics within each domain. It couples its systems integration expertise with the technologies and capabilities and international industrial partners to provide effective, integrated solutions for all of its customers.



Commodore (Retd)
Gyanu Sharma



The game changing E-2D Advanced Hawkeye features completely redesigned aircraft systems, a state-of-the-art AN/APY-9 Electronic Scan Array radar and a new glass cockpit.

The E-2 Hawkeye airborne early warning & control (AEW&C) aircraft, which took its first flight in October 1960, has undergone several, incremental configuration upgrades over the years. In building on the legacy of providing world-class AEW&C capability, Northrop Grumman worked closely with the US Navy to ensure they had the expanded battlespace and situational awareness required for today's and tomorrow's mission. The result is the E-2D Advanced Hawkeye which features completely redesigned aircraft systems, a state-of-the-art AN/APY-9 Electronic Scan Array radar and a new glass cockpit. All E-2D's are newly manufactured aircraft based on a proven platform.

The APY-9 radar, exclusive to the E-2D Advanced Hawkeye, has the capability to "see" greater numbers of smaller targets at a greater range. With its two-generation leap in capability, the E-2D provides the most technologically advanced command and control capability available, with the ability to collect data and supply information to naval and joint forces well ahead of engagement. The new rotodome allows for three modes of operation including an electronically scanned array. Providing critically important, continuous 360-degree scanning allows the operator to focus on select areas of interest, vastly improving situational awareness.

The US Navy has stated it plans to purchase 75 E-2D Advanced Hawkeyes, of which five have been delivered, including the first E-2D to enter the Navy's fleet, delivered in July 2010. Four of the aircraft are continuing flight test with the US Navy while aircrew training is being conducted on the fifth aircraft. Early 2011 will see the E-2D operating on-board a US Navy carrier for the first time. The E-2D program continues to meet, or exceed, all key program milestones with Initial Operational Test and Evaluation scheduled for 2013 followed by Initial Operational Capability with the US Navy in 2015.

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“We, enthusiastically support the enunciated broadening of technology transfer”

WILLIAM J SCHAEFER

Could you please outline the global profile of the company and briefly describe the history of its growth and evolution?

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William J. Schaefer, Sector Vice President, Northrop Grumman Aerospace Systems

120,000 employees provide innovative systems, products, and solutions in aerospace, electronics, information systems, shipbuilding and technical services to government and commercial customers worldwide. With five operating sectors – Aerospace Systems, Electronic Systems, Information Systems, Technical Services and Shipbuilding - Northrop Grumman is well positioned to provide near- and long-term solutions that meet a nation's needs. Northrop Grumman is proud of the successful relationships it has built, and continues to build, around the world. A key element of Northrop Grumman's growth is its commitment to the international marketplace. The company has a range of industry-leading capabilities available for international markets and sells products and services to customers in 25 nations.

Your products span a wide area of defence technologies including military aviation, the maritime regime and space. In which of these areas do you claim to have global leadership?

Northrop Grumman has an industry-leading range of capabilities in Intelligence, Reconnaissance and Surveillance (ISR) including airborne early warning and control systems for maritime reconnaissance, fire control radars and unmanned aerial vehicles. ISR systems are critical to effective homeland security and our leadership in multiple-domain ISR strongly position Northrop Grumman to help create solutions for India's coordinated national defence structure

How do you perceive the business potential of the Indian market for defence hardware?

Northrop Grumman strongly and actively supports the “strategic partnership” enunciated by the President during his recent visit to India and the amplifying statement by Secretary of Commerce Locke during the run-up to Aero India. We have responded to a number of formal requests for

information for some of the most advanced defense systems we make or are in the process of doing so. While realizing that the Indian market is and will continue to be highly competitive, we are confident that given the strong support of the US Government already evident, we can compete successfully.

What is Northrop Grumman's business strategy in the region in general and with India in particular? What is the current level of penetration into the Indian market and the specific projects the company is engaged in?

Northrop Grumman's strong relationship with India goes back many decades and is built on a legacy of trust and of performance. Our desire is to continue this relationship as we continue to seek opportunities where we are mutually benefited. While we have been in dialogue with the Indian Government and the armed services for a number of years, the focus is currently on our most advanced products. Bringing these opportunities to fruition will take some time.

What is Northrop Grumman's assessment of the impact on the business prospects of the company after President Obama's recent visit to India especially with regard to unrestricted transfer of technology classified as advanced, sensitive and dual use?

We share the enthusiasm generated by the President's visit both in the US and in India and enthusiastically support the enunciated broadening of technology transfer. We would caution on the use of the word “unrestricted”. There will always be some constraints on the release of technology, if for no other reason than the protection of intellectual property rights in a free market context.

There is a school of thought that space will be the battleground in the future. Does Northrop Grumman subscribe to this view and if so, is the company pursuing R&D to meet the requirements of space warfare in the future?

Northrop Grumman prides itself on its capabilities from the surface to space to cyberspace and is comfortable competing in all these environments. Our focus in the area of “space” however, concentrates on the peaceful use of the infinite. We firmly believe that our emphasis on intelligence, surveillance and reconnaissance, though vital to the national security equation tends to reduce the possibility of conflict as much as it might respond to it.



In front of a U.S. Navy E-2C Hawkeye aircraft, are Vice Admiral Anup Singh, former Deputy Chief of Naval Staff, Indian Navy and Rear Admiral Nevin Carr, former Navy International Program Office, U.S. Navy.

The E-2 Hawkeye is in use with more customers worldwide than any other such systems and, because it was designed from the beginning as military aircraft, it can withstand the most demanding operational environments. The US Navy currently operates 66 E-2C Hawkeye aircraft. E-2's are also operated by Japan, France, Egypt, Taiwan and Singapore. With one-third of the world's E-2 Hawkeye fleet operated by other countries, a high level of international interest in the E-2D is anticipated, once it becomes operational with the US Navy fleet.

The RQ-4 Global Hawk enterprise carries the lineage of both targets and unmanned reconnaissance drones developed decades ago. The company's history in developing systems to operate in the challenging maritime environment continues as it develops the next-generation maritime and unmanned aircraft systems. Global Hawk is the only unmanned aerial system (UAS) to meet the military and the Federal Administration Aviation's airworthiness standards and have approval to fly regular flights within US airspace. The system is continuing its operational support having logged more than 10,000 combat flight hours with 95 percent mission effectiveness.

As with many of the platforms Northrop Grumman has produced over the years, the Global Hawk's capabilities have been significantly increased through planned block upgrades that provide a more capable and more powerful unmanned surveillance system. The Block 20 Global Hawk represents a significant increase in capability over the Block 10 configuration. The larger Block 20 aircraft will carry up to 3,000 pounds of internal payload and will operate with two-and-a-half times the power of its predecessor. Its open system architecture, a so-called “plug-and-play” environment, will accommodate new sensors and communication systems as they are developed to help military customers quickly evaluate and adopt new technologies.

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The United States Navy's MQ-4C Broad Area Maritime Surveillance (BAMS) Unmanned Aircraft System (UAS) program provides persistent maritime Intelligence, Surveillance, and Reconnaissance (ISR) data collection and dissemination capability to the Maritime Patrol and Reconnaissance Force (MPRF).

When fully fueled for flight, the Block 20 variant weighs approximately 32,250 pounds. More than half the system's components are constructed of lightweight, high-strength composite materials, including its wings, wing fairings, empennage, engine cover, engine intake, and three radomes. Its main fuselage is standard aluminum, semi-monocoque construction.

RQ-4N BAMS UAS

Northrop Grumman's expertise in the design, development and production of unmanned systems is built upon the foundation of the former Grumman Aircraft Company. The company also provides the tools to help its customers successfully define and develop new concepts of operations that successfully integrate both manned and unmanned systems. The Broad Area Maritime Surveillance Unmanned Aircraft System (BAMS UAS) is the next generation of high-altitude, long-endurance UAS. It is designed to provide the US Navy with persistent maritime surveillance and reconnaissance coverage of wide oceanographic and littoral areas. A maritime derivative of the combat-proven RQ-4B Global Hawk unmanned aircraft, the BAMS UAS is equipped with a 360 degree Multi-Function Active Sensor (MFAS) active electronically scanned array along with Navy-specific ground stations. It provides the most advanced autonomous air vehicle with a state-of-the-art service oriented architecture mission control system.

The high quality of Northrop Grumman's RQ-4N BAMS UAS reflects Northrop Grumman's long years of experience in the production of aircraft - including more than 100,000 UAVs. With its low total acquisition and system operating cost over the lifetime of the entire program, the BAMS UAS can deliver unprecedented long-range, persistent maritime ISR capability to the user. Construction of the first BAMS UAS began in September 2010 and the program will be undergoing a critical design review



Admiral Mehta, former Chief of Naval Staff, Indian Navy (2nd from right) and an aide, receive information on Northrop Grumman's E-2D Advanced Hawkeye. Also pictured are Northrop Grumman representatives Tom Trudell (L) and John Brooks (right).



The Northrop Grumman-built MQ-8B Fire Scout VUAS conducting shipboard flights from the USS Halyburton (FFG-40) to verify that its communications link with the ship is functioning properly. (Photo Courtesy of the U.S. Navy)

with the US Navy in mid-February.

The MQ-8B FIRE SCOUT: Northrop Grumman's Vertical Unmanned Aircraft System (VUAS), multi-role Unmanned Aerial Vehicle system provides unprecedented situational awareness and precision targeting support. It is a mature, field-proven, fully-autonomous tactical ISR system with the ability to take off and land autonomously on any aviation-capable warship and at prepared and unprepared landing zones in proximity to ground troops.

Its ability to operate at low ground speeds allows Fire Scout to move with soldiers in the field, and easily acquire and track targets in complex and urban terrain.

MQ-8B Fire Scout VUAS system supports multi-dimensional air-ground operations, manned-unmanned teaming and connectivity to Army and Joint Reconnaissance, Surveillance and Target Acquisition (RSTA) and communications systems.

The MQ-8B Fire Scout's multi-mission capabilities synchronizes soldiers and leaders, allowing the tactical users to see, understand and act first while finishing decisively. Its ability to operate at low ground speeds allows Fire Scout to move with soldiers in the field, and easily acquire and track targets in complex and urban terrain. Northrop Grumman is developing Fire Scout vertical unmanned systems for a variety of US and international military customers.

The Fire Scout is currently undergoing system test and evaluation with the US Navy in both land-based and shipboard environments with a decision on full-rate production expected in fiscal year 2012. A two-aircraft system of the Fire Scout is set to deploy on the USS Halyburton (FFG-40) in early 2011. This will be the second "at-sea" deployment of Fire Scout.

The MQ-8B Fire Scout successfully demonstrates how the combination of manned and unmanned technologies can increase the capability and extend the mission capability of commercially available helicopters.

LEMV: Northrop Grumman is extending its range of ISR capabilities with its Long Endurance Multi-Intelligence Vehicle (LEMV) is a revolutionary aviation concept that will shape the future of



LEMV: Northrop Grumman's open architected Long Endurance Multi Intelligence Vehicle (LEMV) is a revolutionary aviation concept that will shape the future of ISR.

ISR. The company is developing an aerodynamic design with less drag than competing designs, uses existing proven hull materials, has a type-certified engine and off-the-shelf sensors.

Northrop Grumman was awarded a \$517 million agreement, in June 2010, to develop up to three LEMV systems for the US Army. Under the agreement, the company will design, develop and test a long-duration hybrid airship system within an 18-month time period – a very aggressive schedule. Within four months of signing the agreement, Northrop Grumman demonstrated its strong commitment to the customer by completing three important program milestones - including the Preliminary Design Review, which looks at the hybrid air vehicle design, ground station infrastructure, and ground and airborne system software. The next major milestone for the programs is the Critical Design Review, at the end of the first quarter of Fiscal Year 11.

Longer than a football field, taller than a seven-story building and the capability to remain airborne for more than three weeks at a time, LEMV delivers a high level of fuel efficiency. The program leverages Northrop Grumman's longstanding leadership in developing innovative unmanned air vehicles, CAISR weapon systems and leading edge systems integration. LEMV is the unblinking, persistent eye for the emerging market space of airships for the military and homeland defense arenas.

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Northrop Grumman has designed a system with plug-and-play capability to readily integrate into the Army's existing common ground station command centers and ground troops in forward operating bases—the main objective is to provide US military users with persistent ISR capability to increase awareness of the ever changing battlefield.

LEMV will sustain altitudes of 20,000 feet for a three-week period, and it will operate within national and international airspace. It will be forward-located to support extended geostationary operations from austere operating locations using beyond-line-of-sight command and control.

X-47B UCAS-D: Northrop Grumman is building two strike fighter-sized, long-range, high endurance aircraft, designated the X-47B UCAS-D, for the US Navy. In 2009, the X-47B underwent a series of successfully, progressive structural, functional proof and calibration tests to verify the integrity of all flight control surfaces, major structural load paths, main landing gear structure and tailhook assembly. In the 2013 timeframe, the aircraft will demonstrate that a long-range, low-observable, flying-wing unmanned combat aircraft can operate safely from aircraft carriers (launch and recovery), and refuel in-flight to achieve ultra-long mission persistence.

F/A-18: Northrop Grumman designed the prototype YF-17 fighter that has become the US Navy's multi-purpose combat aircraft – the F/A-18 Hornet. The company now is responsible for producing the F/A-18's shipset for prime contractor, The Boeing Company, – for the single-seat F/A-18E, the two-seat F/A-18F Super Hornet as well as the EA-18G Growler electronic warfare aircraft. Each shipset consists of the center/aft fuselage section, twin vertical tails and all associated subsystems. To date, the company has delivered 500 Super Hornet and Growler shipsets. Throughout the life of the program, the skilled Northrop Grumman workforce has continued to maintain high standards of quality and affordability, with all deliveries 100 percent on schedule or ahead of schedule.

ELECTRONIC SYSTEMS: Northrop Grumman is a leading developer, manufacturer, integrator and supporter of a variety of advanced electronic and maritime systems to international customers

for national security and non-defence applications.

The company's versatile Active Electronically Scanned Array (AESA) radars are extending capabilities for searching, mapping and targeting missions – all with no moving parts. The AN/APG-80 radar is designed to search continuously for and track multiple targets within the forward hemisphere of the F-16 aircraft. As a result of increased operational flexibility, pilots will be able to simultaneously perform air-to-air search-and-track, air-to-ground targeting and aircraft terrain-following. The AN/APG-80 shares common architecture with the F-35 Joint Strike Fighter's AN/APG-81 radar and is the only AESA fire control radar in India's Medium Multi-Role Combat Aircraft (MMRCA) competition with



X-47B UCAS

operational experience. Additional advances of the APG-80 agile beam radar include much greater detection range, high-resolution synthetic aperture radar imagery, and a two-fold increase in reliability compared to conventional, mechanically scanned radars.

Northrop Grumman's Multi-Role Electronically Scanned Array (MESA) surveillance radar is an advanced airborne surveillance sensor and provides peninsular protection enabling sophisticated air-to-air and maritime coverage and integrated friend-or-foe identification. The MESA radar provides air-to-air coverage, air-to-surface coverage, integrated identification friend or foe, special track beams and focused sector operation.

Northrop Grumman's STARLite is a small, lightweight wide area surveillance radar used for supporting tactical operations. STARLite features synthetic aperture radar (SAR) and ground moving target indicator (GMTI) capabilities for unmanned and manned aerial vehicle applications.

TO THE SEA

Currently, Northrop Grumman is the US's sole industrial designer, builder, and refueller of nuclear-powered aircraft carriers and one of only two companies that design and build nuclear-powered submarines. The company is also one of the nation's leading providers and life-cycle supporters of major surface ships for the US Navy, US Coast Guard, international navies, and commercial vessels.

Northrop Grumman is building the LPD 17 San Antonio Class, the newest addition to the US Navy's 21st Century amphibious assault force. The LPD 17 platform is ideal for both preserving peace in the region, as well as providing on-demand long-range humanitarian relief to people in need.

The 684-foot-long, 105-foot-wide ships are used to transport and land marines and/or relief workers, with their equipment and supplies by embarked air cushion or conventional landing craft and Expeditionary Fighting Vehicles amphibious assault vehicles, augmented by helicopters or vertical take-off and landing aircraft and assault vehicles, augmented by helicopters or other rotary wing aircraft. The ships will support amphibious assault, special operations, or expeditionary warfare. Survivable in even the harshest conditions, this uniquely capable amphibious transport ship has outstanding medical and evacuation facilities and more than enough room to transport and support hundreds of military personnel and their equipment or relief workers and evacuees, and with airlift capabilities to match and situation.

AND INTO SPACE

Northrop Grumman is the prime contractor developing the James Webb Space Telescope, the world's next-generation space observatory and successor to the Hubble Space Telescope. The most powerful space telescope ever built, Webb will observe the most distant objects in the universe, provide images of the very first galaxies ever formed and see unexplored planets around distant stars. Northrop Grumman will design and build the deployable sunshield, provide the spacecraft and integrate the total system.

Leading the design and development effort for the space agency's Goddard Space Flight Center. When launched in 2014, the James Webb Space Telescope will peer into the past to a time when new stars and developing galaxies were first beginning to form. The Webb telescope's infrared instruments will measure and capture images and spectra of galaxies that formed billions of years ago.

The Webb telescope will use unprecedented near-infrared instruments and angular resolution to discover and study planetary systems like our own, analyze the molecular composition of extrasolar planets' atmospheres, and directly image Jupiter-size planets orbiting nearby stars.

AND IN-BETWEEN

Northrop Grumman's Training Solutions Division has worked closely with thousands of civilian sector professionals, soldiers and commanders over the span of several decades in both the domestic and international arenas. Its training programs are based on up-to-date scenarios and real life situations. The National Level Exercises provide realistic exercising of most senior leaders, allowing them to make sound tactical and strategic decisions during actual crisis situations. Through these exercises, by the time elected and non-elected officials see action, they have, in a sense, already been there.

Providing training applications in live, virtual and constructive training environments, Northrop Grumman offers a full range of training services, from individual training products and courseware to full life-cycle training programs. The company is committed to providing a diversity of training applications and works daily to make them more valuable to its customers.

GLOBAL RELATIONSHIPS: Northrop Grumman is proud of the successful relationships it has built, and continues to build, around the world. A key element of Northrop Grumman's growth is its commitment to the international marketplace. The company has a range of industry-leading capabilities available for international markets and sells products and services to customers in 25 nations.

India represents one of the largest potential growth markets for defence products in Asia and Northrop Grumman is prepared to meet the current and future requirements of the armed forces with its state-of-the-art technologies and advanced capabilities. The company, while involved in a variety of cooperative projects in India, is focused on the critical maritime security and surveillance sector.

Northrop Grumman is proud to have been a trusted supplier to the Indian armed forces and Indian industry for more than 25 years. The company supports India in a variety of defence and civil applications including air traffic control communications systems and radars, unmanned ground vehicles for the Indian Army and marine navigation systems for the Indian Navy. It brings significant, relevant capabilities for homeland defence modernization and command & control, intelligence, surveillance and reconnaissance (C2ISR).

The company continues to expand its presence in India through strategic industrial partnerships and in 2007, opened offices in New Delhi to better meet India's growing demand for homeland defence upgrades, aerospace and commercial capabilities and technologies. At the same time, Northrop Grumman is building stronger working relationships with the Government of India, Indian armed forces military staffs and potential industry partners. Northrop Grumman is committed to working with India to be the trusted provider of the most advanced technology and capabilities to ensure the defence of India's national security.

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