

## Issue File

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Source of Threat to  
Gulf and Arab Security**

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## National Media's Responsibility in the Face of Crises

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The fifth edition of the Emirati Media Forum (EMF), organised by the Dubai Press Club, was held during the last week of May. It was an important opportunity to highlight the challenges faced by the national media, both in terms of the enhancement of its general content and role in developing society, and how to Emiratise this sector. It is necessary to invest in building a qualified national cadre not only to work in the field of media, but also to lead it and develop policies and strategies that help build a responsible national media that keeps up with the ambitions of the UAE and highlights its civilisational achievements.

# Editorial

The vital topics raised at the EMF undoubtedly reflect the keenness of the competent authorities to develop the national media, improve its media message and enhance its competitiveness at the Arab and international levels. The role of the media is now growing as one of the tools of psychological and propaganda warfare used by countries in managing their external crises and conflicts. For this reason, one of the forum's sessions was devoted to the discussion of the 'UAE Media in context crises'.

This was an important opportunity to assess the role of the national media in the face of crises, the extent of confidence of members of society in the way our national media is dealing with different crises, and how to address the rumours that undermine the security and stability of society. The proposals and rich visions presented during the Forum will undoubtedly support national media development policies, improve its content and media message, and enhance its role in serving society, especially in times of crisis and disaster.

It is no secret that the responsibility of media in the face of crises has become a high priority, especially at the current stage of instability and uncertainty in the region, characterised by the spread of malicious rumours that affect the security and stability of countries. Social media is being used as a tool in inter-state conflicts. It is difficult to control social media, as it is not subject to restrictions on the posted ideas and rumours, so it has become one of the most important tools of the so-called fourth generation wars.

The current state of affairs in the region has posed many challenges to our national media and doubled its responsibilities, not only in following up the developments of events, but also in dealing decisively with the malicious campaigns launched against the UAE. Therefore, our national media should be the spearhead in the face of these tendentious campaigns.

Despite the continuation of the dubious and malicious campaigns targeting the UAE, our national media has proven highly efficient in dealing with them and exposing the parties behind them. It has provided a role model as a responsible media, which plays its role effectively, especially in times of crisis, whether through early response to rumours aimed at stirring up confusion and panic in the society, or through letters of reassurance and confidence it sends to the public. In fact, it is playing a vital role in defending the high interests of the UAE and underpinning its positions and constants towards all regional and international issues.



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HENSOLDT  
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Iran is a Constant  
Source of Threat  
to Gulf and Arab  
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"USS Gerald R. Ford"  
21st Century's Super  
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# Paris Air Show to Showcase Cutting-Edge Aerospace Innovations

*The 53rd International Paris Airshow or Salons Internationaux de l'Aéronautique et de l'Espace (SIAE) happening from 17 to 23 June at the Le Bourget Parc des Expositions will bring together all the major players in the global aerospace industry and showcase the latest innovations in the sector. Organised by the French Aerospace Industries Association (GIFAS), the biennial show has been at the very heart of developments in the global aerospace market and has become the most important meeting place over the years.*

Open for both professional and the public visitors, the Show offers fantastic opportunity to discover all the latest developments in aircraft construction, assembly and sub-assemblies, equipment & machines, space and satellite technologies, air-launched weapons,

and aircraft interiors, in addition to Airport equipment and services.

On the back of steadily growing demand for air travel has resulted in the OEMs and their manufacturing supply chains face increasing aircraft production ramp-up demands for civil aircraft.

On the other hand, countries across the world are developing home-grown aircraft programmes to strengthen their armed force's capabilities, and cultivate skills and technologies in their own aerospace industries, driving demand for military application aircraft and oth-





## The 2017 edition saw record-breaking numbers, with over US\$150 billions' worth of orders

er technologies. Besides these, other advances, such as drone or UAV aircraft are also expected to make a big impact at the event.

### **A Century of Aerospace Innovation**

With a history that can be traced back to 1908; since 1953 the show has been held at Le Bourget airport, just a few



Embraer E195-E2

miles from central Paris. With over 2,300 exhibitors participating, the show is a platform to discover all the latest innovations and developments in the aviation, space and support technology solutions. One of the biggest events in the aerospace trade calendar, the Paris Show attracts constructors, components manufacturers and systems developers to present their latest innovations to the world.

The 2017 edition saw record-breaking numbers, with over US\$150 billions' worth of orders placed and 3,22,000 visitors attending the weeklong event to explore over 140 aircraft. The event

also consolidated its international dimension, with attendance from 290 official delegations, and visits from France's President and a great majority of the French government. The event featured numerous dedicated areas and event categories, including the Careers Plane-Jobs and Training Forum and the Paris Air Lab, a new space devoted to research, innovation and forward thinking.

### **A Platform for Everything**

The upcoming show is described as the must-attend event for all professionals working in the aeronautics and space sector. With a 131,500 sqm exhibition

area Paris Air Show will once again feature Paris Air Lab, Careers Plane, and Air and Space Museum.

**Careers Plane:** The French aerospace sector represents some 195,000 jobs (the aerospace workforce in France involving members of GIFAS in 2018), and a total of over 350,000 jobs in France. The sector has demonstrated powerful dynamic energy over the past few years and is looking to recruit around 15,000 new talents this year. The Career Plane Jobs and Training Forum is an ideal platform for young people to explore the professions in the aerospace industry, discussing training courses with young people and recruiting new talents. Co-organised with GIFAS, Careers Plane provides a fresh, informative overview of the sector, types of jobs, internships or training courses available. At Careers Plane young graduates can find their first job, whereas established professionals can pinpoint new opportunities. In a 3,000 sqm hall, host over 70 exhibitors, audiences can explore an immersive educational circuit that includes a demonstration and discussion by professionals, a meeting area where you can talk to companies looking to recruit, as well as schools offering courses.

**Paris Air Lab:** After the success of its first edition, Paris Air Lab returns with 3,000 sqm exhibition area dedicated to innovation and prospective technologies in the aerospace industry. This "event inside the event" will offer trade visitors, as well as general public the chance to witness latest technologies and futuristic innovations. From manufacturing to space exploration and environment, Paris Air Lab will focus on trending topics for the aerospace industry. The exhibition will host 24 display areas that will feature the sector's manufacturers and start-ups and another 12 booths dedicated

### *International Paris Air Show Timeline*

**1909:** The first show was dedicated to aerial locomotion and was created by André Granet and Robert Esnault-Pelterie. It was held from 25 September to 17 October 1909 in Paris's Grand Palais. Around 100,000 visitors attended the show to admire innovations from 380 exhibitors.

**1928:** This was the 11th edition of the show. In 1927, Charles Lindbergh had landed at Le Bourget airport following the first non-stop flight between New York and Paris. This made Le Bourget the best-known aviation platform in the world.

**1953:** The show moved to Le Bourget permanently, and the first exhibition centre became a key venue for the conclusion of contracts between official institutions and constructors.

**1969:** Concorde, the world's first supersonic commercial aircraft, and the Boeing 747 jumbo jet were on display.

**2005:** This edition saw the first public presentation of the Airbus A380. On this occasion, the show broke all previous records, with almost 230,000 visitors in three days.

**2009:** It was the centenary year of the show. Around 30 historic aircraft attended the event, creating a display depicting 100 years of innovation.

**2011:** This was a record-breaking year, with more than 2,110 exhibitors and the presence of Solar Impulse, the first solar aeroplane.

**2013:** The 50th edition of the air show had the theme of "the show of the future", and featured the Careers Plane, the alternative fuels space, certification 20121 and a new mobile app.

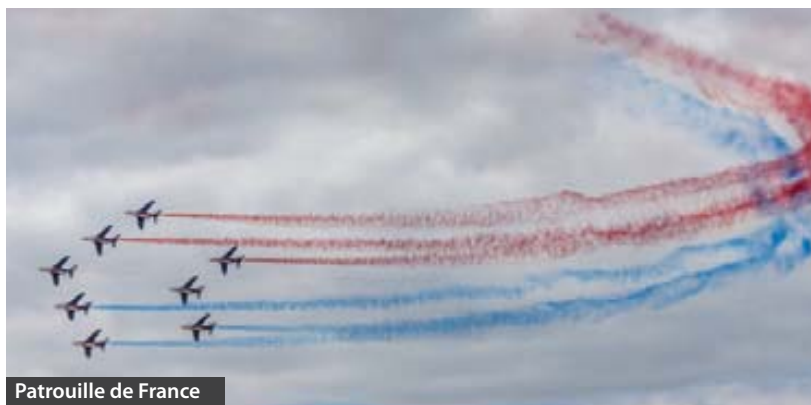
**2015:** The record-breaking edition hosted over 2,300 exhibitors.

**2017:** This edition set a new record, with over US\$150 billions' worth of orders placed. It welcomed over 322,000 visitors who discovered numerous areas and events, including the Paris Air Lab, a new space devoted to research. They also admired the 140 aircraft on show, 45 of which were on flying displays.



Drone Helicopter VSR 700 from Airbus





Patrouille de France



Chalet Thalès - Paris Air show 2017



Zodiac Aerospace Stand

to collaborative and industrial innovation in the areas of innovative technologies (ENABLE), sustainable aerospace (PROTECT), future of aeronautics mobility (TRAVEL), and iconic space missions (EXPLORE).

A special booth, "Understanding climate change", will show how planes

and satellites contribute to the understanding and monitoring of climate change through embedded devices. The area will also provide a platform for at least 80 startups from around the world to display their projects and present their work to visitors and industry professionals during the show.

**Air and Space Museum:** Located in Paris-Le Bourget airport, the Air and Space Museum is one of the top aviation museums in the world both for the wealth of its collections and its history. Thanks to its exceptional historical heritage and more than 40,000 items it has started to collect since the early 20th century, the museum is protected by the "Musée de France" status. As a bond between past and future, the prestigious Air and Space Museum is a lively place, holding events all year round, regularly acquiring collection objects, and providing entertainment for all. Visitors can discover about a hundred aircraft among the 400 composing its collections, from the very first planes to the Breguet 19 "Point d'interrogation", the Spitfire and the Concorde. Le Bourget, where the museum is located, is a place that has seen many aviation heroes and is the birthplace of commercial aviation.

#### **Creating Opportunities for SMEs**

The Paris Air Show is a prime opportunity to exhibit and win new contracts for smaller businesses (SMEs). In 2017, Paris Airshow's managing director, Gilles Fournier reportedly said that 90 per cent of the show's exhibitors were SMEs and that around 70 per cent of the event's SME exhibitors return each year. Apart from big players like Boeing and Airbus displaying their latest aircraft models, smaller companies will also be given the opportunity to share their innovation.

In light of this healthy backdrop, the International Paris will once again be the ideal arena in which to see the very latest advances in aerospace technology and manufacturing. Companies from the UK, Germany and Italy will have a strong presence, along with others from China, Brazil, Spain, Canada and India.

Reference Text/Photos

[www.parisairshow.tv](http://www.parisairshow.tv), [www.siae.fr](http://www.siae.fr)

# ANSYS Shines Light on Disruptive Innovation in Aerospace and Defence

The 2019 Aerospace and Defence Industry conference on “Disruptive Innovation” organised by ANSYS Inc. and Fluid Codes took place in Abu Dhabi on April 18. The C-level conference saw over 80 key executives and officials from the top local and global defence, space and security organisations such as EDIC, Tawazun, UAE Armed Forces, among others.

At the event, the speakers explained that simulation is mission critical for companies in a nation such as the UAE, which emphasises on competency development in aviation, space and defence industry. It highlighted that the industry continues to focus on sustained key business initiatives and constantly innovates to capture the opportunities created by disruptive innovation.

Reportedly, 90 per cent of companies believe they have entered an era of exponential technology advancement. However, significant challenges exist to realising the opportunities. Overcoming these challenges such as faster technology insertion and productivity, more fuel-efficient aircraft, autonomy, connectivity, electrification, additive manufacturing, digitalisation, etc., requires simulation across the life-cycle as it delivers the highest level of competitive advantage. Through engineering simulation using ANSYS, companies improved time to market by 21 per cent as they manufactured 22 per cent more cost-effective products



The C-level conference saw over 80 key executives and officials from top local and global defence, space and security organisations

## Simulation is mission critical for companies in a nation such as the UAE

with 17 per cent higher quality. Established over 45 years ago in the U.S., ANSYS Inc. is a global leader in providing software for engineering simulation in a wide range of segments.

### Strategic Solutions

Airplanes and weapons are among the most complex systems to design and build today: an aircraft can have more than 1 million parts that must be designed and assembled, and each of them can fail leading to a possible cat-

astrophic outcome. On the battlefield, every asset must perform as designed, to protect the people and allow them to accomplish their mission. The only way to test these equipment's in all situations is to get them exposed in a high fidelity, Multiphysics and multi-domain simulation platform. This is what ANSYS has delivered in the past decades.

In order to develop advanced systems, it's now a must to think about a Multiphysics platform. Just to give an example, the performance of many assets today is delivered by the electronic brain. This electronic has to be designed looking into all the electromagnetic interference, signal integrity and power integrity problems. It has to perform in a harsh environment like the desert, at very high temperature and where sand and dust are everywhere, while under hostile attack: mechanical simulation (vibration, hits) and fluid dynamic simulation (cooling and ventilation) must be performed.

## An aircraft can have more than 1 million parts that must be designed and assembled, and each of them can fail leading to a possible catastrophic outcome

The asset then can have a DO-178C DAL-A certified control software that could take decisions in autonomy, so you want to simulate the behaviour of the software as well. Then you want to put the device you are building inside the entire system, looking for the overall performance. This is the real strength of what you can do with ANSYS: simulate every single aspect of the product design in an integrated

fashion, taking into account all the phenomena it will face during real operations, and optimise its performance at system level.

### Simulation in MRO Industry Explained

The goal of simulation has always been to reduce the time and costs associated with technology development, insertion, maintenance and updating. Simulation can help the Maintenance, Repair and Operations (MRO) industry adopt new technologies such as additive manufacturing. ANSYS offers end-to-end additive manufacturing simulation workflow providing predictions to identify and address residual stress, distortion and build failure, enabling users to achieve part tolerances and avoid build failures without physical testing. It also allows to identify and dial in the best process parameters for a particular additive manufacturing machine and material combination, which leads to high level of part integrity and predicts microstructure and properties before building the part.

### Deployed in the Middle East

Many of the ANSYS solutions are developed in the U.S. and are accessible to local offices and partners.

Fluid Codes is an extension of ANSYS

### ANSYS at Paris Air Show

The 53rd Paris Air Show will be held between 17-23 June. As one of the most important global aerospace industry event, it offers the perfect opportunity to collaborate with the aerospace and defence industry of the future. ANSYS will be present at booth B52, 54, 78 - Hall 4, where you can visit them to see their latest solutions.

in the Europe, Middle East and Africa providing exclusive distribution and technical support through their offices in UAE, Saudi Arabia and Bulgaria.

*Example 1. Developing Precision Guided Munitions at Halcon Systems using ANSYS:*

UAE based Halcon Systems has been using ANSYS since the day of inception in the design, simulation and evaluation of precision guided munitions locally. Kobus Mouton, Technical Adviser at Halcon Systems described the importance of prediction and the role played by ANSYS and Fluid Codes in supporting the company to speed up their design process through Extensive Engineering Simulation.

*Example 2. Designing Armoured Personnel Carriers at Ultimate Armour Works using ANSYS*

Ultimate Armour Works, a UAE-based armoured vehicles manufacturer showcased the benefits of using ANSYS to simulate various scenarios such as blast and impact analysis on commercial and military armoured vehicles. Paul Jordaan, Design Manager at Ultimate Armour Works explained how they leveraged ANSYS to ensure product quality, save time and millions of dollars spent in physical testing of their prototypes.





## Converted R22 Helicopter Completes First Unmanned Drone Test Flight

**R**obinson-22 helicopter, converted by UAVOS to unmanned drone, successfully completed in-air programmed missions. Its first flight, with a duration of more than one hour, was fully self-piloted reaching a height of up to 2200ft (670m). During the flight, all scheduled tests were performed including fully automatic take-off, en-route flight and landing. Tuning of UAV control settings was completed as well.

The components, manufactured by UAVOS, such as autopilot, servo drives, sensor system and additional backup power supply were installed into R22-UV helicopter.

During the conversion, the aircraft electrical system was upgraded, manual

control was removed, and the fuselage was altered for servo drives and components of the automatic control system installation. In addition, the pilot seats were removed and replaced by additional fuel tanks.

The converted R22-UV is an instrumental platform for future research and testing of various commercial options. In the scope of the next test flights, cargo delivery of up to 330lb (150kg) in the automatic mode is scheduled. Flights with duration of six plus hours using additional fuel tanks and a payload for monitoring the land

surface are also planned. Besides that, there are plans to check operational limitations of the UAV during night flights and flights under severe weather conditions. One of the top priorities is to test possibility of using spraying equipment and to check whether R22-UV fits for agricultural purposes.



## Turkish Aerospace Debuts Multirole Heavy Combat Helicopter

**T**urkish Aerospace exhibited ANKA-AKSUNGUR and Multirole Heavy Combat Helicopter for the first time at the International Defense Industry Fair (IDEF) 2019, recently in Turkey.

Turkish Aerospace, which extended its product range and made a great impression in the international market, took part in IDEF'19 with ANKA-

AKSUNGUR, Multirole Heavy Combat Helicopter, T129 ATAK, GÖKBAY, ANKA and HÜRKUŞ. Moreover, a new mobile game application named "Operation ANKA" was launched for the first time at the show. The President and CEO Prof. Temel Kotil emphasised the importance of IDEF'19 and the role of Turkish Aerospace as Turkey's leading aviation

company in the defence industry.

He said: "We were aiming to revive our international customer potential at IDEF'19. Our full range of products including AKSUNGUR and Multirole Heavy Combat Helicopter, developed this year, of which we are very proud, were shown at IDEF. We feel proud to present in our country the full range of our products and studies, which are conducted in accordance with international standards and requirements. Turkish Aerospace will become more prominent in the international aviation and defence sector with its projects developed by domestic engineers".



## Norway Selects Schiebel for Arctic 2030 Project

Norway's Andøya Test Center selected Schiebel's CAMCOPTER S-100 Vertical Takeoff and Landing (VTOL) Unmanned Air System (UAS) for extensive search and rescue trials as part of the Arctic 2030 project.

The CAMCOPTER S-100 was selected for its reputation and its successful record of accomplishments in the maritime domain with customers all around the world. In a typical configuration, the UAS operates six hours continuously and is able to simultaneously carry multiple payloads, offering significant flexibility to the user.

The S-100 also offers a number of key advantages for naval operations in the Arctic. As a VTOL platform, the

CAMCOPTER does not require any additional start or recovery equipment and its minimal footprint is perfect for offshore patrol vessels (OPVs) with small deck sizes. It also distinguishes itself through its ability to perform in the harshest weather conditions, flying at temperatures down to -40°C.

The goal of the Andøy Municipality project is a demonstration of VTOL UAS use in the Arctic region in an effort to increase maritime safety. For this purpose, the CAMCOPTER S-100 will be equipped with an Electro-Optical/Infra-Red (EO/IR) camera gimbal, an Overwatch Imaging PT-8 Oceanwatch payload, an Automatic Identification System (AIS) receiver



and a Maritime Broadband Radio (MBR) by Radionor.

Tests are scheduled to commence in the fall of 2019 with the UAS being deployed from Norwegian Coast Guard vessels in Andfjorden, Northern Norway. More operations are planned in Spitsbergen in the spring of 2020.

## DynCorp Wins AFM II Contracts

On April 26, the U.S. Army Contracting Command at Redstone Arsenal awarded DynCorp International (DI) a contract for Aviation Field Maintenance (AFM) and Sustainment Level Maintenance for the AFM Directorate (AFMD) in the West region. The total value of the contract is not to exceed US\$1.1 billion and the period of performance is May 13, 2019, through August 12, 2027, if all options are exercised.



On May 15, the U.S. Army Contracting Command at Redstone Arsenal awarded DI a contract for AFM and Sustainment Level Maintenance for the AFMD in the East Region. The contract is a one-year base with seven one-year options, with a total contract ceiling not to exceed \$2.447 billion. The work involves programme management, aircraft and ground support equipment maintenance, as well as

aircraft modifications, and other logistical support to aviation customers worldwide.

"We are honoured to have been selected to support this critical mission for the U.S. Army," said Joe Ford, president of DynAviation.

This work is similar to the Regional Aviation Sustainment Management (RASM) – West Region contract, which DI has supported since May 2013.

## Diehl Aviation Produces 3D-Printed Serial Part

**D**iehl Aviation recently delivered one of the largest, fully 3D-printed parts for passenger aircraft, which is installed on an A350 XWB. The module, made using the FDM procedure, is a Curtain Comfort Header – a complex enclosure for the curtain rail, that can measure up to 1140 x 720 x 240 mm.

The curtains separate the classes from one another within the cabin. A Middle Eastern airline will be the first airline to use the 3D-printed Curtain Comfort Header on board its aircraft.

In a joint project, Diehl Aviation and Airbus developed the curtain header in close co-operation. With only 12 months between the first improved



concept, until delivery of the first ready-to-use model, the project always was on the fast lane.

One complete Curtain Comfort Header is comprised of up to 12 component parts – all produced by a 3D printer and simply glued together when complete.

This new production procedure has made many of the old, individual tools – which had previously been absolute-

ly essential for manufacturing these parts – redundant.

Given these many advantages, Diehl Aviation is now only producing Curtain Comfort Headers for the A350 XWB with the 3D printing method. Furthermore the parts themselves require less reworks and can easily be removed for repairs or replacement, contributing to even shorter waiting times during repair works.

## Northrop Grumman Delivers First Command Center for IBCS

**N**orthrop Grumman Corporation has recently delivered to the U.S. Army the first production-representative engagement operations center (EOC) for the Integrated Air and Missile Defense (IAMD) Battle Command System (IBCS). "This milestone is testament of the significant progress toward operational capability that will make pivotal differences to warfighters, commanders and acquisition officials," said Dan Verwiel, vice president and general manager, missile defense and protective systems, Northrop Grumman. "We will be delivering more EOCs as well as IBCS integrated fire control network (IFCN) relays in the near future. These articles will be used for initial operational test and evaluation (IOT&E), which informs

future production decisions."

The delivered IBCS EOC has completed all functional configuration audits for major configuration items and system verification review, and is representative of the production configuration for hardware and software that will undergo qualification testing before IOT&E. Northrop Grumman is on pace to deliver 11 EOCs and 18 IFCN relays for the IBCS programme by the end of the year.

IBCS is a paradigm shift for IAMD by replacing legacy stove-piped systems with a next-generation, net-centric approach to bet-

ter address an evolving array of threats. The system integrates disparate radars and weapons to construct a far more effective IAMD enterprise. IBCS delivers a single integrated air picture with unprecedented accuracy as well as broader surveillance and protection areas.





## Raytheon Provides U.S. Marines with Naval Strike Missiles

Raytheon Company will integrate the Naval Strike Missile (NSM) into the U.S. Marine Corps' (USMC) existing force structure under a US\$47.59 million Other Transaction Authority agreement with Marine Corps Systems Command. A USMC NSM supports the 2018 National Defense Strategy and Commandant of the Marine Corps modernisation efforts.

NSM is a long-range, precision strike missile that can detect and destroy heavily defended land and sea targets at long distances. In 2018, the U.S. Navy

awarded Raytheon a contract to manufacture and deliver NSM as the Navy's over-the-horizon weapon system for littoral combat ships and future frigates. The Marine Corps' selection of the Navy's anti-ship missile enhances joint interoperability and reduces costs and logistical burdens.

"This fifth-generation missile adds another dimension for sea control operations and for protection from adversary warships," said Kim Erzen, vice presi-

dent of Raytheon Air Warfare Systems. NSM is the latest product produced in partnership with Norway and its defence leader Kongsberg. A mobile, land-based NSM is deployed with Poland's coastal defence forces.



## Nexter Displays Know-How at SOFINS

Nexter was recently present at SOFINS, an event dedicated to the needs of the Special Forces. As a French architect and system integrator of terrestrial defence, Nexter presented its know-how with a selection of its range of equipment adapted to this field.

A privileged partner of the Army, and many foreign ground forces and intervention groups, Nexter presented its range of products adapted to the specific needs of the Special Forces: configurable, reliable and innovative solutions for operations on difficult terrain, urban environment, for the fight against terrorism or for internal security missions.

With its experience in designing, manufacturing and supporting armoured vehicles, Nexter exhibited TITUS on its



stand. This versatile 6X6 armoured vehicle is suitable for transporting troops and equipment as well as for support. The housing for captive drone IXOS XX, automatic and centralised SYEGON tire inflation, as well as models to 1/10th representative PG Guard protection systems were also presented.

The company also exhibited its robotic products with two NERVA monitoring and reconnaissance mini-robots,

which were presented alongside a captive drone equipped with an IN-PIXAL optronic ball.

The Nexter range of digitised solutions was also highlighted: visitors discovered the FINDMP touch-table decision support system, the FINDSAT satellite "blue force tracking" system, the FIND-ADFI connected headset, the digitised FINDDCN combat logbook and the FINDART fire control system.

# Saab Showcases Naval Expertise at IMDEX

Saab was recently present at IMDEX Asia 2019, an international maritime defence exhibition and conference, which took place at the Changi Exhibition Centre in Singapore. IMDEX Asia is a key event for the expanding Asia Pacific naval market and Saab's strong presence at the show underlined the company's

long-standing commitment to the Republic of Singapore and to support its growing business across the entire region.

"Saab is utterly unique in the naval domain," said Dean Rosenfield, Head of Saab Asia Pacific. "We are the only company with the in-house skills to deliver advanced combat

vessels and submarines plus all of the weapons, sensors, fire control and C2 systems that complete the maritime battlespace. Saab also develops, supplies and sustains all the essential enabling systems on land and in the air that ensure a full-spectrum naval defence and security capability."

*At IMDEX Asia 2019, Saab exhibited products and solutions from its portfolio across the maritime and air domains. It included:*

**Next-generation Warship and Submarine Technology**

Saab is building the A26 submarine, one of the world's most modern conventional submarines. The A26 is eminently suited to global operations but, as a modular design, it can also be closely tailored to the specific needs of individual nations. Saab's next-generation corvette brings advanced technology and smart design to the surface fleet. With a displacement of around 2,000 tonnes, long submerged endurance through the Stirling AIP system and a highly flexible payload capacity, the A26 will be a formidable defence asset. Incredible stealth, supreme intelligence gathering ability, mine searching and clearing capabilities with remote automated vehicles and a defence arsenal of heavy torpedoes are just a glimpse of the A26's capabilities.

The Swedish Navy has ordered the first two next-generation A26 submarines to be built by Saab at its Karlskrona shipyard. In parallel with the



A26 submarine

## Australia's Collins submarine remains one of the world's best conventional-powered submarines

A26 build programme, Saab will also upgrade the Swedish Navy's Gotland Class submarines. By modernising the fleet mid-life with new capabilities, the

Navy will maintain full underwater operational capability to ensure it meets today's defence challenges.

Sweden's Gotland Class and Australia's Collins Class submarines are 'cousins' sharing the same design philosophies developed by Saab in the late 80s–early 90s. The first of each submarine class was also commissioned the same year – 1996.

Australia's Collins submarine remains one of the world's best conventional-powered submarines in the world. The new A26 sets the bar high for future underwater defence capability.

**Combat and Patrol Boats**

Saab's proven and trusted Combat Boat 90 (CB 90) and Patrol Boat (Interceptor) families are in service with



The Combat Boat 90 H is an all aluminium fast assault craft





Interior of SAAB's Interceptor



Saab's Patrol Boats are in service with navies and coast guards worldwide

navies and coast guards worldwide. These fast and agile craft can be integrated with numerous advanced systems from Saab to enhance littoral capabilities.

The Combat Boat 90 H is an all aluminium fast assault craft, heavily reinforced for forceful landing on unprepared beaches. It is capable of transporting 20 soldiers and cargo at more than 20 knots. The general arrangement shows a typical high-speed chine form hull, with reverse sheer and a narrow 1-man landing ramp forward. The aft 25 per cent of the hull, behind an insulated watertight bulkhead, is dedicated to the machinery consisting of two 460 kW Scania DSI 14 diesel engines driving KaMeWa

FF water jets. A cabin with seating for 20 troops, together with their equipment, occupies the mid-body of the craft. The wheelhouse "module" is splinter protected and located between the troop compartment and the bow ramp landing area. The space accommodates the helmsman to starboard and the CO/navigator to port in a compact, cockpit type layout with an extra chair in the centre line for an instructor/troop commander.

The weapon fit comprises a 12.7 mm machine gun (or a 40 mm grenade launcher) carried on a ring mount aft of the wheelhouse and a double 12.7 mm mounted in front of the helmsman's position. The twin mount is fixed in traverse and aimed by pointing the craft



Swedish Navy's Gotland Class submarines

– hence the elevation and fire controls are incorporated in the manoeuvring levers at the helmsman's position. Additionally, the CB 90 H can also carry 2.8 tonne of mines or the modified Hellfire-type RBS 17 SSM system.

#### Naval Combat Systems, Missiles and Radars

Saab can deliver the complete range of naval warfare capabilities, including the 9LV combat management system, Sea Giraffe radar, CEROS and EOS fire control systems, electronic warfare and TactiCall communications – all fully integrated with every class of vessel. TactiCall gives complete control of, and fast access to, all internal communication networks in the system, whether it is on shore or off shore. Be



it functional nets including telephony, public address systems, entertainment systems and the like, or working nets handling alarms, broadcasts and orders. TactiCall puts you in charge.

#### **Saab's Lightweight Torpedo (SLWT)**

It is an anti-submarine warfare (ASW) solution that gives total control to naval forces worldwide. SLWT is based on over 100 years of underwater systems experience. It provides best-in-class capabilities today, but is ready for the challenges of tomorrow. SLWT incorporates a fully digital homing system, offers fire-and-forget and wire-guided operation, and adapts to difficult hydroacoustic conditions. It can also be launched from multiple platforms, ensuring success in any

environment. SLWT offers outstanding operational flexibility. It performs equally well in both shallow and blue water, as well as under cold, warm and brackish conditions.

#### **GlobalEye**

With its all-new Erieye ER radar, advanced C4I and multi-mission capabilities, GlobalEye uniquely combines the roles of airborne early warning and control, maritime patrol and ground surveillance all in a single platform.

#### **Advanced UAV Systems**

Saab, together with its partner UMS Skeldar, has a leading role in the provision of next-generation systems like the rotary V-200, and the essential integration of these systems into the operational networks at sea.

#### **ROV and AUV Systems**

Saab is one of the world's leaders in remotely operated and autonomous underwater systems for complex missions. The unique Multi-Shot Mine Neutralisation System (MuMNS) shows how the highly reliable and adaptable vehicles can be used in many roles, including live operational mine clearance, peacetime operations against historical ordnance, mine investigation and underwater demolitions. The MuMNS is a unique system exclusive to Saab. It consists of three sub-systems: a vehicle, a Mine Disposal Magazine, and a Mine Disposal System. This modularity means that MuMNS has an inherent flexibility and can be modified to meet specific operational requirements.

The vehicle includes a control and display unit, a Launch and Recovery System (LARS) and a Winch. The Mine Disposal Magazine, known as Storm, is designed as a tooling skid, which allows the vehicle to be reconfigured and used for different tasks. The magazine can be fitted to Saab's complete range of vehicles – both defence and commercial.

The third sub-system is the Mine Disposal System, which is loaded into each of the magazine's silos. It combines the mine disruptor with an integrated Remote Command Initiated System (RCIS), producing an operational vehicle with greater flexibility than the current one-shot disposal systems.

Saab's vessel traffic and port management systems control harbours of all sizes and complex traffic flows in waterways or coastal regions. The company's complete range of maritime traffic systems secure safe travel and support economic growth.

Reference Text/Photos:

[www.saabgroup.com](http://www.saabgroup.com)

# QinetiQ Bags C\$51 M UAS Contract



**Q**inetiQ was recently awarded a C\$51 million contract to deliver unmanned aircraft systems (UAS) that will drive enhanced situational awareness for the Canadian Armed Forces. The contract will be delivered from the company's unmanned vehicle manufacturing and operational facilities in Medicine Hat, Alberta, Canada.

The vertical take-off UAS will provide Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) services to the Royal Canadian Navy and Special Operations Forces Command, for both domestic and international operations. The system, based on the UMS SKELDAR V-200 UAS, will be equipped with a number of sensors including an Active Electronically Scanned Array (AESA) radar and Electro-optic infrared (EO/IR) camera.

Robert Aube, Managing Director of QinetiQ in Canada said: "We are delighted with this contract win to deliver critical over-the-horizon situation awareness to the Royal Canadian Navy and Special Operations Forces Command. This generates tactical advantages for commanders while minimising the risk to manned helicopters and personnel. As a result of the contract, we will be pleased to see a large number of jobs created in the Southern Alberta region where UAS repair and overhaul services will be carried out."

While Iain Farley, Managing Director International

Business at QinetiQ added: "International growth is a core part of QinetiQ's strategy and to facilitate this, we continue to make significant investments in our subsidiary businesses and complementary acquisitions. This contract provides an important proof point that this strategy is delivering. The investment we have made in Canada has helped secure our largest Canadian contract to date and provides us with a solid foundation for delivering further QinetiQ products and services into the Canadian market and beyond."

## Strategic Partnerships

QinetiQ will work with four principal partners to deliver the ISTAR services.

**Canadian-UAV:** The company is a Calgary-based solutions provider focused on safety-first data acquisition for unmanned aerial vehicle applications. CUAV provides a range of custom and innovative UAV solutions for industrial environments where advanced imaging is necessary for surveying on an iterative or fixed-point basis.

Sean Greenwood, President, and CEO of Canadian UAV said: "It's a privilege and an honour to be able to work with the Canadian Armed Forces and QinetiQ, especially on such a novel project. This is the foundational contract the Canadian UAV industry has been waiting for to become world-class in autonomous vehicle service delivery and technology development. QinetiQ's recognition of CUAVS' work to date with Transport



Canada in developing advanced UAV operations and their commitment to supporting local SMEs has been fundamental to our growth and cannot be understated."

**UMS SKELDAR:** A joint venture between Saab and UMS AERO Group, the firm is Europe's leading provider of Rotary Unmanned Aerial Vehicle (UAV) platforms, including the NATO-compliant rotary SKELDAR V-200 and the ITAR-free light-tactical R-350. Incorporating the Sentient Vision Systems ViDAR (Visual identification Detection and Ranging) payload into its vertical take-off & landing (VTOL) fleet, UMS SKELDAR is engaged in a highly active research and development programme, and provides solutions to a wide variety of defence, civil security and maritime sectors globally.

"This is an important contract win for us alongside our partners including QinetiQ and confirms our stated strategic commitment to working with

global navies following our announcement last year with the German Navy," explained Axel Cavalli-Björkman, CEO of UMS SKELDAR. "With multiple systems to be delivered in Q3 this year, the Royal Canadian Navy has secured a maritime UAV platform that not only includes our heavy fuel engine manufactured by German-based Hirth Engines, but also has an ability to carry multiple payloads."

**Leonardo:** A global high-technology company, Leonardo is among the top 10 world players in Aerospace, Defence and Security and Italy's main industrial company. Organised into five business divisions, Leonardo has a significant industrial presence in Italy, the United Kingdom, Poland and the U.S. Wayne Smith, Head of Radar Campaigns from Leonardo highlighted: "We are pleased to be a part of this project with QinetiQ. Our PicoSAR AESA radar provides an unrivalled all-weather capability for UAS. It delivers

## International growth is a core part of QinetiQ's strategy

a high resolution Synthetic Aperture Radar imaging and Ground Moving Target Indication capability that will allow the SKELDAR V-200 to easily acquire a true, all-weather ground mapping and surveillance capability."

**L3 Wescam:** L3 WESCAM is a world leader in the design and manufacture of stabilised, multi-spectral imaging systems and system solutions.

"L3 WESCAM is proud to have been chosen by QinetiQ, as it confirms our role as a trusted global supplier of advanced imaging technologies to the UAS market," said Cameron McKenzie, Vice President, Global Sales & Business Development, L3 WESCAM. "This order marks many strategic firsts for WESCAM in the Canadian marketplace, including a first for our MX Series turrets to be used by the Royal Canadian Navy, a first order for our MX-8 and MX-10D in Canada and our first contract with QinetiQ in Canada."

Reference Text/Photos:  
[www.qinetiq.com](http://www.qinetiq.com)

NATO-compliant rotary  
SKELDAR V-200



SKELDAR V-200 flight with  
extra payload





# Raptor Takes To Sky With Blue Angels

In a historic moment for aviation, the F-22 Raptor Demonstration Team flew alongside the U.S. Navy Blue Angels creating a rare formation over the skies of Beaufort, South Carolina, during the Marine Corps Air Station Beaufort air show on April 25th. The

two aerial demonstration team came together to create the never-before-seen flight of both the F-22 Raptor and F/A-18 Hornet.

According to F-22 Raptor Demonstration team commander Maj. Paul Lopez, the feat represented the profes-

sionalism and excellence of the United States military. In his statement Maj. Lopez commended the maintenance team for their vital role in making the mission a reality. "Flying alongside the Blue Angels was an incredible experience and seeing it all from the cockpit



U.S. Navy Maj. Jeff Mullins, Blue Angels #4, about the possibility of getting the two teams together. After months of deliberations between both teams and matching aircraft capabilities, what started as ‘what if’ was realised when the world’s premier fifth-generation fighter flew alongside the iconic blue and gold of the U.S. Navy Blue Angels.

#### **Modernisation to Defeat Emerging Threats**

The F-22 is critical component of the Global Strike Task Force. The fifth generation F-22’s unique combination of stealth, speed, agility and situational awareness make it one of the best fighters in the world with lethal long-range air-to-air and air-to-ground weaponry system. With its Supercruise, better manoeuvrability, integrated avionics, and improved supportability, F-22 represent an exponential leap in warfighting capabilities.

With capabilities crucial to 21st century Air Force missions, F-22 projects air dominance rapidly and at great distances and defeats threats attempting to deny access to Air Force, Army, Navy and Marine Corps. Its ability to collect and share tactical information with friendly assets enables the U.S. and

allied forces to engage targets with unmatched battlespace awareness, as well as makes other coalition aircraft more survivable.

The F-22 possesses a sophisticated sensor suite that allows the pilot to track, identify, shoot and kill air-to-air threats before being detected. Furthermore, significant advances in cockpit design and sensor fusion improve the pilot’s situational awareness. In the air-to-air configuration, the Raptor carries six AIM-120 AMRAAMs and two AIM-9 Sidewinders. The Raptor also has a significant capability to attack surface targets, and it can carry two 1,000-pound GBU-32 Joint Direct Attack Munitions. It is expected to be further enhanced with the addition of an upgraded radar and up to eight small diameter bombs. The Raptor will also carry two AIM-120s and two AIM-9s in the air-to-ground configuration. The aircraft will use onboard avionics for navigation and weapons delivery support.

With advances in low-observable and stealth technologies, F-22 brings improved survivability and lethality against air-to-air and surface-to-air threats. It can not only protect itself, but other assets as well. The combina-

of the F-22 is something I will never forget,” he added.

The concept for the unique formation began when cofounder of 3G Aviation Media, Douglas Glover, who is also the mastermind behind coordinating the dissimilar formation, reached out to



**Loading a bomb onto an F-22 Raptor during the Weapons Load Crew Competition**



tion of sleek aerodynamic design and increased thrust allows the F-22 to cruise at supersonic airspeeds (greater than 1.5 Mach) without using afterburner - a characteristic known as Supercruise.

Supercruise greatly expands the F-22's operating envelope in both speed and range over current fighters, which must use fuel-consuming afterburner to operate at supersonic speeds. The combination of reduced observability and Supercruise accentuates the advantage of surprise in a tactical environment.

The F-22 design has been extensively tested and refined aerodynamically during the development process to enable it with sophisticated aero design, advanced flight controls, thrust vectoring, and high thrust-to-weight ratio that allows it to outmanoeuvre all current and projected aircraft. The combination of stealth, integrated avionics and Supercruise will drasti-

cally shrink the surface-to-air missile engagement envelope and minimise enemy capabilities to track and engage the F-22. Increased reliability and maintainability in F-22 also pays off in less manpower required to fix the aircraft and the ability to operate more efficiently. The F-22, reportedly, will have better reliability and maintainability than any fighter aircraft in history.

#### **F-22 Evolution**

The Advanced Tactical Fighter entered the Demonstration and Validation phase in 1986, with the prototype aircraft, YF-22 and YF-23 completing their first flights in late 1990. Ultimately, the YF-22 was selected as best of the two and the engineering and manufacturing development effort began in 1991 with development contracts for airframe and engine to Lockheed/Boeing and Pratt & Whitney respectively. Engineering, Manufacturing and Development included extensive subsys-

tem and system testing as well as flight testing with nine aircraft at Edwards Air Force Base, California. The first EMD flight was in 1997 and at the completion of its flight test life, the aircraft was used for live-fire testing.

Subsequently, the programme received approval to enter low rate initial production in 2001. Initial operational and test evaluation by the Air Force Operational Test and Evaluation Center was successfully completed in 2004. Based on the maturity of design and other factors in the programme received approval for full rate production in 2005. The aircraft designation was the F/A-22 for a short time before being renamed F-22A in December 2005. Air Education and Training Command, Air Combat Command and Pacific Air Forces are the primary Air Force organisations flying the F-22.

Reference Text/Photos

[www.af.mil](http://www.af.mil)

[www.lockheedmartin.com](http://www.lockheedmartin.com)



F-22 Demo Team commander flies above the U.S. Navy Blue Angels

# Nexter Robotics Heads to Canada

**N**exter, a KNDS group company, recently announced that it has officially been selected by the Canadian government to supply the Canadian Army with 88 multi-purpose robots.

Furthermore, Nexter Systems will provide overall HRS-ROV programme and configuration management for the delivery of 79 NERVA-LG and 9 NERVA-XX robots through its subsidiary Nexter Robotics. The team includes Nexter Robotics and ECA Robotics for the supply of the robots, and Deltic Group (Oakville, Ontario, Canada) for the In-Support (ISS). The HRS-ROV contract has a value of C\$6 million CAD GSTE (4 million EUR).

"We are honoured that the Department of National Defense and Public Services Procurement Canada found our team and robots best suited to the Canadian needs for this programme," said Nexter Robotics Deputy General Manager Joël Morillon.

A pioneer in its field, Nexter Robotics' is known to be fully dedicated to unmanned military and security systems.

## Multi-Mission Robotic Systems

The NERVA range represents the best-in-class technology in multi-mission robotic systems. The NERVA-LG ranks high here thanks to its robustness and waterproofness that allows it to be thrown on any terrain. It can easily be controlled from any standard PC, tablet or smartphone, and proposes semi-autonomous capabilities to reduce operator workload.

NERVA LG robotic system is a light, versatile platform, and an associated control station. The four cameras and microphone that are equipped in the robot make it immediately usable to perform long-range observation missions. The platform is compatible with more than 20 optional "Missions Kits" which extend the set of missions.

These characteristics, when coupled with NERVA-LG's wide range of payloads, make Nexter Robotics' solution an efficient tool for all types of situations.

## Meeting Defence Needs

Nexter is a leading French land defence company that meets the needs of the

French land forces and of nations on an international scale. The scope of its business also includes supply of weapon systems and ammunition for air and naval forces. The company also provides systems and protection solutions in the field of homeland security. The group continues to apply its international development policy with 58 per cent of the order intake in 2017 intended for the export market.

In France, Nexter is committed to meeting the objectives of the SCORPION programme, through the upgrade of the Leclerc tank and the development of the future VBMR Griffon and EBRC Jaguar vehicles within the temporary business venture between Nexter, Thales and Arquus, as well as the Lightweight VBMR. The group's range of products also includes ARAVIS, TITUS and VBCI armoured vehicles, CAESAR, TRAJAN and 105LG1 artillery systems, smart ammunition (BONUS), among other equipment, as well as provides customer service, support and revaluation.



NERVA robotic system





# Celebrating 60 Years of Supersonic Talon

**On** April 10, 1959, at Edwards Air Force Base, California, U.S., Lew Nelson took to the skies for the very first time in a Northrop Grumman built T-38 Talon. Serving critical missions for six decades, the admired T-38 has consistently performed and has assisted in flight training exercises for 80,000 pilots. And thanks to its various modernisations, the aircraft has maintained low operating costs, is maintenance-friendly and has a great safety record.

Said to be one of the safest supersonic airplanes ever built, the twin-engine, high-altitude, jet trainer, can fly at a maximum speed of 858 mph and can climb from sea level to 33,600 feet in 60 seconds. Out of the 1,187 aircraft produced between 1959 and 1972, half are still in use today!

## Major Milestone

Northrop Grumman recently celebrated the 60th anniversary of the T-38 Talon's first flight with the U.S. Air Force at an event hosted by Air Education and Training Command at Randolph Air Force Base, Texas.

Major General Patrick Doherty 19th Air Force Commander was quoted saying, "This aircraft will always be remembered in our Air Force and in our nation as being one of excellence that has produced the number one Air Force in the world."

John Parker, vice president and general manager, global logistics and modernisation, Northrop Grumman, attended the event and discussed the contributions of the T-38 programme to the aviation industry.

"Northrop Grumman is proud to be a member of the T-38 sustainment community," said Parker. "Over the past several decades, the sustainment community has conducted numerous engineering and logistics analyses, combatted



U.S. Air Force and Northrop Grumman Celebrate 60 Years with the T-38 Talon Aircraft



parts obsolescence and ensured that spare parts were available to maintain flight operations. Few weeks ago, the U.S. Air Force Life Cycle Management Center awarded Northrop Grumman a US\$22 million contract for T-38 and F-5 for the system's sustainment and engineering. We look forward to continuing the system modernisation and upgrades for this agile aircraft so it stays mission ready for years to come." More than 1,100 T-38s were delivered to the U.S. Air Force before production ended in 1972; more than 500 are still in service. As the T-38 fleet has aged, specific airframe, engine and system components have been modified or replaced. Now known as the T-38C, the aircraft boasts a variety of Pacer Classic modifications. Pacer Classic is the name given to a sustainment programme that integrates essential modifications, and includes major structural replacements into one process.

#### **World's First Supersonic Trainer**

T-38 Talon was considered as the world's first supersonic trainer when it entered service. Northrop Grumman Corporation has produced a replacement wing for the T-38 that will help to extend the service life of the aircraft, introduced in 1961, until at least 2020. T-38 wings are single units from tip to tip, constructed of aluminium alloys with control surfaces reinforced with internal honeycomb. Design improvements developed from usage were retrofitted into many operational T-38's. Every T-38 Talon built by Northrop Grumman was delivered on time, at or below the contract price and with performance as promised. The final T-38 was delivered to the Air Force in 1972.

#### **Key Features**

The T-38 has swept wings, a streamlined fuselage and tricycle landing gear with a steerable nose wheel. Two



**T-38 wings are single units from tip to tip**

independent hydraulic systems power the ailerons, rudder and other flight control surfaces. Critical aircraft components are waist high and can be easily reached by maintenance crews.

The T-38C incorporates a glass cockpit with integrated avionics displays, head-up display and an electronic "no drop bomb" scoring system. The AT-38B has a gun sight and practice bomb dispenser.

The T-38 needs as little as 2,300 feet (695.2 metres) of runway to take off and can climb from sea level to nearly 30,000 feet (9,068 metres) in one minute. T-38s modified by the propulsion modernisation programme have approximately 19 per cent more thrust, reducing take-off distance by 9 per cent. The instructor and student sit in tandem on rocket-powered ejection seats in a pressurised, air-conditioned cockpit.

#### **Preparing Pilots**

The U.S. Air Force has used the T38 for over half a century for specialised undergraduate pilot training. Air Education and Training Command (AETC) uses the T-38C to prepare pilots for front-line fighter and bomber aircraft

such as the F-15E Strike Eagle, F-15C Eagle, F-16 Fighting Falcon, B-1B Lancer, A-10 Thunderbolt and F-22 Raptor. AETC began receiving T-38C models in 2001 as part of the Avionics Upgrade Programme. Advanced Joint Specialized Undergraduate Pilot Training (JSUPT) students fly the T-38C in aerobatics, formation, night, instrument and cross-country navigation training. Test pilots and flight test engineers are trained in T-38s at the U.S. Air Force Test Pilot School at Edwards Air Force Base, California, and Air Force Materiel Command uses the T-38 to test experimental equipment such as electrical and weapon systems.

Pilots from most NATO countries train in the T-38 at Sheppard AFB, Texas, through the Euro-NATO Joint Jet Pilot Training Programme. Furthermore, the National Aeronautics and Space Administration uses T-38 aircraft as trainers for astronauts and as observers and chase planes on programmes such as the space shuttle.

Reference Text/Photos:

[www.Northropgrumman.com](http://www.Northropgrumman.com)

[www.Af.mil](http://www.Af.mil)

# Boeing Opens New Frontiers for Space Exploration

Recently, Boeing unveiled its Gateway Demonstrator, a prototype of the deep-space outpost that is key to the U.S.' plan to return astronauts to the moon's surface within five years. The Gateway will be a small spaceship in orbit around the Moon that will provide access to more of the lunar surface than ever before with living quarters for astronauts, a lab for science and research, ports for visiting spacecraft, and more.



Boeing's Gateway concept featuring the habitat design



Lockheed Martin's Gateway Concept

NASA contracted with Boeing and five other companies in August 2016 to design and build ground-based Gateway prototypes. The Gateway will act as a reusable moon-orbiting exploration hub, a technology test bed, and a research base for government and private organisations. It will enable crewed and robotic missions in lunar orbit, on the moon's surface, and eventually to Mars.

Boeing built and is testing its demonstrator at NASA's Marshall Space Flight Center in Huntsville, Alabama. The demonstrator's design is based on the International Space Station (ISS) modules that Boeing built and has supported for more than 20 years – ex-

cept with 30 per cent more habitable volume in each module.

"Our Gateway engineering is well beyond Systems Requirements Review maturity and leverages the flight-proven structural design heritage of ISS," said Mark Ortiz, Boeing programme manager for the Gateway Demonstrator.

The demonstrator includes prototypes of a habitation module (Hab) and airlock module that are designed to be launched into space on a Space Launch System rocket and assembled on orbit around the moon.

Boeing's Gateway concept can host a crew with only the Hab module and a Power and Propulsion Element (PPE)

that the company also is developing for NASA. The PPE, with a design derived from Boeing's successful 702 satellite line, will be able to guide the Gateway into various orbits around the moon to serve different mission needs.

## Unique Habitats

NASA is conducting a series of ground tests inside five uniquely designed, full-size, deep space habitat prototypes. The mock-ups, constructed by five American companies, offer different perspectives on how astronauts will live and work aboard the Gateway – the first spaceship designed to stay in orbit around the Moon, providing the critical infrastructure needed for exploration,



Northrop Grumman's Gateway concept featuring their habitat design



Sierra Nevada's Gateway concept

science and technology demonstrations on the lunar surface.

NASA doesn't plan to select one habitat prototype to advance to flight – rather, the tests will help NASA evaluate the design standards, common interfaces, and requirements for a future U.S. Gateway habitat module, while reducing risks for eventual flight systems.

"These tests were formulated so that we can do a side-by-side comparison of very different and innovative concepts from U.S. industry," said Marshall Smith, who leads human lunar exploration programmes at NASA Headquarters in Washington. "While we won't dictate a specific design when

we procure the U.S. habitat, we will enter the procurement phase with far less risk because of the knowledge we gain from these tests."

NASA assembled a team from across the agency and from U.S. industry to conduct these tests. Engineers and technicians will analyse habitat system capabilities and performance proposed by each prototype concept, while human factors teams consider layout and ergonomics to optimise efficiency and performance. During the tests, future Gateway flight operators at NASA's Johnson Space Center in Houston will collect actual live telemetry streams from each prototype. Flight operators will monitor habitat

performance and support realistic mission activities as astronauts conduct "day-in-the-life" procedures within each habitat prototype, providing their perspectives as potential crew members who may one day live and work aboard the Gateway.

In addition to the physical enclosure, each company has outfitted their prototype with the basic necessities to support humans during deep space expeditions—including environmental control and life support systems, avionics, sleeping quarters, exercise equipment, and communal areas.

#### Reaching for the Moon

"This prototyping approach allows us to design, build, test and refine the habitat long before the final flight version is developed," said NASA astronaut Mike Gernhardt, principal investigator of the agency's habitation prototype test series. "We are using this operational-driven engineering approach to gain an early understanding of exactly what we need to address the mission, thereby reducing risk and cost."

Using this approach, the builders, operators, and future users of the Gateway work together to evaluate concepts earlier and more completely, which helps NASA move forward to the Moon as early as possible.

#### Range of Prototypes

Following are some of the other prototypes that are under testing:

#### Lockheed Martin – Testing at NASA's Kennedy Space Center, Florida

The Lockheed Martin prototype is based on a Multi-Purpose Logistics Module (MPLM), which was originally designed to provide logistics capabilities for the ISS. The design leverages the capabilities of Lockheed's robotic planetary spacecraft and the Orion capsule that will transport astronauts to and from the Gateway. The proto-



## The Gateway will act as a reusable moon-orbiting exploration hub, a technology test bed, and a research base

type includes a reconfigurable space that could support a variety of missions and combines hardware prototyping and software simulation during the test.

### **Northrop Grumman – Testing at NASA’s Johnson Space Center, Texas**

Northrop Grumman’s prototype leverages the company’s Cygnus spacecraft that delivers supplies to the ISS. The Cygnus took its maiden flight in 2013 and is already human-rated. The company’s habitat mock-up focuses on providing a comfortable, efficient living environment as well as different internal configuration possibilities.

### **Sierra Nevada Corporation – Testing at NASA’s Johnson Space Center, Houston, Texas**

Sierra Nevada’s Large Inflatable Fabric Environment (LIFE) habitat is designed to launch in a compact, “deflated” configuration, then inflate once it’s in space. The benefit of inflatables (also called expandables) is their final configuration that is capable of providing much larger living space when compared to traditional rigid structures, which are limited in size by the payload volume of the rocket used to launch it. The LIFE Prototype inflates to 27 ft in diameter and simulates three floors of living areas.

### **Bigelow Aerospace – Testing at Bigelow Aerospace, North Las Vegas, Nevada**

Bigelow’s B330 prototype is an expandable module that expands in

space, as its name suggests, to provide 330 cubic meters of liveable area. The company sent a smaller module, the Bigelow Expandable Activity Module (BEAM) to the space station in 2015, where astronauts expanded the structure live on NASA Television with compressed air tanks. The BEAM completed a two-year demonstration aboard the station, proving soft-goods resilience to the harsh space environment. Following its demonstration period, NASA extended BEAM’s time aboard the station to become a storage unit.

### **NanoRacks – Concept Study**

NanoRacks has proposed a concept to maximise the habitable volume for Gateway astronauts. The company’s idea is to refurbish and repurpose a spent rocket propellant tank, leveraging the natural vacuum of space to flush the tank of residual propellants. The company completed a feasibility study outlining the concept and next plans to develop full-scale prototypes demonstrating robotics development, outfitting and systems integration to convert the tank into a deep space habitat.

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Concept image of NanoRack’s habitat concept docked to the International Space Station



Bigelow’s Gateway concept

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# Made in India “INS Vela” Launched

The Indian Navy launched its fourth P75 Scorpène submarine, INS Vela, which is totally built by state-owned Mazagon Dock Shipbuilders Limited (MDL) via technology transfer and partnership with France's Naval Group. The submarine is fourth of overall six units that will be delivered to the Indian Navy through a transfer of technology (TOT) agreement.

The submarine was launched in Mumbai on May 6th, 2019. The domestically constructed vessel highlights the success of indigenous submarines construction programme under the 'Make in India' policy of the Indian Government. The six submarines were ordered by India in 2005, and constructed units have been fitted with a number of equipment built in India by qualified and highly trained industrial MSMEs, which form the sound base of submarine building ecosystem of India. The Vela launch followed the commissioning of INS Kalvari in December 2017 and launching of the INS Karanj in January 2018.

INS Vela is now set to undergo a series of harbour and sea trials run by the skilled MDL team, who will also integrate the equipment and machinery onboard, before being delivered to the Indian Navy.

According to Naval Group, P75 submarine programme demonstrates the success of technology transfer efforts, given the complexity of building submarines. "Naval Group is proud to reiterate its long-term commitment to In-



The Scorpène submarine is powered by the innovative combat system – SUBTICS







dia. The P75 programme is the key element of the strategic partnership built in the domain of submarine building, over the last decades between India and France. This launch represents a new milestone for this unique and one-of-a-kind industrial programme and illustrates the self-reliance of Indian Navy," stated Massi Begous, SVP of the international industrial development at Naval Group.

"By building upon and nurturing this know-how and skills in India, Naval Group is committed to significantly enhancing the level of indigenisation in future projects of the Indian Navy supported by the Indian Government," he added.

Capitalising on existing skills, experience and track records, the local partners reportedly have been able to adopt and integrate into their respective organisations Naval Group's stringent quality standard, procedure and requirements. Apart from the ToT agreement to build submarines, MDL has signed three contracts with Naval Group for Manufacturing/Procurement and delivery of selected submarine equipment/items commonly known as MPM (Mazagon Dock Procured Material) to be fitted in these Scorpène submarines.

Naval Group India, a subsidiary of Naval Group in India, has been assigned the responsibility for indigenisation

of selected MPM items from submarine No 3 to 6. It has hence entered into strategic partnerships with three companies including, SEC Industries Private Limited, Hyderabad for manufacturing of mechanical MPM items; HBL Power Systems Limited, Hyderabad for manufacturing of electronic MPM items; and Flash Forge Private Limited for forging items.

#### **A Multi-Mission High-Performing Stealthy Submarine**

The Scorpène is a 2,000 tonnes conventional-propulsion submarine designed and developed by Naval Group for all types of missions. Extremely stealthy and fast, it has a level of operating automation that allows having only a small crew, which reduces its operating costs significantly. Its combat edge is highlighted by the fact that it features large payload of 18 weapons with six launching tubes, minimum hydrodynamic noise and innovative combat system. Integrating the improvements from Barracuda, Scorpène 2000 has the latest cutting-edge capabilities, and it is designed to be easily adapted for improvements required by any navy.

According to Naval Group, the Scorpène submarine is suited for action and operational effectiveness, as well as designed for long-range and oceanic deployments. Robust and multi-purpose, it fulfils the entire scope of missions, such as anti-surface and anti-submarine warfare, strikes against land-based objectives, integration in a naval force, special operations, offensive mine-laying, area surveillance and blockade, intelligence gathering. Scorpène has two diesel generation sets providing 1,250kW of power, and an elastically supported 2,900kW electronic engine. At the top of the hull immediately above the diesel generator sets is a Dutch Breach machinery

shipping hatch. There are two variants of Scorpène, the CM-2000 with the conventional propulsion system and the AM-2000 equipped with air-independent propulsion. The AM-2000 is capable of remaining submerged on underwater patrol for three times longer than the CM-2000.

#### **Innovative Combat System**

The Scorpène submarine is powered by Naval Group's innovative combat system – SUBTICS. The system is sea-proven with Navy SSN and SSBN, and with the SSK of several foreign navies. It addresses the growing challenges faced during modern submarine missions in "blue" and "brown" waters. It supports detection, classification of threats to provide clear and reliable situational awareness. SUBTICS empowers the submarine with anti-surface and anti-submarine warfare, intelligence gathering, land-attack and deep strike, sea denial and area clearing, naval force support capabilities. The system is being improved further to address new missions such as anti-air warfare and UUV/deployment. SUBTICS also ensures safe, rapid and flexible weapon engagement and easy interface for enhanced force integration.

#### **Attack Ready Weapon System**

The weapon system in Scorpène is robust and features advanced self-guidance, high endurance and speed, as well as advanced acoustic counter-countermeasure. Scorpène can carry 18 torpedoes and missiles or 30 mines. It is equipped with six bow-located 21 in torpedo tubes providing salvo launch capability. The French Navy's new heavyweight torpedo, F21 in Scorpène provides exceptional performances. The weapon system fulfils the stringent French Navy requirements, like advanced self-guided mode, shallow and confined water capability, the latest generation of countermeasures

resistance and compliance with nuclear submarines safety norms.

The F21 will equip the entire French SSBN and SSN fleet, as well as the Brazilian Scorpène SSKs. The F21 is also launchable from surface ships. Thanks to its intelligence, range and firepower, it offers navies an unrivalled tactical advantage by increasing the spectrum of operational scenarios.

The submarine's weapons include anti-ship and anti-submarine torpedoes, as well as anti-surface missiles. The anti-torpedo decoy and the chemring launch module, CANTO acts completely independently. Its foundation lies in saturating the torpedo sonar and data processing by generating a permanently renewed 360° tactical picture resulting in exhausting the torpedo energy. Thanks to the small number of CANTO units needed per salvo and its compatibility most of the anti-missile decoy launchers can be easily installed on board surface vessel and submarine.

#### **Highly Stealthy**

Planning and design of the Scorpène were directed towards achieving an

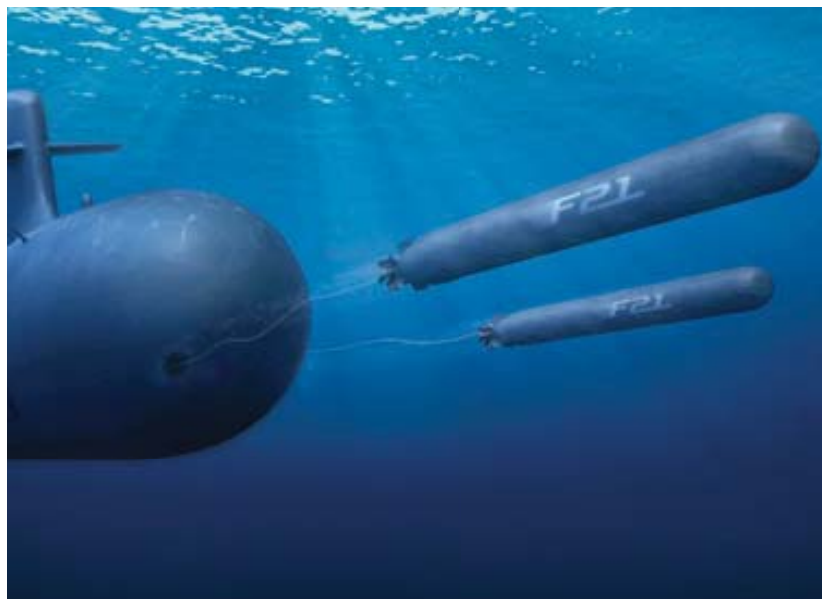
extremely quiet vessel with great detection capability and offensive power. Its hull, sail and appendage forms have been specifically designed to produce minimum hydrodynamic noise. The various items of equipment are mounted on elastic supports, which are in turn mounted on uncoupled blocks and suspended platforms. The isolation also provides better shock protection to the equipment.

#### **A Worldwide Reference For Oceanic Submarines**

Through the various genuine transfer of technologies of major equipment integrated into the P75 submarines, Naval Group has contributed to the development of skills and expertise of an industrial eco-system for the benefit of Indian Navy's self-reliance. With fourteen submarines sold to various navies across the globe, the Scorpène proposed by Naval Group has now become an essential reference product in the area of conventional attack submarines (SSK).

Reference Text/Photos:

[www.naval-group.com](http://www.naval-group.com)



The F21 heavyweight torpedo in Scorpène provides exceptional performances



## Thuraya Wins Top Innovation Award



**T**huraya Telecommunications Company, a subsidiary of Al Yah Satellite Communications Company (Yahsat), recently won the Top Mobility User Experience Solution at this year's Mobile Satellite Innovation award. The event was organised by Mobile Satellite Users Association (MSUA). The accolade was won by the Thuraya's X5-Touch device – one of the world's smartest and most innovative satellite phones. The announcement was made during the company's participation at the Satellite 2019 Conference in Washington DC, U.S.

### Fulfilling Unique Needs

The Top Mobility User Experience Solution award recognises the X5-Touch's superior usability, as well as its market-leading status, which is underpinned by a series of category-firsts. The X5-Touch is the first satellite phone to run on the Android operating system – a fundamental pillar of its award-winning flexibility and user experience. The operating system provides users with a multitude of apps on purchase, while developers gain the freedom to develop and customise bespoke apps to meet the unique needs of device

users. This complements the 'bring your own application' (BYOA) concept, where customers can download any app of their choice.

A 5.2-inch HD touchscreen protected by a rugged Gorilla glass display, front and rear camera, and high-capacity battery, bring everyday smartphone functionality to the remote environments of satellite communication. Meanwhile, the X5-Touch's omni-directional satellite antenna ensures uninterrupted communications in more than 160 countries, including a number across Africa, Asia, Australia, and Europe. In addition, full dual-mode and dual-SIM capabilities provide the flexibility to switch between satellite and terrestrial networks.

A host of safety features such as advanced navigation and tracking functions, alongside a built-in SOS button, reinforce the X5-Touch's credentials as a device built for the most remote and testing environments.

### Dependable Communications

"Congratulations to all at Thuraya for securing the award, which is testament to the inventive mind-set we encourage at every level of our organ-

isation," said Ali Al Hashemi, Thuraya CEO. "Our customers rely on dependable communications to do their job and, in many cases, remain safely connected in remote environments. With this award, the X5-Touch continues to reinforce its credentials for the most demanding of users."

The MSUA accolade isn't the first to be awarded by the association to Thuraya. In 2017, the company's XT-PRO DUAL device won the Top Land Mobility Satcom Innovation Award for a second year, after winning same title in 2014.

The Thuraya X5-Touch launched in November 2018. Just four months earlier, Thuraya and Yahsat announced an agreement that saw Yahsat acquire a majority and controlling stake in Thuraya. The agreement enabled Thuraya to significantly expand Yahsat's satellite solutions portfolio on both commercial and government fronts, while creating a strong platform to capture the growing opportunity around IoT and M2M applications across both sectors.

Reference Text/Photos:  
[www.thuraya.com](http://www.thuraya.com)



# MAGMA Demonstrates Breakthrough Technologies

In a series of flight trials that took place in the skies above northwest Wales, the MAGMA unmanned aerial vehicle (UAV) demonstrated two innovative flow control technologies, which could revolutionise future aircraft design.

MAGMA, designed and developed by researchers at The University of Manchester in collaboration with engineers from BAE Systems, successfully trialled the two 'flap-free' technologies earlier this month at the Llanbedr Airfield.

For the first time in aviation history, an aircraft was manoeuvred in flight using supersonically blown air, removing the need for complex movable flight control surfaces. This new concept for

aircraft control removes the conventional need for complex, mechanical moving parts used to move flaps to control the aircraft during flight. This could give more control as well as reduce weight and maintenance costs, allowing for faster and more efficient military and civil aircraft in the future. The technologies have been designed to improve the control and performance of aircraft. By replacing moving surfaces with a simpler 'blown air' solution, the trials have paved the way for engineers to create better performing aircraft that are lighter, more reliable and cheaper to operate. The technologies could also improve the stealth of the aircraft as they reduce the number of gaps and edges that currently make

aircraft more observable on radar.

Developing such technologies will allow the UK to have the right technologies and skills in place for the future and could be applied to the development of a Future Combat Air System. It is the latest technological breakthrough to come from a number of BAE Systems collaborations with academia and industry, that will help the UK to deliver advanced capability quickly, and through shared investment.

Julia Sutcliffe, Chief Technologist, BAE Systems Air said: "MAGMA is a great example of how collaborating with bright minds at British universities can deliver ground-breaking research and innovation. Our partnership with The



University of Manchester, added: "We are excited to have been part of a long-standing effort to change the way in which aircraft can be controlled, going all the way back to the invention of wing warping by the Wright brothers. It's been a great project for students to be part of, highlighting that real innovation in engineering is more about finding practical solutions to many hundreds of small technical challenges than having single moments of inspiration.

"The partnership with BAE Systems has allowed us the freedom as a university to focus on research adventure, with BAE Systems providing the pathway to industrial application. We made our first fluidic thrust vectoring nozzle from glued together bits of plastic and tested it on a hair drier fan nearly 20 years ago. Today, BAE Sys-

tems is 3D printing our components out of titanium and we are flight testing them on the back of a jet engine in an aircraft designed and built by the project team. It doesn't get much better than that."

#### **Technologies Demonstrated**

**Wing Circulation Control:** Taking air from the aircraft engine and blowing it supersonically through narrow slots around a specially shaped wing tailing edge in order to control the aircraft.

**Fluidic Thrust Vectoring:** Controlling the aircraft by blowing air jets inside the nozzle to deflect the exhaust jet and generate a control force.

#### **Innovation at the Forefront**

The trials form part of a long-term collaboration between BAE Systems, academia and the UK government to explore and develop flap-free flight technologies, and the data will be used to inform future research programmes. Other technologies to improve the aircraft performance are being explored in collaboration with NATO Science and Technology Organisation.

Innovation is a key focus for BAE Systems, having invested £4.4 billion in Research and Development (R&D) over the past five years. The company has spent £1 billion on R&D in 2016 alone, including £10.7 million partnering with leading UK universities in areas such as novel materials, advanced manufacturing, artificial intelligence, air vehicles and avionics testing. It has also made strategic investments in a range of evolving technologies in the aerospace sector including the SABRE air-breathing rocket engine with Reaction Engines Ltd and mixed reality cockpit technology in partnership with The University of Birmingham as well as unique flight control technology with The University of Manchester.

Reference Text/Photos:

[www.baesystems.com](http://www.baesystems.com)



MAGMA unmanned aerial vehicle

University of Manchester has identified cutting-edge technology, in this case flap-free flight, and turned what began as a feasibility study into a proven capability in just a number of months. It demonstrates how STEM can be applied in the real-world and I hope the success of these trials inspires the next generation of much-needed engineers and scientists."

Bill Crowther, senior academic and leader of the MAGMA project at The

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## BAE Systems have invested £4.4 billion in R&D over the past five years

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# Training AI for Close-Range Aerial Dogfight

Artificial Intelligence (AI) has evolved to challenge human intellect in poker, chess, and online strategic combat games, such as Dota 2 and StarCraft II. Although no AI has ever defeated a human fighter pilot in a High-G dogfight. This is to change in the future as Defense Advanced Research Projects Agency (DAPRA) is seeking to automate air-to-air combat, enabling reaction times at machine speeds and freeing pilots to concentrate on the larger air battle.

According to DAPRA, handing aerial dogfight to AI is more than creating automated fighters, it is more about giving pilots confidence and to accelerate the transformation of pilots from aircraft operators to battle commanders. However, for pilots to entrust the dynamic air combat tasks to unmanned, semi-autonomous airborne assets from the cockpit, the AI must first prove it can handle the basics. Hence, DARPA created the Air Combat Evolution (ACE) programme, which aims to increase

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Automated air-to-air combat may soon become a reality with AI handling High-G dogfights, allowing pilots to be cockpit based mission commanders

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war-fighter trust in autonomous combat technology by using human-machine collaborative dogfighting as its initial challenge scenario.

ACE is one of several STO programmes designed to enable DARPA's "mosaic warfare" vision, which targets shifting warfighting concepts away from its focus on manned systems to a mix of manned and less-expensive unmanned systems. These systems can be rapidly developed and fielded and will have room for technology upgrades to address changing threats. The concept here is to inter-link manned aircraft with significantly cheaper unmanned systems to create a "mosaic" where the individual "pieces" can easily be recomposed to create different effects or quickly replaced if destroyed, resulting in a more resilient warfighting capability.

Under the ACE programme, AI systems will be trained in the rules of aerial dogfighting, right from basic fighter manoeuvres to highly nonlinear and dynamic combat situations. Though highly nonlinear in behaviour, dogfights do have a clearly defined objective, measurable outcome and



Two U.S. Air Force F-15C Eagles, a B-52 Stratofortress bomber, and two Royal Moroccan air force F-16 Fighting Falcons



the inherent physical limitations of aircraft dynamics. This also makes them a great test case for advanced tactical automation. ACE expects to clearly monitor the AI performance expansion, as the training and performance upgrades to the systems will be closely watched and evaluated by autonomous fighter instructor pilots and subject experts to enhance tactics and technology parallelly.

According to Air Force Lt. Col. Dan Javorsek (Ph.D.), ACE programme manager in DARPA's Strategic Technology Office (STO), being able to trust autonomy is a critical move towards a future of warfare involving unmanned platforms fighting alongside manned systems. "We envision a future in which AI handles the split-second manoeuvring during within-visual-range dogfights, keeping pilots safer and more effective as they orchestrate large numbers of unmanned systems into a web of overwhelming combat effects," he says.

He further adds that after the virtual testing DAPRA plans to demonstrate the dogfighting algorithms on a sub-scale aircraft, ultimately leading to a live full-scale manned-unmanned team dogfighting with operationally representative aircraft in the future.

He opined that the aerial engagement scenarios increase in difficulty and realism, only after human pilots are confident that the AI algorithms are trustworthy in handling bounded, transparent and predictable behaviours.

DAPRA is on the look-out for a broad spectrum of solutions and is open for proposals from small companies and academics, and even gaming developers with little previous experience with the Defense Department. Called the "AlphaDogfight Trials," this initial solicitation will be issued by AFWERX, an Air Force innovation catalyst tasked to find novel solutions to Air Force challenges at start-up speed.

To move further towards Phase 1 of the programme, DAPRA will be sponsoring a stand-alone, limited-scope effort focused on automating individual tactical behaviour for one-on-one dogfights. Dubbed as the first technical area of the trials, the AFWERX Challenge will pit AI dogfighting algorithms against each other in a tournament-style competition. Individuals, start-ups, small businesses, large enterprises, academics and research labs will be able to submit their solutions to specific challenges that the U.S. Air Force (USAF) launches as a part of the AFWERX Challenge.

At these initial stages, the challenges will be open and aim to facilitate dialogue and collaboration, hence participants will be able to see, comment, rate and community vote on submissions. Moving forward, these solutions will be reviewed by the USAF and winning selections will be engaged for further discussions which are expected to take place either as an event or private meetings. Ultimately, the solutions selected in the final might be funded for demonstrations, testing, and may even be eligible to be awarded a military contract.

"Through the AFWERX Challenge, we intend to tap the top algorithm developers in the air combat simulation and gaming communities. We want them to help lay the foundational AI elements for dogfights, on which we can build as the programme progresses," Javorsek said.

The AFWERX Challenge does not ask for IP, trade secrets or financial information to be disclosed publicly. But participants have the option to attach files (in the desktop browser view) that can only be viewed by the USAF evaluation team.

Reference Text/Photos:  
[www.media.defense.gov](http://www.media.defense.gov)  
[www.darpa.mil](http://www.darpa.mil)



Formation with the A-10 Thunderbolt II, F-35 Joint Strike Fighter and F-15 Strike Eagle

# Strata and Pilatus Extend Partnership

**S**trata Manufacturing recently extended its agreement with Pilatus Aircraft Ltd to cover a new composite work package for the PC-24, a twin-engine business jet. Strata is the advanced composite aero structures manufacturing company wholly-owned by Mubadala Investment Company PJSC.

The new agreement will see Strata manufacture PC-24 flap track fairings and comes exactly a year after the two manufacturers signed a partnership on the PC-24. The expanded deal positions Strata as one of the major suppliers of both belly and flap track fairings for the world's first 'Super Versatile Jet'. Ismail Ali Abdulla, CEO of Strata, said: "During the past 12 months, Strata worked diligently to ensure the smooth delivery of the belly fairing for Pilatus' ground-breaking aircraft. Our production and delivery track record have exceeded expectations and, ultimately, led to the award of this new work package.

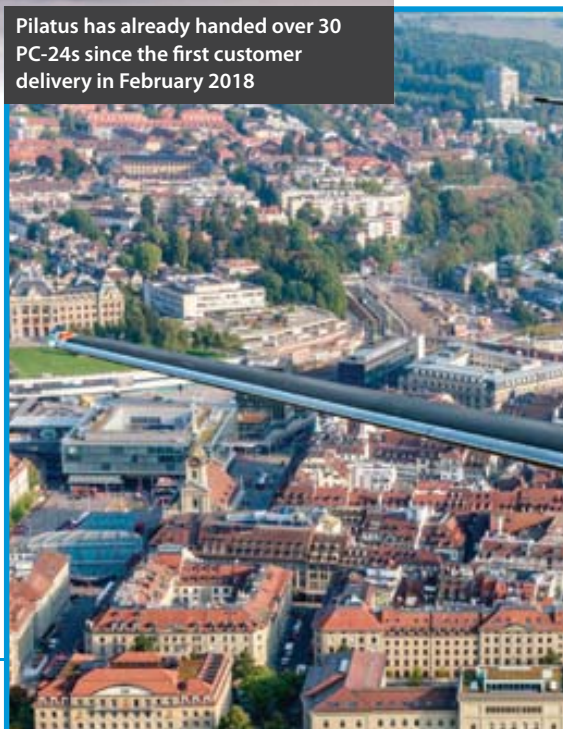
"Pilatus is a key customer of our global partner network and this extended agreement highlights Strata's advanced technological capabilities in the global aerospace supply chain – including our UAE-made components." The first flap track fairings, designed to cover the gaps between aircraft parts to reduce drag and improve appearance, will be delivered for First Article Inspection by the end of this year.

"The delivery of the first complete PC-24 Belly Fairing shipset in just eight months after contract signature in April this year is a very significant mile-

stone that demonstrates the capabilities and performance of Strata. We are extremely satisfied, and look forward to continuing to strengthen the relationship with Strata and the UAE in line with the Vision 2030. We are launching the second PC-24 composites package and we look forward to receive the First Article from Strata in 2019," added Roman Emmenegger, VP Manufacturing at Pilatus Aircraft Ltd.

In February, Strata celebrated the delivery of its first shipset of belly fairings for the PC-24, which is specifically engineered to take-off and land from unpaved runways with incredible short-field performance. The extended agreement between the two compa-

Pilatus has already handed over 30 PC-24s since the first customer delivery in February 2018







PC-24 twin-engine business jet

ties marks the next step in a long-term alliance aimed at delivering holistic production of the complete PC-24 composite shipset requirement in the UAE.

Strata works with leading aircraft manufacturers, including Airbus, Boeing, Leonardo, and Pilatus. Based at Nibras Al Ain Aerospace Park, Strata supports the development of a leading aerospace hub in Abu Dhabi as part of the emirate's economic diversification initiatives. The homegrown manufacturer employs more than 700 people of 30 different nationalities, with more than half of its workforce being represented by Emirati nationals.

#### Versatile Jet

Pilatus has already handed over 30 PC-24s since the first customer delivery in February 2018. The PC-24 fleet leader, serial number 101 belonging to PlaneSense, has flown over 1,100 hours in its first 15 months of operation. The fleet as a whole has clocked up over 5,000 hours of safe airborne time – an impressive result for the newly launched business jet.

30 PC-24s are currently in operation around the world, including three PC-24s used as medevac aircraft for the Royal Flying Doctor Service of Australia. Pilatus plans on delivering about 40 PC-24s in 2019, and on stepping up produc-

tion to 50 aircraft the following year.

Oscar J. Schwenk, Chairman of Pilatus, said: "Demand for the PC-24 is phenomenal. From day one, there has been keen interest from various customer segments all over the world. Feedback from the first 30 PC-24 operators is extremely positive, with special mention for the aircraft's versatility, its spacious, quiet cabin and the incredible performance of the PC-24. These remarks plus the high degree of attention which the aircraft commands all confirm our chosen PC-24 strategy."

#### Certified for Operation

The European Aviation Safety Agency (EASA) and the US Federal Aviation Administration (FAA) have already certified the PC-24 for use on unpaved runways. Work to obtain post-certification for other surfaces, including grass, are currently underway. The PC-24 has also been certified for steep approaches as required for e.g. the approach into London City Airport.

The very first PC-24 of the Royal Flying Doctor Service of Australia (RFDS Central Operations) with serial number 118 arrived in Australia on April 29, 2019. A few days later, the first landings on unpaved strips went ahead in Kingoonya, a small and almost totally abandoned farming settlement in the central outback of the Australian state of South Australia.

#### Order Book Reopens

In 2014, Pilatus sold 84 PC-24s in the space of one and a half days. The order book was subsequently closed until receipt of feedback from the first PC-24 operators.

Pilatus and its Authorised Pilatus Centres are now taking orders for the PC-24 again, with delivery positions programmed for late 2020 and 2021.

Reference Text/Photos:

[www.pilatus-aircraft.com](http://www.pilatus-aircraft.com)





# Boeing Receives USN Contract for Super Hornet Upgrade

Boeing has received a one-year contract, which also includes a one-year option for 2020, to continue modernising the U.S. Navy's F/A-18 Super Hornet fleet. This will be done under the Service Life Modification (SLM) programme. The US\$164 million contract for FY19 funds the stand-up of a second SLM line in San Antonio, Texas, complementary to the line established last year in St. Louis.

"The Service Life Modification programme is making great strides as we've already inducted seven Super Hornets into the programme, and will deliver the first jet back to the Navy later this year," said Dave Sallenbach, programme director. "This programme is crucial in helping the Navy with its readiness challenges, and will continue to grow each year with the number of jets we induct."

The San Antonio SLM line is scheduled to receive its first Super Hornet in June, and a total of 23 Super Hornets over the course of this contract. The U.S. Navy fleet consists of more

than 550 Super Hornets. The SLM programme extends the life of existing Super Hornets from 6,000 to 10,000 flight hours.

## Latest Modifications

In the early 2020s, Boeing is scheduled to begin installing initial updates to the aircraft that will convert existing Block II Super Hornets to a new Block III configuration.

The Block III conversion will include enhanced network capability, longer range with conformal fuel tanks, an advanced cockpit system, signature improvements and an enhanced communication system. The updates are expected to keep the F/A-18 in active service for years to come.

## Combat Proven

The F/A-18 Block III Super Hornet is a highly capable, affordable and available tactical aircraft in the U.S. Navy inventory. The Super Hornet has been referred to as the backbone of the U.S. Navy carrier air wing.

The combat-proven Super Hornet delivers cutting-edge, next-generation

multi-role strike fighter capability, outdistancing current and emerging threats well into the future. The Super Hornet has the capability, flexibility and performance necessary to modernise the air or naval aviation forces of any country.

Two versions of the Super Hornet – the single-seat E model and the two-seat F model – are able to perform almost every mission in the tactical spectrum, including air superiority, day/night strike with precision-guided weapons, fighter escort, close air support, suppression of enemy air defences, and maritime strike.

Boeing's F/A-18 programme recently unveiled its Super Hornet large-area display, the Advanced Cockpit System (ACS), in its Flight Simulation Lab facility in St. Louis. The ACS increases situational awareness for pilots and is a next-generation Block III capability. The ACS has been installed in the first Super Hornet that was delivered to Kuwait. It underwent its first flight in March of this year.



The FA-18 Service Life Modification programme has received its second contract to induct 12 jets

# BAE Systems Receives Fresh Orders for APKWS

The U.S. State Department has approved a possible Foreign Military Sale of Advanced Precision Kill Weapon Systems (APKWS) II All-Up-Rounds to a Middle Eastern strategic partner for an estimated US\$900 million. The Defense Security Cooperation Agency reportedly delivered the required certification notifying Congress of this possible sale last month. The partner country has requested a possible sale of 20,004 APKWS, and the contract will also include weapon support and test equipment, spares, technical publications, personnel training, other training equipment, transportation, U.S. Government and contractor engineering, technical and logistics support services, and other related elements of logistical and programme support. The prime contractor will be BAE Systems in Nashua, and no known offset agreements have been proposed in connection with this potential sale. APKWS is the U.S. Government's only programme of record for 2.75-inch

laser-guided rockets and it can complement the Hellfire II missile as a secondary precision munition with lower collateral damage potential. These aspects make it an appropriate munition for counterterrorism operations. APKWS can be easily absorbed into the customer's existing weapon system.

The APKWS rocket bridges the gap between unguided rockets and anti-armour munitions. It will provide customers with flexibility in the use of proportional, precision fires when operating in remote and mountainous regions as well as populated areas. The APKWS guidance kit transforms an unguided 2.75 inch (70 mm) rocket into a precision-guided rocket, giving warfighters a low-cost surgical strike capability, and redefines precision by hitting the target with pinpoint accuracy and minimal collateral damage. Especially, in critical air-to-ground missions when the fighter has only one shot.

The APKWS' guidance section is designed to lock onto targets from over 3 km away, keeping aircraft and laser designators at a safe distance from threats. The innovative design of the APKWS rocket includes advanced DASALS seeker optics located on all four guidance wings, which once fired

locks-in to the target guiding the rocket to it, thus delivering accuracy when it matters most. Wing slot seals protect optics from adjacent firings, sand, and moisture prior to launch to ensure no damage or debris inhibit the seeker from locking onto targets.

The optics in APKWS lock onto moving or stationary targets in open or confined areas, supporting a wide variety of missions and enables better control over the rocket after launch. Used by all four U.S. armed forces, with a 40-degree instantaneous field of regard, the APKWS provides broad capture area for mid-flight adjustments.

The rocket is proven in combat for five years running and has achieved over a 93 per cent hit rate when fired from rotary- and fixed-wing platforms. Also, it can be fired from more than 20 different fixed- and rotary-wing platforms. U.S. Army has achieved numerous confirmed successful engagements in support of combat operations in Iraq and Afghanistan; U.S. Air Force has fired hundreds of fixed-wing units in theatre to date, and the U.S. Marine Corps and U.S. Navy have fired thousands of combined fixed- and rotary-wing shots in total and hundreds in combat scenarios.



The APKWS laser-guided rocket fired off of an F-16 aircraft

# HENSOLDT

## Transforms Electronic Protection

**H**ENSOLDT recently introduced the new radar warning system, Kalaetron Radar Warning Receiver (RWR), into the market. The aim of the product is to revolutionise the protection of aircraft and helicopters from radar-guided weapons. This new product was showcased for the first time at the Electronic Warfare Europe Conference in Stockholm.

"With the help of the latest Artificial Intelligence (AI) and digital signal processing methods, our Kalaetron RWR detects radar-based threats early and reliably," said Celia Pelaz, Head of the Spectrum Dominance / Airborne Solutions Division. "Our new product thus increases the assertiveness of aircraft and helicopters and their survivability, especially in view of the increasingly dense signal spectrum and the grow-

ing threat posed by highly integrated air defence systems."

Thanks to its fully digital design, the new radar warner detects and identifies threats quickly and with a low false alarm rate, over an extremely wide frequency range. The Kalaetron RWR uses AI techniques to detect new threat patterns from a huge amount of collected raw data. This is important in order to identify the latest air defence radar systems that cover an extremely wide bandwidth or which hop between particular frequencies in fractions of a second. Kalaetron thus enables fighter or transport aircraft to be protected even against upcoming anti-aircraft weapons and integrated air defence systems, while also offering potential for adaptability to cope with future threats.

### Displaying Naval Expertise

At the recently concluded Maritime Defence Exhibition & Conference 2019 (IMDEX), HENSOLDT showcased its range of innovative, sensor technologies.

"Modernisation efforts of naval capabilities will become increasingly crucial with the challenging environment of the Indo-Pacific," said Nathan Manzi, head of Asia-Pacific at HENSOLDT. "As a specialist in defence electronics, we have a strong reference in this area with more than 3,000 periscopes delivered to 20 prominent naval forces and more than 1,000 radars installed with over 30 customer navies."

*Below is a look at the products showcased at IMDEX:*

### Twin Optronic Mast Solution

HENSOLDT's unique twin optronic mast solution combines the OMS 150







TRS-4D naval radar is already in use on board the German Navy's new F125 frigate

and OMS 200 periscopes. The implementation of this twin optronic mast solution enables new operational capabilities in a changing operational environment in all light and weather conditions. Its modular and compact design ensures ease of installation, integration and logistic maintainability. The OMS solution can be fully integrated into combat management systems, ensuring full remote control.

Bringing together the latest optronics sensor technologies such as low light level TV camera, high-definition mid-wave infrared and short-wave infrared, this product enables new submarine capabilities in all light and weather conditions.

#### **TRS-4D Naval Radar**

HENSOLDT's TRS-4D naval radar is designed to support anti-air and anti-surface operations. It is available with one rotating antenna or four fixed antenna panels, respectively. TRS-4D is HENSOLDT Sensors' latest member of the C-Band (NATO G-Band) naval radar family. It is available with a single face-rotating antenna and also as a four fixed-panel configuration. Based on the most advanced Gallium Nitride Active Electronically Scanned Array (AESA) sensor technology with

## **Twin optronic mast solution combines the OMS 150 and OMS 200 periscopes**

multiple digitally formed beams, the new generation TRS-4D opens a new dimension for maritime missions.

TRS-4D's unique concept of simultaneous multi-beams and Doppler processing ensures reliable performance of all operational tasks at a high update rate. Its very flexible installation concept enables ships like offshore patrol vessels, corvettes and frigates to exert the different functions of a shipborne surveillance and target acquisition radar, in blue waters and in complex littoral environment with high target densities.

TRS-4D marks an innovative step beyond conventional radar into a "new dimension" of operational capabilities.



**COLDs NGB**

The benefits of the new technology are tailor-made for naval customers. The radar's AESA technology delivers increased sensitivity to detect smaller and manoeuvring targets with greater accuracy, as well as faster track generation to give naval vessels more time to react to hostile threats. The radar is integrated into the U.S. Navy's Littoral Combat Ship LCS and the German Navy's new F125 frigates.

Another part of HENSOLDT's display was dedicated to protection systems enhancing the survivability of naval vessels.

#### **COLDs NGB Warning System**

Common Optoelectronic Laser Detection System Next Generation (COLDs NGB) has been designed for naval applications. It detects lasers range finders, laser target designators and laser beam riders with efficiency in all bearings. Each COLDs NGB sensor unit covers more than 180-degree in azimuth and 90-degree in elevation. Therefore, a full coverage of 360-degree in azimuth can be obtained for each cluster, with two sensors installed on starboard and portside. Depending on the size of the ship, the system allows configuration with up to 16 sensor units to ensure full protection of the platform. The secondary radar, transponders and encryption devices ensure reliable identification-friend-or-foe (IFF).

Reference Text/Photos:

[www.hensoldt.com](http://www.hensoldt.com)



# Elettronica Showcases Maritime Excellence

**E**lettronica Group recently attended IMDEX Asia 2019 in Singapore, and highlighted its brand in a rapidly growing global area, distinguishing itself on the topic of general and maritime safety. The Italian company has its own branch in Singapore since 2015. A company statement stressed that the city represents a strategic area in growth objectives, with medium and long-term business opportunities, due to the attractiveness of the global market and because it is a strategic hub for expansion in the Asia-Pacific region. At IMDEX, Elettronica displayed a renewed brand identity to better

enhance its three industrial assets: Elettronica S.p.A (Electronic Warfare), Elettronica GmbH (Homeland Security & EW) and CY4GATE (Cyber Warfare).

## Naval Expertise

IMDEX Asia offered Elettronica the opportunity to showcase its advanced EW suite for naval applications, initially developed for Italian Navy PPA vessel requirements. The core component of the suite is the EW Manager (EWMU), a computer-aided C2 fully dedicated to the EW layer and functionally integrating the EW subsystems. Furthermore, the inclusion of an EW Manager provides an additional optimisation of the EW management unit (sensor and countermeasures), based on signal correlation and fusion, threat situation, and mission status. The EWMU

functionally integrates the ELT\33 CESM, ZEUS/VIRGIULIUS RECM/RESM capabilities and in, the near future the DIRCM in the naval configuration. Solutions showcased included:

## ELT\332

It is part of a new generation software/firmware defined sensor designed for fast real time interception, direction finding and automatic classification of complex broadband communication signals.

## VIRGIULIUS/ZEUS

VIRGIULIUS is an advanced, fully integrated Electronic Warfare system for Alarm, Surveillance and Countermeasure functionality. It is a complete break-through in the traditional approach to the ESM- ECM (RADAR Electronic Support Measure-Electronic counter Measure) system architecture taking all the possible advantages from the state-of-the-art technology,



stressing the signal processing techniques and market component availability aspects to deliver an integrated product.

These architectures are suitable for any combat or multirole platform, including naval surface/submarine platforms. VIRGILIUS is conceived to perform emitter detection, classification, identification and to counter a large variety of threats including: radar controlled Anti-Aircraft Artillery (AAA), Surface-to-Air Missiles (SAM), Air-to-Air Missiles (AAM), Early Warning, Search radars and modern Multifunction LPI Radars.

During the AOC EW Europe Show in Stockholm, Elettronica and Sphera signed an agreement for collaboration on EW test solutions for ESM/RWR suites installed on helicopters. With reference to the German NH90 Navy helicopter Programme, Elettronica is proposing its Radar Warning Receiver ELT 160, already selected by Italian Army and Italian Navy for their TTH fleet; Sphera supplies end-to-end test solutions to be used directly on the platform.

#### **ADRIAN**

Anti-Drone Interception Acquisition and Neutralization (ADRIAN) is an ad-

vanced anti-drone system dedicated to the protection of critical infrastructures and public areas during public events and civil airspace from hostile mini and micro drones threats. It is able to operate effectively in urban, rural and in military operations theatres with the aim of protecting a site, structures of strategic importance (such as an airport, a barracks or a power plant), a public or religious event with presence of a crowd, a convoy or a military camp. The system has a multi-sensor and multi-domain architecture suitable for complex scenarios and numerous types of constantly evolving threats.

ADRIAN guarantees a high probability of interception and stands out for its high flexibility and scalability to guarantee operational effectiveness while minimising acquisition and maintenance costs. It is capable of detecting the threat, discriminating it, identifying it and tracing it continuously, and then neutralising it by minimising the side effects. It consists of active (radar) and passive (radio direction finder, EO/IR and acoustic) sensors, a control link jammer and GNSS signal with selective and controlled contrast capability and a Command Station

## VIRGILIUS is an advanced, fully integrated Electronic Warfare system

with data fusion, presentation on cartographic map and Artificial Intelligence/Machine Learning algorithms to support the operator's decision and responsiveness.

ADRIAN's reactive and smart jammer is capable to deny the remote control link of the platform and the navigation aids signals used to follow the programmed route through proper waypoints. Plus, the innovative jamming techniques enhance the effectiveness of soft kill disruption of hostile platforms and maintain full operational services of active friendly platforms.

Elettronica Group, based in Rome, has been on the cutting-edge of Electronic Warfare for more than 60 years, supplying strategic surveillance capabilities, self-defence and electronic attack systems for naval, airborne and ground use to the Armed Forces and Governments of 30 countries.

Privately controlled, both Thales and Leonardo own important minority stakes in the Group, which is composed by Elettronica S.p.A, leader in EW capabilities, CY4GATE, specialising in Cyber EW, Cyber Security and Intelligence, and Elettronica GmbH, the German subsidiary specialised in EW signal processing design and production and Homeland Security solutions.

Reference Text/Photo:

[www.airbus.com](http://www.airbus.com)

[www.elettronica-elt-roma.com](http://www.elettronica-elt-roma.com)



# Stryker Prepares You Today for Tomorrow's Fight

General Dynamics (GD) has collaborated with the U.S. Army to modernise the Stryker family, readying it today for tomorrow's fight. The new vehicles combine versatility, survivability, lethality and manoeuvrability in wider-ranging missions.

Introduced in 2000, the eight-wheeled, medium-weight Stryker Double-V Hull is known as the gold standard of protection. The latest features include a 450-horsepower engine to buy back mobility and power, 910-amp electrical power generation, improved suspension, smart displays for driver/commander's stations, and upgraded ethernet and infrastructure for future Army network systems. The addition of a 30mm weapon system now gives soldiers an unmatched capability for any Strykers deployment anywhere.

## U.S. Army's Backbone

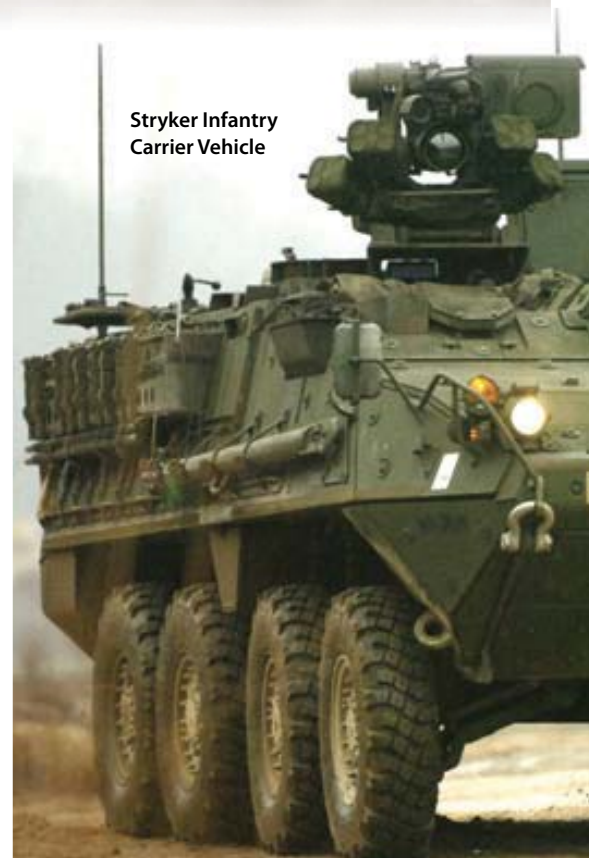
Weighing approximately 19t and achieving off-road speeds of 62 mph

with a maximum range of 312 miles, the Stryker's effective mix of capabilities enables soldiers to execute their missions successfully across the full spectrum of operations. Survivable, agile, manoeuvrable and capable of transporting soldiers safely to their battlefield objectives, the U.S. Army has awarded General Dynamics Land Systems a US\$402 million contract for Systems Technical Support (STS) for the Stryker Brigade Combat Team (SBCT) in first quarter 2019.

Under the five-year STS contract, GD will maintain high operational readiness for the soldiers serving in the SBCT, performing log, development and support of government testing. Starting this year, the work will be conducted with current employees at GD operations in Sterling Heights and London, Ontario.

Considered the backbone of the army with nearly 4,700 vehicles fielded, the

Stryker Infantry  
Carrier Vehicle



## The SHORAD configuration is a new version of the Stryker 8x8 armoured vehicle

U.S. Army continues to modernise its Stryker vehicle fleet with the new 30mm, up-gunned Infantry Carrier Vehicle, Dragoon (ICVD) and the Double-V Hull A1 platform. The A1 eight-wheeled vehicle vastly increases power, survivability and mobility, providing extra stowage and seating for nine soldiers additional to a 3-Soldier crew.

### Countering Short-Range Threats

The Short-Range Air Defence (SHORAD) configuration is a new version of the Stryker 8x8 armoured vehicle. It meets the U.S. Army's emerging operational need to counter Unmanned Aerial Systems (UAS), Rotary Wing (RW) and Cruise Missile (CM) threats.

The Stryker MSL is fitted with a Boeing

## Lethal Variants

With 11 different configurations and 85 per cent commonality across the entire fleet, the Stryker reaches speeds up to 60 mph in any type of terrain. All the Stryker variants combine maximum commonality and proven performance with low-operating and life cycle costs:

**Stryker A1:** The Stryker A1, also known as the Double-V Hull (DVH) Engineering Change Proposal 1 configuration, provides unprecedented survivability against mines and improvised explosive devices.

**STRYKER CV:** The Stryker Command Vehicle (CV) is a fast-moving, armoured tactical operations centre allowing commanders to manage efficiently and effectively the battlefield with real-time intelligence and communication with their unit, all while on the move.

**STRYKER ESV:** The Stryker Engineer Squad Vehicle (ESV) transports combat engineers to decisive locations on the battlefield providing required mobility and limited counter mobility to support their respective units.

**STRYKER ICV:** The Stryker Infantry Carrier Vehicle (ICV) transports a nine-man infantry squad and a two-man crew to the battlefield with a mounted remote weapon station providing direct fire support to dismounted infantrymen.

**STRYKER ICV, DVH:** The Stryker Double-V Hull (DVH) ensures survivability against mines and IEDs, while the new driveline and suspension improves the vehicle's payload capacity, ride stability and reliability.

**STRYKER ICV DRAGOON:** The Dragoon delivers greater firepower via an XM 813 weapon to support dismounted soldiers from a nine-man Infantry Squad.

**STRYKER MC:** The Stryker Mortar Carrier (MC) provides accurate and lethal high-angle fire support, providing rapid delivery of indirect fire across the battlefield.

**STRYKER MEV:** The Stryker Medical Evacuation Vehicle (MEV) is an essential element to combat formations, giving Brigade Combat Teams the capability to transport wounded soldiers quickly to treatment facilities.

**STRYKER MGS:** The Stryker MGS variant is a direct-fire infantry assault platform with a 105mm cannon.

**STRYKER NBCRV:** The Stryker NBC Reconnaissance Vehicle (NBCRV) houses an integrated NBC sensor suite and meteorological system enabling crews to detect areas of contamination and plot a clean bypass route.

**STRYKER RV:** The Stryker Reconnaissance Vehicle (RV) is a platform enabling reconnaissance elements to collect information and conduct surveillance operations with the same cross-country mobility capabilities as the rest of the Stryker fleet.





## Strykers can be transported on the ground using trucks, or transported by air on C-17, C-5 and C-130 aircraft

unmanned turret mounted at the rear of the chassis, with the original infantrymen compartment replaced by a cargo area. The turret is armed with four Longbow Hellfires on the right side and four launchers for the Raytheon Stinger short-range air defence missile positioned across the vehicle on another pod.

Boeing and GDLS have built a new short-range air defence system mounted on the Stryker, essentially composed of a modernised Avenger air defence system reconfigured to fit the turret. The Boeing turret is fitted with an organic sensor suite, including electro-optical (EO) and infrared sensors with laser range-finder and designator.

### Survivability and Mobility

The Stryker brigade combat team (SBCT) combines rapid deployment with survivability and tactical mobility. This innovative vehicle enables the team to manoeuvre in close and urban terrain, providing protection in open terrain while transporting infantry rapidly to critical battlefield positions. Hence, it is unsurprising that the eight-wheeled Stryker is the first new military vehicle to enter into U.S. Army service since the Abrams tank in the 1980s.

### Remote Air Transportation

Strykers can be transported on the ground using trucks, or transported by air on C-17, C-5 and C-130 aircraft which can carry seven and four Stryker vehicles respectively. The C-130H can still fly safely carrying a maximum 38,000 lb load for up to 1,000 nm, including all Stryker configurations disembarking from the C-130 in combat-ready status. The Stryker's 36,240 lb weight and size are therefore within the payload limit of the C-130H, operating from smaller airfields in more remote locations.

### Positive Corporate Outlook

General Dynamics' total backlog was US\$69.2 billion at the end of first-quar-

ter 2019, up 11.4 per cent year-on-year. Based on management value estimates of unfunded indefinite delivery, the estimated potential value of indefinite quantity (IDIQ) contracts and unexercised options was US\$33.9 billion, while total potential contract value as the sum of backlog components was US\$103.2 billion up 17.7 per cent. Order activity has remained strong across both aerospace and defence portfolios, with aerospace enjoying than US\$3.1 billion orders last quarter and significant awards in defense portfolios.

Reference Text/Photo:

[www.army.mil](http://www.army.mil), [www.gdls.com](http://www.gdls.com)



Stryker vehicles from the 1st Stryker Brigade Combat Team



Rear security in a Stryker armoured vehicle



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# Embraer

## Praetor 600 is Now Triple-Certified



**E**mbraer recently announced that the company's new Praetor 600 super-midsize business jet was granted its Type Certificate by European Union Aviation Safety Agency (EASA) and by the Federal Aviation Administration (FAA). The announcement was made during the company's press conference at the European Business Aviation Conference and Exhibition (EBACE) in Geneva, Switzerland.

"Now certified by the key aviation safety agencies of the world, the Praetor 600 has proven to be the most disruptive and technologically advanced super-midsize business jet to enter the market, paving the way to begin deliveries now in the second quarter," said Michael Amalfitano, President & CEO, Embraer Executive Jets. "Just over six months since its launch and debut, the Praetor 600 has already been outperforming its certification goals, raising expectations of the ideal super-midsize. Once again, I want to thank and congratulate the entire Embraer family for bringing to market such a revolutionary aircraft, designed to create a new value experience for customers

and shareholders alike."

Brazil's Civil Aviation Authority (ANAC—Agência Nacional de Aviação Civil) awarded the new aircraft its Type Certificate on April 18. The Praetor 600 was announced and debuted at NBAA-BACE, in October 2018, and became the only super-midsize business jet to be certified since 2014.

The Praetor 600 began its journey to EBACE at São Paulo International Airport in Brazil, on May 8, arriving in Fort Lauderdale, Florida, with a six-passenger equivalent payload of 1,200 lb (544 kg). This was the longest flight of the aircraft to date, covering 3,904 nm (7,230 kilometres) over an air distance of 3,678 nm (6,812 kilometres), having faced up to 43 knots of headwinds and descended into Miami's distinct air space pattern.

On May 16, the Praetor 600 departed the U.S. to Europe fuelled by Sustainable Alternative Jet Fuel (SAJF) to join the Embraer portfolio fleet at "Fuelling the Future," a business aviation biofuel event held at Farnborough Airport, on May 18. The Praetor 600 arrived in Farnborough, UK, having departed



Michael Amalfitano, President & CEO, Embraer Executive Jets

from Teterboro Airport in the U.S. The first transatlantic flight of the Praetor 600 covered about 3,000 nautical miles with about 15,000 lb of fuel, of which 3,000 lb was SAJF.

The "Fuelling the Future" event marked the first anniversary of the launch of the Business Aviation Coalition for Sustainable Alternative Jet Fuel, at EBACE 2018, and the 10th anniversary of the Business Aviation Commitment on Climate Change, announced in 2009. The event gathered business aviation and civic leaders to discuss the path forward for the continued adoption of SAJF in business aviation, in order



The Praetor 600



Praetor 600 cockpit

to fulfil the coalition's goal of reducing emissions through investments and innovation.

The Praetor 600 is one of the best performing super-midsize jets developed, surpassing all its main design goals and becoming capable of flying beyond 4,000 nautical miles in long-range cruise speed or beyond 3,700 nautical miles at Mach .80 from runways shorter than 4,500ft, complemented by an outstanding payload capability. It is now the farthest-flying super-midsize jet, able to make nonstop flights between London and New York, São Paulo and Miami, Dubai and London. With four passengers and NBAA IFR Reserves,

the Praetor 600 has an intercontinental range of 4,018 nautical miles (7,441 km). Take Off Field Length for such a mission is only 4,436 ft (1,352 m). At M0.80, range is 3,719 nm (6,887 km) with four passengers and NBAA IFR Reserves.

#### Advanced Tech

The Praetor 600 is the first super-midsize jet with full fly-by-wire technology, which powers the Active Turbulence Reduction that not only makes every flight the smoothest but also as efficient possible.

The class-exclusive Active Turbulence Reduction and 5,800-foot cabin altitude, complemented by a whisper silent cabin, have set high standards in

customer experience in the super-mid-size category. The aircraft is a disruptive and technologically advanced carrier to enter the super-midsize category, delivering great customer experience with a combination of performance, comfort and technology.

Advanced technology can be seen throughout the cabin beginning with the industry-exclusive Upper Tech Panel that displays flight information and offers cabin management features also available on personal devices through Honeywell Ovation Select. Air to ground Gogo AVANCE L5 connectivity is available for U.S. operators. High-capacity, ultra-high-speed connectivity for all aboard is available through Viasat's Ka-band with speeds of up to 16Mbps and unlimited streaming, another industry-exclusive among mid-size business jets. An optional in-flight entertainment system consists of a high-definition video system, surround sound, and multiple audio and video input options.

The Praetor 600 features state-of-the-art Rockwell Collins Pro Line Fusion avionics suite with four 15.1-inch high-resolution LCD displays, and paperless operations capability, with graphical flight planning and industry-first vertical weather display, air-traffic-control-like situational awareness with ADSB-IN, and predictive wind shear radar capability, in addition to Jeppesen charts and maps as well as, an Inertial Reference System (IRS), a Synthetic Vision Guidance System (SVGS), and the Embraer Enhanced Vision System (E2VS) which features a Head-up Display (HUD) and an Enhanced Video System (EVS). The Praetor 600 is powered by two advanced, fuel-efficient Honeywell HTF 7500E turbofan engines, one of the most greenest in the class.

Reference Text/Photo:

[www.embraer.com](http://www.embraer.com)



# JLTV Packs Protection, Performance,

Early military light utility vehicles were simple and small allowing easy maintenance by novice personnel and seamless manoeuvre in tight spaces. They were also light enough that a crew could dig them out when they got stuck in sand or mud, but provided little protection to the drivers and passengers. They were built to fulfil the requirements at a time when there were well-defined front lines and rear areas and mines and improvised explosive devices (IEDs) were not very common. Then came High Mobility Multipurpose Wheeled Vehicles (HMMWVs or “Humvees”) that were bigger, heavier, and more agile.

Designed in the 1970s, Humvees entered service in 1983. Although initially they were not designed to provide

protection against IEDs and ballistic threats like machine guns and rocket fire, Humvees underwent significant improvements in the years that followed, which include a thicker armour, ballistic glass, and top-mounted gun turrets. These enhancements, however, added significant weight to the vehicle degrading its mobility and reliability as the engines, drivetrain and suspension components were not engineered to handle the added tonnage.

Achieving a tactical advantage on the modern battlefield requires speed and agility to get to the fight quickly, to outmanoeuvre threats, and to strike fast and hard. The U.S. military’s latest light wheeled utility vehicle, the Joint Light Tactical Vehicle (JLTV) is a next-generation tactical vehicle that combines

world-class MRAP-level protection, performance and power in a single mine-resistant, ambush-protected all-terrain mobility. Developed by Oshkosh Defense, JLTV sets a whole new standard for protected off-road mobility and firepower in one highly-transportable package. This next generation JLTV reportedly is a combination of payload, performance, and protection with the flexibility to meet a wide variety of mission requirements and offers greater speed, acceleration, reliability and fuel efficiency when compared to the other tactical vehicles.

## **The JLTV Capabilities**

Developed to restore the payload, performance ratio and to improve crew protection, JLTV vehicle family was built in two variants and four mission



# Power for the Tough Battlefield

package configurations. JLTV is approximately two-thirds the weight of a Humvee and is capable of carrying heavy weapons. With configurations for Utility, General Purpose, Heavy-Guns Carrier and Close-Combat Weapons Carrier, mission equipment on JLTV can be installed at the field level. It is light enough at about 10,000 kg to be sling-loaded under a CH-47 helicopter, yet powerful enough to haul up to 2,300 kg and to seamlessly support a host of powerful weapon systems from a variety of manufacturers, depending on the mission or threat environment. An optional turret also supports standard weapon mounts for 7.62mm manned or remotely-operated machine guns or for a variety of cannon and tube-launched missile systems.

JLTV's integrated driveline lockup con-

trol provides extra traction as needed and a centralised tire-inflation system lets drivers select among four terrain settings all without exiting the protective crew capsule. It also boasts an integrated Drivers Smart Display Unit and Health Management System, which continuously monitor vehicle conditions, predicting and diagnosing faults, and improving overall sustainability.

Powered by a 340-horsepower Banks 866T 6.6-litre turbo diesel engine mated to a proven Allison 6-speed automatic transmission, the JLTV has the power, torque, and off-road mobility to conquer even the roughest terrain. In addition to this, Oshkosh Defense's patented TAK-4i intelligent independent suspension provides 508mm of wheel travel on all four wheels. The JLTV has an armoured panel and bigger and more complex engine requiring less maintenance, ultimately making it more reliable for Marines than the Humvees are today. The Humvee goes between 500 and 600 miles between operational mission failure, compared to the JLTV's threshold requirement of 2,400 miles before operational mission failure. The JLTV has a maximum speed of greater than 113 km/hr on road and with its superior suspension design, JLTV is capable of achieving off-road speeds 70 per cent faster than other tactical wheeled vehicles with comparable levels of protection.

According to Mike Ivy, senior vice president of International Programmes and Global Product Support for Oshkosh Defense, "The JLTV can get to the fight, close in on an enemy and get out of range faster and safer than any of the competition with a cruising range of an outstanding 483 km with superior reliability and performance. It is built to go

anywhere in any terrain, which is a critical feature as extreme off-road mobility means you get to be unpredictable, which is key to achieving a tactical advantage."

## Unmatched Crew Protection

Protection is likewise a must for any combat vehicle. The JLTV includes best-in-class armour and engineered ballistic glass, along with superior blast-protected seating, 5-point crew harnesses, and advanced V-hull design to deflect blasts away from the crew compartment. Each JLTV is pre-wired to support a range of integrated command, control, communications and intelligence systems from common manufacturers for maximum situational awareness. The design innovations include automatic fire-extinguishers in the crew space, engine compartment and wheel wells. Besides these features, gruelling U.S. Army field testing and extensive modelling and simulation further fine-tuned the JLTV's design. In addition to protection and performance, the JLTV is designed to be customised for virtually any mission requirement.

The JLTV programme entered the engineering and manufacturing development phase or EMD phase in 2012. When there were conscious decisions made to reduce the cost and save the taxpayer dollars, one of those approaches was to not mature logistics products. The Marine Corps will field its first 55 vehicles to support units at training locations across the country, including the School of Infantry West, School of Infantry East, and the Motor Transport Maintenance Instructional Company, as well as the operational units will begin receiving their first vehicles that will eventually replace the legacy Humvee fleet in July 2019.



# BriteCloud to Provide Extra Layer of Survivability

The United States Department of Defense has selected Leonardo's BriteCloud expendable active decoy (EAD) to be evaluated under the U.S. Foreign Comparative Testing (FCT) programme. The announcement was made at the recently concluded Electronic Warfare Europe conference in Stockholm. The mission of the FCT programme is to find, evaluate and field products and technologies produced by U.S. allies, such as the UK, where these products have a high technology readiness level in order to satisfy valid defence requirements more quickly and economically.

The Air National Guard (ANG) will lead this FCT by evaluating BriteCloud as it is launched from countermeasure dispensers installed on U.S. Air Force ANG aircraft. During the trials, ANG F-16 jets will dispense BriteCloud rounds, demonstrating the ability to enhance F-16 survivability. It will be tested in a variety of challenging scenarios to

provide a high level of confidence in the performance of the system.

BriteCloud is a compact, self-contained radio-frequency (RF) countermeasure system that is launched by a combat aircraft pilot to defeat attacks from radar-guided missiles. Effective against the latest and radar-guided threat systems, it provides an extra layer of survivability for pilots.

Designed for fast jet and fixed-wing aircraft, BriteCloud is a battery powered, self-contained advanced digital countermeasure designed to enhance platform survivability by defeating RF-guided missiles and fire control radars. The system can be dispensed from standard chaff/flare dispensers, and requires minimal platform integration. Utilising advanced techniques it is effective against active and semi-active RF seekers, and fire control radars.

By completely separating from its host aircraft and falling away, the decoy im-

proves aircraft survivability by guiding the incoming missile away from the aircraft. As an off-board capability, the BriteCloud Digital RF Memory (DRFM) jammer addresses the 'home-on-jam' vulnerabilities inherent with on-board solutions, while a quick deployment time creates a large miss distance, drawing the threat away from the platform. Designed for launch from a conventional decoy dispenser (55 or 218), BriteCloud has already been extensively trialled by UK and other nations on platforms including the F16, Tornado and Gripen.

First deliveries of BriteCloud by Leonardo to the RAF went into service on-board UK Royal Air Force Tornado jets in April 2018. In late 2017, following extensive testing, the UK MOD approved the BriteCloud 55 (named for its compatibility with 55mm flare dispensers such as those on Tornado, Typhoon and Gripen aircraft) for operations and production.



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*Either the country acts as a responsible state or pursues a policy of brinkmanship*

**W**ith the acceleration of political pressure and economic sanctions against Iran since the United States implemented its 'Zero Oil Exports' strategy, the Iranian regime has been facing an unprecedented predicament. It has lost its balance and committed mistakes, as usual, in assessing the course of the crisis it is experiencing. Even the bets that this regime thought they could reduce have proved to be "a loss" by all standards, not only because these bets pose a clear threat to regional and international security and peace, but also because there is almost a regional and international consensus to reject Iran's aggressive and interventionist policies. All parties hold Iran responsible for the instability taking place in many countries in the region.

The first bet placed by Iran – envisioning that it could push major powers to intervene to ease the pressure on it – was its threatening to obstruct navigation in the waters of the Arabian Gulf, thereby threatening the energy security that is the nerve of the global economy. In this context, many indicators and data point accusing fingers at Iran for its involvement in the sabotage operations targeting tankers in the UAE's territorial waters in May 2019. The latest assessments from the Pentagon charged Iran's Revolutionary Guards with direct responsibility for these operations.

The Iran-backed terrorist Houthis claimed responsibility for the attack with booby trapped drones on two oil pumping stations of Aramco in Riyadh

two days later. This confirms that these sabotage and terrorist operations cannot be separated, and that they were intended to deliver a message to oil consumers in the world that energy security is at risk and that the countries of the region cannot compensate for the absence of Iranian oil. However, this bet has proved to be a loss and exacerbated the isolation of Iran. This is evidenced by the international solidarity with the UAE and Saudi Arabia and the support of their calls upon the international community to shoulder its responsibilities towards maintaining the safety of navigation in the waters of the Arabian Gulf.

Iran's second bet was to abandon some of its commitments to the nuclear deal and threaten additional measures in

the coming weeks if other countries don't meet their obligations in an effort to pressure U.S. allies in Europe to work to preserve the nuclear deal. The European response, however, proved to be a disappointment for Iran, where the three European countries in the nuclear agreement, Britain, Germany and France, described Iran's abandonment of its obligations in the nuclear agreement as an "undesirable step". They even warned that this move by Iran could lead to new Western sanctions.

The third bet was the demonstration of military power in an attempt to give the impression to the world that Iran is capable of carrying out its threats to close the Strait of Hormuz and target the interests of the U.S. and its allies in the region. However, this bet also failed in front of the U.S. accelerated and intensive military moves in the region. These moves began by sending an amphibious attack ship and Patriot batteries to the Middle East to reinforce the capability of the aircraft carrier and B-52 bombers in the region and concluded with President Donald Trump's announcement that he would send around 1,500 additional troops to the Middle East. This has been a crucial factor in deterring Iran.

The last bet which Iran resorted to was spoken by Foreign Minister Mohammed Jawad Zarif during his recent visit to Iraq, where he pointed out that his country has proposed a non-aggression agreement with neighbouring Gulf countries, and welcomes dialogue with any of the Gulf States to find balanced relations based on mutual respect and common interests. This call, like its predecessors, is neither serious nor credible. The experience of the past years indicates that Iran has always renounced its commitments, and that it resorts to calls for dialogue and a commitment to respect

neighbouring countries only when it is under international pressure or real military threats. Therefore, Iran's call for dialogue is nothing more than a new manoeuvre or a phased tactic in which Tehran tries to bend to the storm, in order to get out of the great predicament it faces.

Iran is now in a state of confusion. All of its bets have proved a loss, because it has not yet abandoned its regional project of expansion, dominance and export of revolution, unaware that

the developments in the regional and international environments are unfavourable to its aspirations for hegemony. If it were serious in its call for dialogue with the Gulf States, it should associate it with genuine evidence that supports confidence in it, such as abandoning its hostile policies, stopping interfering in the affairs of the region, and stopping its support for the region's armed militias and terrorist organisations. In other words, the ball is now in Iran's court.







## Iran is a Constant Source of Threat to Gulf and Arab Security

*The country continues to infringe upon the principles of the international law and has adopted hostile policies*

Since its 1979 revolution, Iran has remained the main source of instability in the Middle East because of its hostile and interventionist policies, which have never changed. It has always sought to assert its regional standing and to prove that it is the main actor in any arrangements in the region. The state behaves arrogantly and ignores the sovereignty and national security of its neighbouring countries. In this issue, Nation Shield sheds light on the threat posed by Iranian political and military behaviour in the Middle East.



## Iran has stepped up its hostilities and continued its interventionist policies that pose a clear threat to Gulf and Arab national security

2018 and impose sanctions on Iran. Since then, Iran has stepped up its hostilities and continued its interventionist policies that pose a clear threat to Gulf and Arab national security: either by continuing to support and arm armed militias and terrorist organisations in more than one country, by inciting Shiite minorities against the ruling regimes in many countries, or through threatening to close the Strait of Hormuz and threaten the traffic of navigation in the waters of the Gulf.

### **First: The Manifestations of Iran's Violation of International Law**

The experience of the past few years indicates that Iran is an irresponsible country that does not respect international law or the principles of good neighbourliness. Proof of their misconduct includes:

**1. Exporting the Revolution:** Since the 1979 revolution, Iran has been trying to present itself as the leader of the Muslim world. Khomeini, leader of the Iranian Revolution, had thought that he was the sole sultan, the first leader, and the guardian appointed by God to renew Islam, revive the Shari'a, and advocate the vulnerable in the world. He thought that world Muslims must

Iran has always sought to capitalise on the developments in the region to serve its expansionist project. When unrest erupted in the Middle East in 2010, Iran imagined that it could proceed to establish an Iran-led Islamic Middle East and even instigated chaos in some countries of the region. When

it concluded the nuclear agreement with the group "5 + 1", it fancied it was given a green light to precede a step further with its expansionist and sectarian project. Thus it committed foolish acts that proved that it is an irresponsible state. This led the U.S. to withdraw from this agreement in May





submit to his sovereignty. Therefore, he imagined that his duty was to lead the Islamic peoples in the East and West, considering that his revolution in Iran was not local, but was beyond the Iranian borders, so it should reach all parts of the earth. When the events of the so-called “Arab Spring” began at the end of 2010, Iran described it as an extension of the Iranian Revolution or an “Islamic Awakening” in the region, as Supreme Leader Ayatollah Khamenei called it. It has strived to incite the Shiite groups in the Kingdom of Bahrain to revolt against the regime. The Iranian project depends on two notions. The first is the ideological conviction of the Iranian regime in the inevitability of the global government

of Islam and the need for Iran to play a strong role in preparing for this, according to the Iranian constitution. The second, is strategic, and is related to Iran’s attempts to create a security belt that would serve as a shield against all attempts of its opponents to penetrate it from inside or besiege it through neighbouring countries.

## **2. Continuing interference in the affairs of the countries of the region:**

Iran is trying to justify its interventions in regional countries by claiming that it aims to defend the vulnerable, especially the Shiite minorities. Article 152 of the Iranian Constitution is entitled “Defending the rights of all Muslims” and Article 154 is entitled “Supporting the legitimate struggle of the op-



pressed against the arrogant everywhere in the world”.

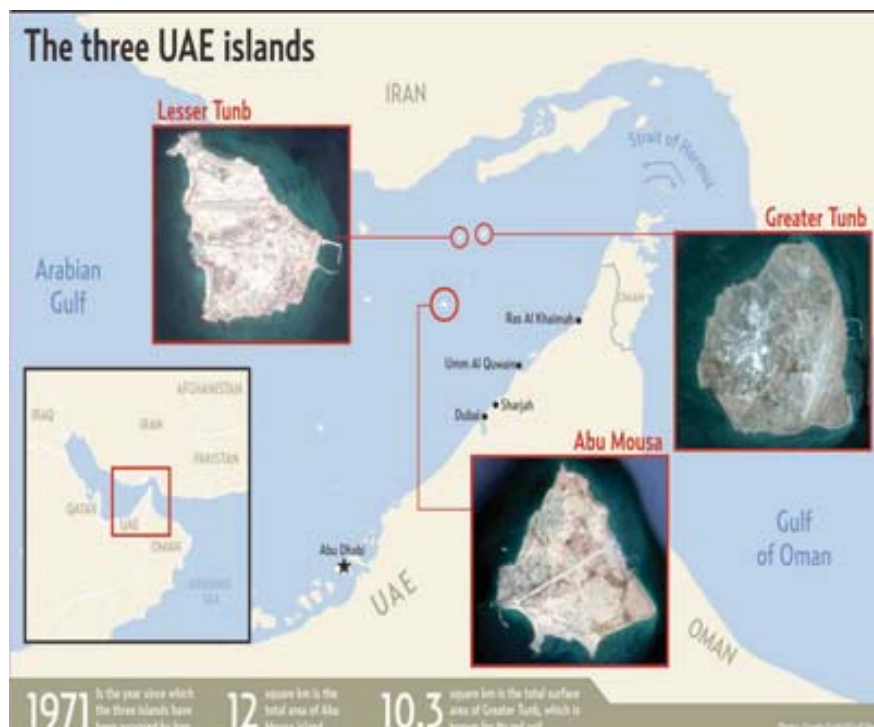
## **3. Providing support and finance for terrorism:**

In recent years, Iran’s relationship with the support and financing of terrorism is manifest, both through direct supervision (by funding, arming and planning) of many armed militias or terrorist organisations (as in the case of Houthi militias in Yemen and Hezbollah in Lebanon), or through its explicit involvement recently in many terrorist activities in a number of European countries. Many studies indicate that Iran spends one or two billion dollars a year on Hezbollah militias in Lebanon, especially after expanding its military operations in Syria. While it supports Houthi rebels by providing them with arms and financial aid.

## **4. Violation of Security Council resolutions on the prohibition of export of weapons abroad:**

Iran’s involvement in supplying the Houthi militias





with arms is certainly a clear violation of the resolution of the UN Security Council on Iran No. 2231 of 2015, under which the Security Council agreed to the nuclear agreement concluded between Iran and Western countries in 2015, and put a ban on Tehran to supply, sell or transfer heavy and light weapons outside its territory without the consent of the Council. It also violated a second resolution on Yemen No. 2216 issued on April 14, 2015, which banned supplying weapons to Houthi rebel leader Abdulmalik Badruddin al-Houthi and two military leaders in Yemen, as well as the deposed Yemeni President Ali Abdullah Saleh and his son Ahmed.

**5. Threatening the freedom of international shipping and commercial traffic:** There is no doubt that Iran's continued threat to close the Strait of Hormuz and to incite the Houthi militias to disrupt traffic in the Bab al-Mandeb Strait is a flagrant violation of in-

## The Arab Summit in Tunis in March 2019, affirmed the sovereignty of the UAE on the three islands

ternational law, which guarantees free passage, safety and sailing to all States and ships without any discrimination. The Strait of Hormuz is one of the most important international straits, since it is the only connecting waterway between the eastern and western worlds.

**Second: The Manifestations of the Iranian Threat to Gulf and Arab National Security**

In light of the above, Iran poses a real threat to the national security of the Gulf and Arab countries, as demonstrated by its following practices:

**1. Continued occupation of three UAE islands (Greater Tunb, Lesser Tunb and Abu Musa):** Iran doesn't respond to diplomatic and political efforts to resolve this issue. The country continues to criticise any Arab and Islamic positions that support the sovereignty of the UAE on these islands. It said in a statement that the "Abu Dhabi Declaration" issued by the 46th Conference of Foreign Ministers of the Organization of Islamic Cooperation in March 2019 did not take its objection into consideration. It also rejected the statement issued by the Arab Summit in Tunis in March 2019, which affirmed the sovereignty of the UAE on the three islands and supported all peaceful measures taken by the UAE to restore its sovereignty over its occupied islands.

## 2. The continuation of Iranian ambitions in Arab territories:

The fact is that the three islands of the UAE are not the only case that reveals Iranian ambitions in the Arab region. As expressed by the statements of Iranian officials, there are also dreams of control over four Arab capitals, and annexing them to their alleged empire, whose central capital is Baghdad according to their claims.

## 3. Continued military threat through the display of power:

Iran is trying to assert its own capabilities and achieve strategic superiority at the regional level at least. Its military doctrine is in line with this trend. Iran views itself as the major dominant regional power, as well as a revolutionary state, and is still seeking to spread its revolution across the region. However, the fact is that Iran is using its military force to carry out its expansionist project in the region.

## 4. Strategic expansion in the countries of the region:

The Iranian regime's arrogance and pride in its power makes it always think of strategic intervention and expansion in neighbouring countries, stressing that there is a model that can be replicated in other countries, since Iran considers itself the largest country in the Arabi-an Gulf region. The Iranian regime has prepared a document known as the "Twenty Iranian Strategy" (2005-2025), or the 20th Iranian Plan (Iran: 2025), which describes the Iranian future role in 20 years and aims to transform Iran into a central nucleus of dominance in South-West Asia region (i.e. the Arab region in particular, which includes the Arabian Peninsula, the Levant and the Sinai).

## 5. The employment of affiliated armed militias and terrorist organisations to wage wars by proxy:

Iran is aware that its involvement in a di-



rect military confrontation with the countries of the region may cost a lot, since the only regular direct war it had with Iraq in the 1980's made it feel the bitterness of defeat and setback. In order to avoid entering into a direct military confrontation, therefore, in recent years Iran began to use its military militias and local arms in regional countries to achieve its military objectives.

## 6. The attempts to incite Shiites in the Gulf Cooperation Council states:

Since the outbreak of the Iranian revo-

lution at the end of the 1970's, Tehran has sought to penetrate the Gulf communities by inciting the Shiite citizens there to put pressure on their states. It treated them as a geographical and demographical extension. Over the past few years, Iran has been trying to incite the Saudi Shiites against Saudi Arabia, by raising their economic and political demands. It even intervened directly in the judgments of the Saudi judiciary in protest against the execution of Shi'ite cleric Nimr Baqir al-Nimr in January 2016.



**7. Spy networks and sleeper terrorist cells:** Iran resorted to spy networks to penetrate the Gulf communities. In Kuwait, authorities announced the detection of a spy network connected to Tehran, known as the “Abdali cell,” which was revealed in December 2015. In September 2012, the Kuwaiti security services were able to dismantle another Iranian espionage cell in one of the Husayniyat in the Benidalqar area. In Saudi Arabia, authorities announced in February

2016 that they had begun trial of 32 people, including 30 of the country’s Shia minority, on charges of spying for Iran. In addition to espionage networks, Iran’s Islamic Revolutionary Guard Corps (IRGC) relied on sleeper terrorist cells to destabilise the GCC states, particularly the Kingdom of Bahrain and Saudi Arabia.

**8. Attempts to control water straits and corridors:** As part of its quest for hegemony and control, Iran gives exceptional attention to strengthen-

ing its presence in the waterways and straits of the region (Hormuz, Bab al-Mandeb, Gulf of Aden). The movements and official statements of the leaders of Iran point out that Iran seeks to control, alone, the fate of the Strait of Hormuz, in spite of the historical right of the Sultanate of Oman to do so and its exercise of this right. It seeks to acquire another advantage, in addition to the geopolitical and geostrategic features of the maritime location of Iran, extending from Lake Caspian to the North, through Shatt al-Arab and the Arabian Gulf to the Arabian Sea and the Indian Ocean to the south. It may employ these features economically and politically against its Gulf neighbours.

### Conclusion

The experience of the past years has shown that Iran poses a serious threat to regional and international security and stability in many respects. In addition to its hostile policies, which violate the principles of international law such as the violation of the right of sovereignty, non-observance of the principles of good neighbourliness, support and financing of terrorism and the threat of freedom of navigation and international trade. It seeks to destabilise the region, whether by proxy wars through its armed militias or by trying to penetrate the Gulf and Arab communities through spy networks and sleeper cells waiting for the chance to destabilise these countries. While the international community hopes that Iran will listen to the voice of wisdom and stop its hostile policies of tension, chaos and turmoil, it is unfortunately pursuing the policy of manoeuvring, dodging, bargaining and extortion, not mindful of the implications of this policy for its people, who face catastrophic conditions at all levels.



A Lockheed SR-71 Blackbird aircraft is shown from a front-three-quarter view, parked on a tarmac. The aircraft's distinctive features, including its large, dark, pointed nose, two large engines mounted on the wings, and its high-wing configuration, are clearly visible. The aircraft is casting a long shadow on the ground. The background shows a clear sky and a distant horizon.

# OX CART vs Blackbird: Do You Know the Difference?

**Can** you tell the difference between the OXCART and a Blackbird? Most people can't and often confuse one with another. Yet the Central Intelligence Agency's (CIA) A-12 OXCART and the U.S. Air Force's SR-71 Blackbird are two very different aircraft.

Becoming operational on 12th November 1965, the CIA developed the highly secret A-12 OXCART as the U-2 spy plane's successor to meet the need for a very fast, high-flying reconnaissance aircraft to avoid Soviet air defenses. Not only did the A-12 prove its worth, but the overall OXCART project produced the second longest-lasting aerial reconnaissance platform in U.S. intelligence history: the SR-71.

Although the SR-71 Blackbird was the Air Force's two-seat follow-on version

of the OXCART, the A-12's unique design features became the foundation for three other versions: the YF-12A, the M-21 and, of course, the SR-71. The OXCART hence produced the two fastest, highest-flying, piloted jet aircraft (the A-12 and SR-71) ever seen, while pioneering stealth technology for future use.

## How It Began

Lockheed's aviation genius, Clarence Leonard "Kelly" Johnson, is credited with the OXCART and Blackbird. Born in Ishpeming, Michigan, he joined Lockheed in 1933 to design and contribute significantly to the development of at least 40 well-known, highly valued military and civilian aircraft, including the U-2, the A-12 and SR-71. One of the preeminent aircraft design-

ers of the twentieth century, Johnson and his Skunk Works team had a track record of delivering 'impossible' technologies on incredibly short, strategically critical deadlines. For instance, in 1959, CIA awarded the OXCART contract to Lockheed, with Johnson's team having overcome several daunting technical challenges to create a high-speed, high-altitude reconnaissance aircraft capable of avoiding interceptors and missiles.

Engineers used cutting-edge innovations in titanium fabrication, lubricants, jet engines, fuel, navigation, flight control, electronic countermeasures, radar stealthiness and pilot life-support systems to deliver the A-12 as America's first stealth plane. However, this aircraft was never completely

'stealthy', for the fuel it had to carry for exceptional flight speed required air-frame design changes making radar tracking easier.

After hundreds of hours flown at high personal risk by an elite team of CIA and Lockheed test pilots, the A12 was declared fully operational in 1965. It attained a sustained speed of Mach 3.2 (just over 2,200 miles per hour) at 90,000 feet altitude, which was an unbroken record for piloted jet aircraft.

#### **OXCART's First Mission**

The only A-12 reconnaissance operation, codenamed BLACK SHIELD, took place from May 1967-May 1968, initially over south-east Asia and North Korea. A detachment of six pilots and three A-12s flew 29 missions over East Asia, based at Kadena Air Base, Okinawa, Japan.

Piloted by Mele Vojvodich, the first BLACK SHIELD flight took off in torrential rain just before 11:00 local time on 31st May 1967. The A-12 had never

## The only A-12 reconnaissance operation, codenamed BLACK SHIELD, took place from May 1967-May 1968

operated in such conditions, but the flight went ahead and Vojvodich flew the planned route at 80,000 feet and Mach 3.1, refuelling immediately after taking off and during each of two loops over Thailand, before safely touching down at Kadena with a total

flight time of 3 hours 39 minutes.

The intelligence mission was a resounding success, with photo interpreters finding no surface-to-surface missiles threatening the U.S. and allied military forces when assessing the status of 70 of 190 known surface-to-air missile sites and 9 other priority targets. In fact, Chinese or North Vietnamese radar did not track the aircraft during the Vojvodich flight, nor did North Vietnam fire any missiles at it, although during other missions in October 1967 and January 1968, North Vietnam fired three SAMs at BLACK SHIELD A-12s but only once caused damage.

#### **OXCART Transforms into Blackbird**

In December 1962, the Air Force ordered six "reconnaissance/strike" over hostile territory by the SR-71 Blackbird, a new SR aircraft for high-speed, high-altitude flights. Although anticipated speed exceeded 2,000 mph, the plane



YF2Y-1 Seadart and Lockheed A-12 Blackbird-San Diego Air and Space Museum



## The A-12 was painted black to earn its name, "Blackbird", and made its first flight on April 30, 1962

needed to maintain a record-setting speed for hours at a time where, at such velocity, friction with the atmosphere generated temperatures melting a conventional airframe.

With anticipated temperatures exceeding 1,000 degrees Fahrenheit, a titanium alloy was the only option for the airframe to deal with the heat, providing the strength of stainless steel alongside relatively light weight and durability. Yet titanium also proved to be a particularly sensitive material, with the brittle alloy shattered if mishandled, entailing great frustration on the Skunk Works assembly line and new training classes for Lockheed's machinists.

Conventional cadmium-plated steel tools also embrittled the titanium on contact, requiring new tools to be designed and fabricated from titanium. While friction would generate incredible heat at the leading edges of the aircraft, the ambient temperature outside the cockpit window could reach -60 degrees Fahrenheit.

Skunk Works' Ben Rich thus spent untold hours tackling the problem of how heat could be dissipated across the entire airframe. Here he recalled a simple lesson from one of his uni-



A-12 is America's first stealth plane



A-12 cockpit

versity courses: black paint both emits and absorbs heat. The A-12 was painted black to earn its name, "Blackbird", and made its first flight on April 30, 1962.

The otherwise single-seat A-12 soon evolved into the larger SR-71, with a second seat added for a Reconnaissance Systems Officer, carrying more fuel than the A-12 for its debut flight on 22nd December 1964. Although the Blackbird's stealthiness resulted from radar absorbent structures along the chines, wing edges, vertical tails and inlet spikes, the paint helped to release some of the heat generated by air friction and camouflage the aircraft against the dark sky at high

altitudes.

As a modified version of the A-12 OXCART, the SR-71 Blackbird was about six feet longer, weighing an additional 15,000 pounds fully loaded, with a more prominent nose and body chines. It had a two-seat cockpit and carried additional optical and radar imagery systems.

After an initial contract for six Blackbirds, the Air Force ordered 25 more aircraft in August 1963, with the first SR-71 flying out on 22nd December 1964. Throughout its operational career, the SR-71's primary operation base was the Kadena Air Base in Japan, while Beale AFB in California and RAF Mildenhall, England, also hosted



Blackbird operations.

### **A Stealthy Pioneer**

Reducing the size of the Blackbird's radar image meant an even further reduction in the likelihood that the plane would be perceived and shot down. Although the initial test results were good, rumours of Soviet radar advances led the U.S. government to ask for an even smaller radar profile.

With the Blackbird model being more than 100 feet in length, surfaces had to be redesigned to avoid reflecting radar signals, while the engines moved to a subtler mid-wing position and a radar-absorbing element was added to the paint. When a full-scale

## Throughout its operational career, the SR-71's primary operation base was the Kadena Air Base in Japan



A12 could fly at speeds exceeding 2,000 mph



By the late 1980s, enthusiasm for the expensive SR-71 programme had waned in preference for space-based systems

model of the Blackbird was hoisted on to a pylon for radar-testing at Skunk Works' secret location in the Nevada desert, the results were impressive.

Following tests carefully scheduled to avoid Soviet satellite observations, the Blackbird model was shown to appear on a Soviet radar as bigger than a bird but smaller than a man. The A-12 team had succeeded in reducing radar cross section by 90 per cent.

### **Piloting the Blackbird**

Flying the Blackbird was an unforgiving endeavour, demanding total concentration. Yet, "At 85,000 feet and Mach 3, it was almost a religious experience," said Air Force Colonel Jim Wadkins. "Nothing had prepared me to fly that fast... My God, even now, I get goose bumps remembering."

The best air defence systems had no hope of catching the Blackbird and when anti-aircraft weapons were fired, a warning light glowing red on the control panel would typically be the last the pilot would see of the attempted attack, as surface-to-air missiles consistently missed wildly, exploding many miles from the intended target. The Blackbird remains the world's fastest and highest-flying manned aircraft and on its retirement flight from Los Angeles to Washington in 1990, the plane flew coast to coast in 67 minutes to its final resting place in the Smithsonian Air and Space collection. Most importantly, the aircraft has provided the United States with detailed, mission-critical reconnaissance for more than two decades, while its Cold War legacy as a game-changer will be admired for generations.

### **OXCART Retirement, CORONA Replacement**

With the overt SR-71 and covert A-12 fleets having similar capabilities, President Johnson ordered retirement of the A12 OXCART by 1968. By then,



Lockheed SR-71A Blackbird, Warner-Robbins Air Museum

CORONA satellites were collecting thousands of images worldwide each year and although its imagery was less timely and of poorer resolution than the A-12 and SR-71, it was safe from anti-aircraft missiles and much less provocative than aircraft overflights.

The A-12's original mission to monitor the Soviet Bloc had been halted after the U-2 piloted by Francis Gary Powers was shot down over the Soviet Union in May 1960. However, the SR-71 continued to fly for intelligence gathering, providing vital information in formulating successful U.S. foreign policy.

By the late 1980s, enthusiasm for the expensive SR-71 programme had waned in preference for space-based systems and the Air Force deactivated the Blackbird in November 1989. On 21st January, the last SR-71 Blackbird left Kadena Air Base, while the SR-71 was decommissioned at Beale Air Force Base in California on 26th January 1990.

NASA crews flew four Lockheed SR-71 airplanes during the 1990s, with two used for research and two to support Air Force reactivation of the SR-71 for reconnaissance missions. Although the Air Force retired the Blackbirds in 1990, Congress reinstated funding for additional flights several years later and the SR-71A (61-7980/NASA 844) arrived at Dryden in February 1990.

Placed in storage in 1992, Blackbird served as a research platform until its final flight on in October 1999, SR-71A (61-7971/NASA 832) arrived at Dryden in March 1990, but was returned to Air Force inventory as the first aircraft was reactivated in 1995. Along with SR-71A (61-7967), it was flown by NASA crews in support of the Air Force programme. In July 1991, the SR-71B (61-7956/NASA 831) arrived at Dryden to serve as a research platform and for crew training until October 1997. In October 1997, President Bill Clinton vetoed further funding and in June 1999, the SR71 pro-

gramme was officially terminated.

#### Which One is Faster?

The OXCART has a documented maximum speed and altitude of 2,208 mph at 90,000 feet from 1965, while the SR-71 holds the official speed record for a piloted operational jet aircraft of 2,193 mph, set on 28th July 1976. On the same date, the Blackbird set an official world altitude record of 85,069 feet.

Unofficially and not without controversy, the pilots of both aircraft have anecdotal stories indicating the numbers for both aircraft may be higher. Some SR-71 test reports attest that the aircraft surpassed the official records for speed and altitude.

Nevertheless, both the A-12 OXCART and the SR-71 Blackbird are regarded as pioneering achievements in aeronautical engineering, representing the pinnacle of Cold War aviation technology.

Reference Text/Photos:

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# Multi-Domain Battle

## ***Part 1: Primary Enemy Systems: New Methods for Armed Conflict***

In a rapidly changing world, the military's operating environment is becoming more contested, more lethal and more complex. While the integration of land, air, sea, space and cyber operations has been a long-term concept, over the last 20 years potential adversaries have also studied the capability of nations to develop the means of countering once-guaranteed domain overmatch. Now, adversaries can demonstrate asymmetric capabilities suitable for

denying access to theatres and challenging the unity of coalitions, so negating freedom of action at the operational and tactical level. The purpose of the Multi-Domain Battle (MDB) concept is thus to drive change in battle management by designing a future army.

In response, **Nation Shield** is publishing a two-part series providing a detailed study of the future vision of the United States Army and its combat plans. Based on the document "Multi-Domain Battle: Evolution of Combined Arms for the 21st Century" published by U.S. TRADOC Army Capabilities Integration Centre, we are delighted to

present Part 1 of the study.

### **Operational Purpose of MDB**

Multi-Domain Battle is an operational concept with a deliberate strategic and tactical focus on increasingly capable adversaries who challenge deterrence and pose a strategic risk to U.S. interests in two ways.

Firstly, regarding armed conflict operations, these adversaries employ systems to achieve the strategic end of avoiding war within the traditional operating methods of Joint Forces. Secondly, if these adversaries choose to wage a military campaign, then they will employ integrated systems to contest and then separate Joint Force



ISR operations - Eye in the sky



The F-35 Patuxent River Integrated Test Force is testing aboard the Royal Navy aircraft carrier HMS Queen Elizabeth

# Management

capabilities simultaneously in all domains, operating at extended ranges to make a friendly response prohibitively risky or irrelevant.

Within this context, the Multi-Domain Battle concept describes how the U.S. and her partner forces organise, practice and employ capabilities or methods across domains, environments and functions over time and physical space. Its objective is to contest these adversaries in operations below armed conflict and, where required, defeat them.

Although it recognises the unique capabilities and roles of the Services, MDB seeks common and interoper-

able capabilities to provide Joint Force Commanders with complementary and resilient forces to prosecute campaigns and further the evolution of combined arms through the 21st century.

## **Primary Enemy System Conflict**

Once engaged in armed conflict, the enemy will seek a swift and favourable outcome to limit the risk to its forces and civil stability. Here, enemy systems will fragment the integrated employment of forward-positioned Joint Force elements to prevent follow-on by deploying timely echelons to reinforce the theatre of operations, achieving a successful outcome.

Conventional forces are the enemy's main tool in armed conflict, supported by unconventional warfare, information warfare and nuclear capabilities. The following is an overview of how and where enemy military systems are deployed to achieve rapid, decisive victories.

- **Conventional forces.** As the primary means of accomplishing objectives in armed conflict, conventional forces execute offensive operations to seize key terrain and destroy friendly formations through follow-on operations that reinforce or exploit reconnaissance, unconventional warfare (UW) and information warfare (IW) activities initi-

ated in competition. In both offence and defence, the enemy converges its ISR-strike system, IADS, ground manoeuvre formations and maritime capabilities in a systems approach that places the Joint Force in multiple, simultaneous forms of contact in all areas of the battlespace. Irregular forces often transition to a supporting role during armed conflict and conduct security operations that shape an occupied area (often through ethnic cleansing or other population-control measures), while offering conventional forces a layer of immunity from war crimes.

**(a) ISR-strike system.** The enemy's ISR-strike system is a critical capability in armed conflict. It employs long-range, anti-surface strike and fire (air-launched, maritime-launched and ground-launched cruise/ballistic missiles) integrated with ISR capabilities (including unmanned aerial systems, SOF and sensors) to overwhelm the following: friendly headquarters, ground manoeuvre formations and naval concentrations, embarkation and debarkation at air and sea ports, and sustainment facilities in the Strategic and Operational Support Areas. Attacks from this integrated system provide the enemy with its most effective means of delaying and disrupting the Joint Force's echelon of forces into the theatre of operations, preventing it from integrating and sustaining combat power once in theatre. The enemy's threats or attacks on civil targets also influence domestic and allied decisions to deny Joint Force use of key terrain and access to additional military capacities, but while enemies possess large numbers of long-range fire platforms and supporting munitions, they do not have an infinite supply.

Successful employment of the ISR-



Two UH-1N helicopter pilots practicing formations, manoeuvre and rescue tactics

strike system depends on timely reconnaissance, sufficient logistics support and adequate command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) to engage dynamic friendly targets across the battlespace. Thus, the protection of enemy long-range fires by sophisticated IADS, ground manoeuvre formations and maritime forces in multiple regions of the enemy homeland makes attacking them a challenge.

**(b) Integrated air defence system (IADS).** This defence consists of firing batteries, radars, command and control (C2) networks and air superiority aircraft. They provide essential protection for the enemy's long-range fire, ground manoeuvre formations, maritime surface ships, bases and sustainment and C2 functions. It restricts friendly airborne reconnaissance and strike systems throughout the depth of the battlespace, providing the backbone of adversary A2/AD capabilities. The IADS also contests friendly air superiority aircraft, exposing friendly

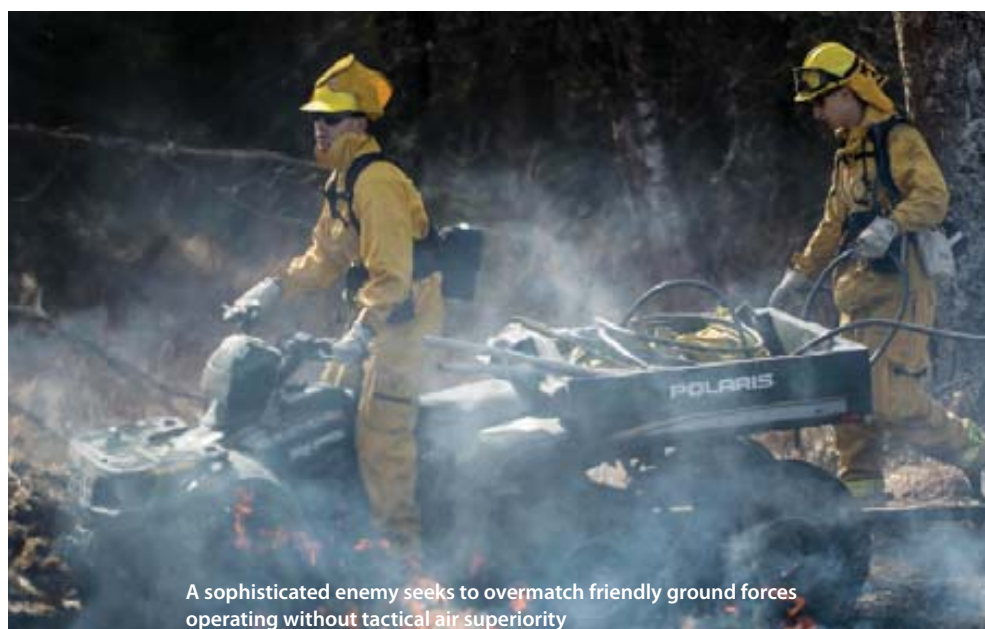
ground formations, bases and naval forces to both enemy airborne reconnaissance and attack. The enemy's firing batteries and radars generate physical and electronic signatures with finite magazine capacity making them vulnerable to air and ground attack by friendly ground forces.

As a defence against friendly airborne reconnaissance and strike capabilities, sophisticated IADS networks are multi-layered, mobile, dispersed and capable of autonomous operations. The IADS not only protects strike and fires systems, but also enables effective ground and maritime manoeuvre while challenging friendly forces' ability to enter the theatre of conflict.

**(c) Ground manoeuvre formations.** Here, the enemy depends on the effect of the ISR-strike systems, executing offensive and defensive combined-arms operations to seize and hold key terrain in order to secure the enemy's primary military objectives, so protecting ISR-strike and IADS assets while destroying friendly forces.

A sophisticated enemy seeks to over-





A sophisticated enemy seeks to overmatch friendly ground forces operating without tactical air superiority

match friendly ground forces operating without tactical air superiority in the Close Area by combining the following: arms formations converging on massed tactical fires; mobile, protected and lethal manoeuvre units; manned and unmanned reconnaissance and strike aircraft; and tactical air defence, electronic warfare, chemical weapons and C2.

The enemy's combined-arms formations defeat friendly manoeuvre units by enabling tactical indirect fires via positioning the ISR-strike and IADS systems together to defeat friendly airborne and ground reconnaissance missions. By adding attack-friendly command nodes and systems, tactical fires batteries and sustainment activities, this combined effect separates and isolates friendly manoeuvre units in the Close Area. The enemy uses manoeuvre elements and systems to fix friendly forces and tactical fires to destroy them, although they have a limited sustainment capacity exhaustible in an extended or destructive campaign.

**(d) Maritime.** The enemy's maritime forces can disrupt friendly inter- and intra-theatre sea and air movement, attack friendly ships and seize key littoral terrain. Enemy submarines provide reconnaissance for long range-fires and attack friendly ships in 'blue water', acting as launch platforms for submarine-launched cruise missiles while laying mines to block important maritime choke points and harbours.

The enemy's surface combatants and amphibious forces exploit local sea control and seize key littoral terrain under the cover of enemy long-range fires and IADS, although they are vulnerable with limited or unavailable coverage. Enemy submarines are a growing threat to friendly strategic and operational rear, with the ability to separate the strategic and operational movement of U.S. forces long enough to change the outcome of any campaign dependent upon maritime support to maintain its lines of communications.

In summary, the enemy can attack strategic, operational and tactical tar-

## MDB concept describes how the forces organise, practice and employ capabilities or methods across domains

gets simultaneously throughout the battlespace with multiple-domain capabilities to overwhelm existing mission command practices and systems, making friendly forward-deployed forces fight isolated in domain-centric battles without mutual support.

Friendly air forces face sophisticated IADS and aviation threats and massed fire against airfields and bases. The enemy can detect forward-positioned maritime forces at long range and attack them with massed shore-based fires, rendering them unable to contribute strikes or amphibious forces to air and ground campaigns for operationally significant periods.

Without air cover, ground forces lack deep reconnaissance for fires and are exposed to enemy reconnaissance, air attack and massed fires. In not possessing the ability to operate semi-independently across domains, friendly ground-manoevr forces can be easily defeated in the Close Area by enemy combined-arms formations.

### **2. Unconventional warfare (UW).**

The enemy's UW activities enable operations in the Close and Support Areas, especially when enabled by proxy forces, while operations in the Strategic and Operational Support Ar-

as provide the enemy with invaluable reconnaissance for long-range fire targeting and even limited ground attack capabilities. Enemy SOF and proxies in the Tactical Support and Close Areas assist in the reconnaissance effort, conducting attacks against undefended mission command, fires and sustainment targets as economy-of-force efforts or in advance of enemy offensives.

UW is also integral to the enemy's consolidated gains in newly-secured territory, although effective security, counter subversion and policing can limit the enemy's ability to expand this capability in most areas. Although it will require the support of effective Information warfare (IW) narratives, high levels of enemy UW activity can strengthen friendly resistance.

**3. Information warfare (IW).** Enemy IW operations in armed conflict complement long-range fire and focus attacks on friendly cyberspace networks and space-based communications, intelligence, reconnaissance and positioning, navigation and timing (PNT) systems. Attacks on these systems complicate friendly forward-deployed

force operations and delay reinforcing forces by restricting friendly space-based reconnaissance, so preventing Joint Forces from conducting movement and making distributed mission command difficult in all areas.

The enemy's cyber and space attacks originate from ambiguous or Deep Fire Areas, making them difficult to counterattack and pose a serious threat to friendly network-centric militaries and civil societies. The pro-

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During armed conflict, enemy conventional forces quickly separate and overwhelm friendly forward-deployed forces

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paganda narratives dominating the enemy's IW operations in competition underscore the flow of operations in armed conflict, enabling the enemy to translate battlespace success to political success or threatening deployment of tactical nuclear weapons in an effort to terminate the conflict through escalation.

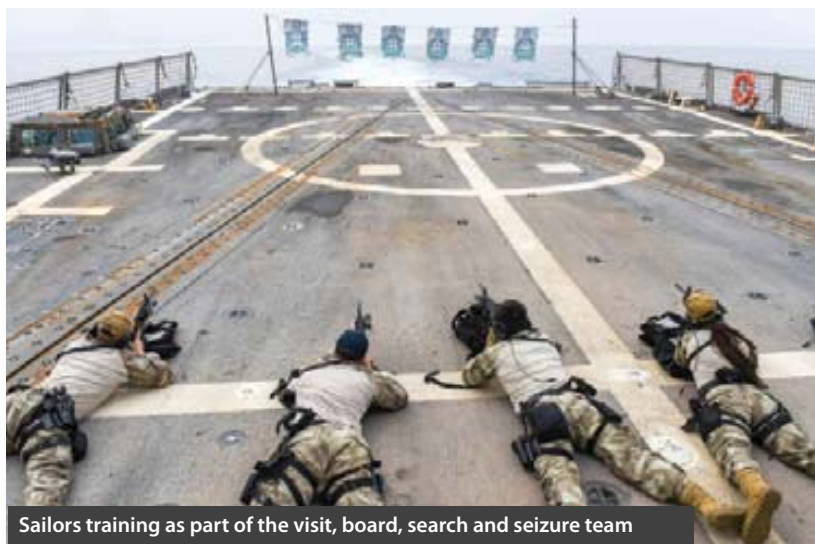
**4. Nuclear weapons.** In conjunction with IW activities, the enemy uses the psychological threat of employing nuclear weapons against population centres and military targets to coerce friendly decision-makers and fundamentally alter negotiating calculus and end the conflict in its favour.

Enemy nuclear weapons are delivered by missiles, aircraft and artillery, inserted as area-denial ground placement into the Support and Close Areas then producing specific physical and psychological effects to friendly forces, populations and leaders, both military and political. The enemy subsequently employs nuclear weapon blast effects to destroy friendly force concentrations, critical infrastructure and even civilian populations.

Radiological effects deny key terrain

F-15E Strike Eagle





Sailors training as part of the visit, board, search and seizure team



A-10 Thunderbolt II, a single-seat, twin turboprop-powered aircraft designed specifically for close air support and ground attack missions



UH-60 Black Hawk training. It is the U.S. Army's primary medium lift utility transport and air assault aircraft.

while electromagnetic pulses destroy unhardened electrical circuits across a wide variety of military and civilian networks. The use of nuclear weapons against the U.S. or a treaty-ally government risks the escalation of strategic nuclear systems and total destruction of enemy territory in a general nuclear exchange.

As outlined above, the enemy integrates its systems first in competition and then in armed conflict, presenting friendly commanders and forces with multiple interconnected problems impossible to solve before the enemy concludes its *fait accompli* campaign. In competition, the enemy's shaping operations serve to position its forces advantageously for escalation, enabling both surprise and justification for an offensive campaign.

During armed conflict, enemy conventional forces quickly separate and overwhelm friendly forward-deployed forces, while enemy long-range fire, IW and UW prevent effective friendly echelonment from operational and strategic distances. Weakened friendly forces are then immobilised and cannot attack well-defended enemy critical capabilities effectively in the Deep Manoeuvre and Fires Areas.

The upshot is that the enemy will seek to defeat friendly forces rapidly by isolating forward-positioned forces and matching the Joint Force's corresponding inability to isolate enemy forces. The enemy can then fight them in an orchestrated sequence across domains.

*In Part Two, we will explore methods for defeating enemies in armed conflict*

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# "USS Gerald R. Ford"

## 21st Century's Super Aircraft Carrier

*The USS Gerald R. Ford (CVN 78) aircraft carrier, with its embarked carrier air wing, is a preeminent asset for maintaining maritime superiority across the oceans. The aircraft carrier, combined with the ships in an accompanying carrier strike group, is capable of carrying out missions across the full spectrum of military operations from military action to humanitarian assistance. Built on the legacy of both today's Nimitz-class aircraft carriers and the investments the U.S. Navy has made since World War II, the Ford-class carrier is flexible and adaptable and will be the most advanced ship on the sea.*

Ford-class ships will succeed the Nimitz-class carriers that have played the first-responder role in crises and conflicts for over 40-years. These ships deliver lethality, survivability, and joint interoperability, along with unmatched versatility and compatibility with continuing joint-force transformation. Ford class is capable of carrying the Navy's most advanced aircraft, such as

the F-35C Lightning II; F/A-18E/F Super Hornet; E-2D Advanced Hawkeye; EA-18G Growler electronic attack aircraft; MH-60R/S helicopters and unmanned air vehicles. Adding to its versatility, Ford class can recover and launch various Short Take-Off and Vertical Landing (STOVL) aircraft flown by the United States Marine Corps.

USS Gerald R. Ford (CVN 78) is the first

new design for an aircraft carrier since USS Nimitz (CVN 68) and is named to honour the 38th President of the United States, Gerald Ford. The ship is equipped with two newly designed reactors and has 250 per cent more electrical capacity than previous carriers. The improvements will allow the ship to load weapons, launch aircraft faster than ever before, and future in-



tegration of manned and unmanned aircraft with minimal ship alterations.

#### **Designed with Futuristic 3-D Product Modelling**

USS Gerald R. Ford (CVN 78) is the Navy's first aircraft carrier to be completely designed using a 3-dimensional product model. The shipbuilders of Newport News Shipbuilding utilised the latest and most advanced computer tool capabilities and functionalities for visual integration in design, engineering, planning and construction. Every piece part is created in a 3-D model at a full scale, which includes structure, various equipment, piping systems, machinery, electrical,

wire-ways, gauges, pumps, berths, medical and galleys.

#### **Construction, Planning and Design**

USS Gerald R. Ford is the product of years of construction, planning and design with more than 5,000 shipbuilders in Newport News and thousands of suppliers across the United States contributing to its completion. In addition to the complicated warfighting components of launching and retrieving jet aircraft, beneath the surface of Ford is a bustling city with two power plants, food services, medical facilities, waste management systems, and even desalination plants that convert seawater to fresh water. With new software-controlled electromagnetic catapults and weapons elevators, and a redesigned flight deck

and island, Ford carriers are truly designed for the 21st century and beyond. The ship has an enhanced flight deck capable of increased aircraft sortie rates, and growth margin for future technologies.

Each Ford-class ship will operate with a smaller crew than a Nimitz-class carrier and will provide US\$4 billion in total ownership cost savings for the Navy. Aircraft carriers provide sovereign, mobile U.S. territory and are a visible symbol of the U.S. power.

#### **Gerald R. Ford Class Ship Capabilities**

In line with advancements in technology, Ford carriers provide the ability to implement future improvements with relative ease. The CVN 78 and its successors will keep pace with the future threats arising in the 21st century, and present increased warfighting capability and enhanced survivability. The island on CVN 78 is smaller and further aft than that of previous carriers, which increases space for flight-deck

operations and aircraft maintenance. This allows the ship and air wing to launch more aircraft sorties per day.

The aircraft carrier has replaced legacy steam-powered systems with electric-drive components, which brings in three times the electrical-generation capacity of any previous carrier. Improvements in its hull design, fire-fighting systems and weapons stowage provide improved survivability and longer time between maintenance availabilities allows for increased steaming days over the life of the ship. The Advanced Weapons Elevators provides improved weapon and material handling. Moreover, the Ford class carrier is readily susceptible of future modernisation throughout its 50-year service life.

Ford-class Electromagnetic Aircraft Launch System (EMALS) provides for more accurate end-speed control, with a smoother acceleration at both high and low speeds. The system also possesses the necessary energy capacity to support an increased launch envelope and a capability of launching both current and future carrier air wing platforms be it the lightest unmanned aerial vehicles or heavy strike fighters. In addition, the Advanced Arresting Gear (AAG) system provides Ford-class ships with the ability to recover both current and projected carrier-based, tailhook-equipped aircraft, and is the follow-on system to the Mark-7 system of the Nimitz class. AAG allows for the recovery of a broader range of aircraft, and the architecture includes built-in test and diagnostic technologies.

Ford-class carriers also include quality of life enhancements, such as improved berthing compartments, better gyms, and more ergonomic workspaces.

The CVN 78 is designed to operate effectively with almost 700 fewer crew



members than a CVN 68-class ship. Improvements in the ship design will also allow the embarked air wing to operate with a smaller crew. Gerald R. Ford is the first aircraft carrier designed with all electric utilities, eliminating steam service lines from the ship, reducing maintenance requirements and improving corrosion control. The new A1B reactor, EMALS, AAG, and Dual Band Radar (DBR) all offer enhanced capability with reduced manning.

#### **Advanced Weapon's System**

The ship's systems and configuration are optimised to maximise the sortie generation rate (SGR) of attached strike aircraft, resulting in a 33 per cent increase in SGR over the Nimitz-class. The ship's configuration and electrical generating plant are designed to accommodate new systems, including direct energy weapons, during its 50-year service life. The Gerald R. Ford-class builds upon the Navy's legacy of aircraft carrier innovation, stretching back to the first aircraft carrier, USS Langley (CV-1). Gerald R. Ford continues the aircraft carrier history of innovation and adaptability that will enable her to serve the country for decades to come. Weapons systems involve Evolved Sea Sparrow Missile, Rolling Airframe Missile and Close-In Weapon System (CIWS).

#### **Evolved Sea Sparrow Missile (ESSM):**

In service on approximately 230 ships of 12 navies, the versatile ESSM is an intermediate range anti-ship cruise missile, which is guided via active radar and midcourse data uplinks. ESSM is a tail-controlled missile that provides critical performance in situations requiring quick reaction capability and improves ship self-defence against low-altitude, high-velocity and advanced manoeuvre anti-ship cruise missiles. ESSM also provides an effective defence against the surface

and low-velocity air threats, and is integrated with seven combat systems and four launching systems.

**Rolling Airframe Missile (RAM):** A supersonic, lightweight, quick-reaction, fire-and-forget weapon, the RAM system is designed to destroy anti-ship missiles. Its passive radio frequency and infrared guidance design provide high-firepower capability for engaging multiple threats simultaneously. The Block 2 variant, the latest evolution in the development of the RAM missile, has a larger rocket motor, advanced control section and an enhanced RF

receiver capable of detecting the quietest of threat emitters. The improvements make the missile two and a half times more manoeuvrable, with one and a half times the effective intercept range. This provides the Block 2 variant with the capability to defeat highly stressing threats, increasing the survivability of the defended ship.

#### **Close-In Weapon System (CIWS):**

Typically mounted on shipboard in a naval capacity the close-in weapon system is a point-defence weapon system for detecting and destroying short-range incoming missiles and enemy



Pre-flight test during flight operations aboard the aircraft carrier USS Gerald R. Ford





An FA-18F Super Hornet performs an arrested landing aboard USS Gerald R. Ford



ESSM provides effective defence against all surface and low-velocity air threats

aircraft that have penetrated the outer defences. Nearly all classes of larger modern warships are equipped with either a gun-based CIWS or missile system CIWS. A gun-based CIWS usually consists of a combination of radars, computers, and multiple-barrel, rotary rapid-fire cannons placed on a rotating gun mount. The missile systems on the other hand use infrared, passive radar/ESM or semi-active radar terminal guidance to guide missiles to the targeted enemy aircraft or other threats.

**Dual Band Radar (DBR):** Ford Class has a Dual Band Radar, which is the first radar system in the U.S. Navy fleet capable of simultaneously operating

over two frequency ranges coordinated by a single resource manager. It combines the functionality of the X-band AN/SPY-3 Multifunction Radar and the S-band Volume Surveillance Radar (VSR).

Operating at X-band with high accuracy, AN/SPY-3's narrow beam width and wide frequency bandwidth provide superior coverage and effective discrimination of low-altitude targets. It also provides target illumination and uplink/downlink capabilities for SM-2 and Evolved SeaSparrow missiles. Whereas, using S-Band, VSR delivers all-weather search capabilities with its high-power aperture and narrow

## Technical Specifications

*General Characteristics, Gerald R. Ford class*

**Propulsion:** Two nuclear reactors, four shafts.

**Length:** 1,092 feet

**Beam:** 134 feet, Flight Deck

**Width:** 256 feet.

**Displacement:** approximately 100,000 long tonnes full load.

**Speed:** 30+ knots (34.5+ miles per hour)

**Crew:** Approximately 4,550 (ship, air wing and staff).

**Armament:** Evolved Sea Sparrow Missile, Rolling Airframe Missile, CIWS.

**Aircraft:** 75+.

beam enabling it to accurately resolve and track targets. The DBR's ability to utilise a multitude of frequencies in the two different operating bands dramatically mitigates the varied effects environmental phenomena has on SPY-3 and VSR radars. The separate band radar arrays provide extensive search, track and multiple missile illumination capacities, which is essential in support of multi-target raid engagements. DBR further enhances reliability with its electronically steered phased-array radar systems and 24/7 operational availability. It offers greater than 95 per cent operational availability via multilevel redundancy to ensure continuous operation in the event of component failure.

The Navy plans to build 10 more Ford-class aircraft carriers, and construction of Ford-class aircraft carriers is projected to continue through 2058.

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[www.raytheon.com](http://www.raytheon.com)