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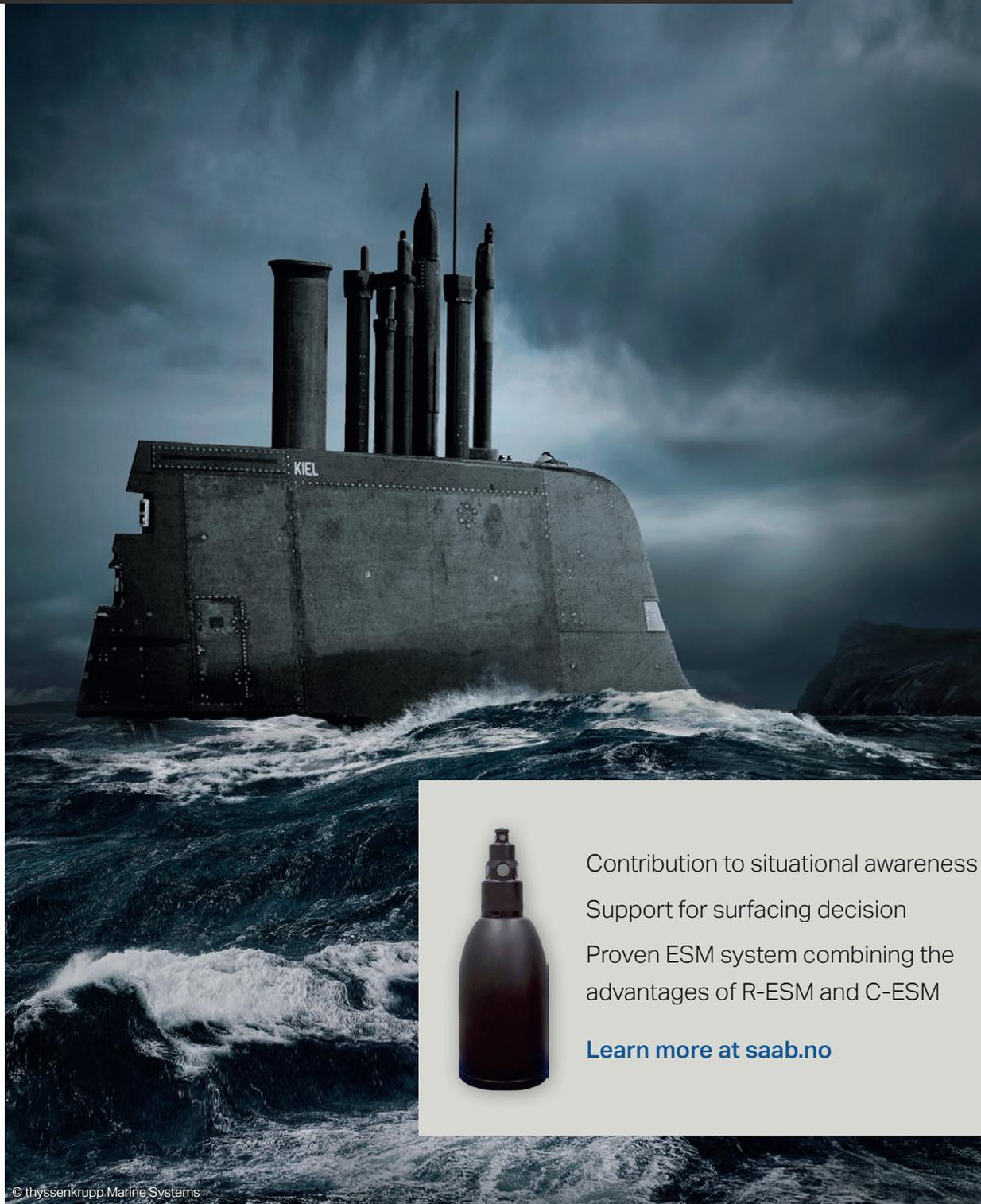
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**SAAB**

## 6TH GENERATION FIGHTERS: EUROPE LOSES AGAIN?

Several countries are already at work with programmes for the development of the next generation of fighter aircraft, planned to enter operational service after 2040.

In Europe, France and Germany have indicated that they will collaborate on a fighter plane for the future. At the same time, Great Britain is being kept out of the French-German programme.

The European nations have a long and colourful, if not very successful, story on the joint development of fighter aircraft. The airplanes that have come out of European development have been really excellent aircraft as such, but the economics of the projects have let the side down. The joint European projects have been suffering from each participating nation's interests taking precedence over the overall picture, leading to increased costs. The tangible results are that European fighters like the Tornado and Eurofighter have hardly been sold outside the partnering nations themselves, while the US competition like the F-5, F-16, F-18, and more recently the F-35 Eagle, can point to an extensive list of export customers.

The American side has a great advantage in the substantial number of planes being ordered by their own American defence, allowing the development costs to be spread across a vast number of airplanes, even before the first export contract has been signed. This sizable number of aircraft is no less important when it comes to the distribution of future upgrade costs. The number of planes should indeed be the best and most important argument for European collaboration, whereby the greatest number of partnering countries make for an even greater number of aircraft.

The Americans, however, have had a further advantage in having the development and production performed in established enterprises, such as Lockheed Martin or Boeing. In these businesses, the culture for aircraft development is entrenched in the walls, and much of the required facilities are already in place and operational. This is in stark comparison to Eurofighter, where it was deemed necessary to establish one assembly plant for finishing the fighters in England, and one in Spain, and another in Germany, not forgetting one in Italy.

Now that work is commencing on the 6th generation fighter aircraft in Europe, with France and Germany keeping Great Britain out in the cold, this is Europe continuing down the same path as before. The difference being that for the next generation of fighters, the competitors on the export market will be not just the American planes, but will include Russian, Chinese, possibly even Indian and Japanese fighter aircraft.

For the Europeans to sustain and develop its competence and capability in the field of fighter aircraft, Europe has to pool its forces into one fighter plane project. What is more, the future development and manufacturing of fighter aircraft in Europe must be concentrated into one enterprise with the majority of its facilities assembled in one place. This would of course require some tough political decision processes, during which some countries may see jobs and competencies migrating to a different country. Without such a pooling of resources, however, the European fighter aircraft industry will proceed slowly towards a quiet and very expensive demise.

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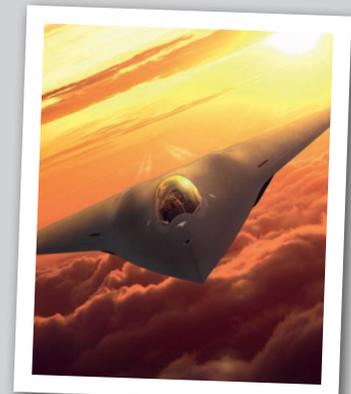
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### Coverphoto: 6th generation fighter aircraft.

Several nations have launched programs for the next generation of combat aircraft.

The cover photo displays how Lockheed Martin Skunk Works (previous named Lockheed Martin Advanced Development Projects) imagine that their future fighter might be.

Art impression by Lockheed Martin Skunk Works





# THE SIXTH-GENERATION FIGHTER FIGHT

Several countries have announced programs for development of sixth-generation fighter aircraft, including the United States, United Kingdom, Russia, China, Japan, Germany, and France. But whom to partner with and whom not to partner with, has turned out to be quite a fight.

A sixth-generation jet fighter is a conceptualized class of fighter aircraft design more advanced than the fifth-generation jet fighters that are currently in service and in development.

## USA

The United States Air Force (USAF) and United States Navy (USN) are anticipated to field their first sixth-generation fighters in the 2030–40 timeframe. The USAF is pursuing a sixth-generation fighter to replace its existing aircraft such as the F-15 Eagle and complement existing platforms such as the F-22 Raptor. The USN is pursuing a similar program and likewise

intended to complement F-35 and replace its existing aircraft such as the F/A-18E/F Super Hornet.

As of today, all the three major US industrial players are working on their sixth-generation fighter concepts.

In September 2011, Boeing unveiled a sixth-generation fighter concept for the U.S. Navy and Air Force. It is planned to have supercruise and to fly faster and farther than the F-35 Lightning II. Boeing is self-funding the project until an official fighter program starts to have a design ready.

Lockheed Martin's Skunk Works division revealed in 2012 a conceptual

next-generation fighter design for the new class of tactical aircraft that will emerge after 2030. Lockheed Martin has called for greater speed, range, stealth and self-healing structures.

In January 2015, Northrop Grumman revealed it had stood up teams dedicated to developing a sixth-generation fighter and that it would compete for the next fighter. The company indicates it is looking at a supersonic tailless jet, something never created before due to complexity; it may also be optionally manned.

## France and Germany, -and Spain

In July 2017 France and Germany announced they would jointly develop a New Generation European Combat Aircraft to replace the Eurofighter Typhoon, Tornado and Dassault Rafale fighters.

Dassault and Airbus have been named the primary industrial partners in the Franco-German project, while France will lead the programme.



*In July 2018 the UK announced the development of a sixth-generation fighter named the Tempest.*

*Art impression: BAE systems*

In December this year the Spanish Minister of Defence has announced, by letter to her French and German counterparts, the Spanish firm's interest in being part of the future European fighter program. Whether Spain will become a primary partner or a more secondary partner in the French-German program has not yet been clarified.

### **United Kingdom, – and Sweden?**

The announcement of the French-German program took the UK government by surprise. BAE has for several years been working with France's Dassault Aviation on a future unmanned fighter. Britain has also been a primary partner in the Eurofighter program, with Germany, Italy and Spain.

Germany and France have said they would be open to working with other partner nations, but at a later stage. This has raised concerns that if Britain were to join the project, it could be forced to take a secondary role and be locked out of the crucial planning and design phase of any future fighter. In addition, the Brexit tensions have probably not made it easier to join the French-German partnership.

In July 2018, British Secretary of State for Defence Gavin Williamson unveiled the UK's Combat Air Strategy, and announced the development of a sixth-generation fighter named the Tempest for

the Royal Air Force at Farnborough Air Show 2018.

The UK MOD also announced that the UK and Sweden have conducted initial talks regarding collaboration on a future fighter aircraft. The Swedish company Saab, manufacturer of the Gripen fighter, has however also been evaluating the rival German-French fighter plan. But Håkan Buskhe, the CEO of Saab, has been quoted as saying: "We are in much more intensive discussions with the Brits than the other consortium".

Meanwhile Boeing, the world's largest aircraft maker, has expressed interest in the Tempest program. Head of Boeing Defence, Space & Security, Leanne Caret, said in an interview with Reuters that Boeing is watching the situation, but that it is too early to make definitive statements. But, if there is an opportunity, Caret added, Boeing would be thrilled to participate.

### **Japan**

Japan has been seeking to replace its aging fleet of fighter aircraft for almost two decades. In the first years of the millennium

Japan made efforts to purchase Lockheed Martin F-22 Raptor fighters. However, the U.S. Congress had banned the exporting of the aircraft in order to safeguard secrets of the aircraft's technology such as its extensive use of stealth. This rejection necessitated Japan to develop its own modern fifth generation stealth fighter.

The 40-billion-yen development project called the ATD-X program began in 2009, and in April 2016 the ATD-X prototype, (named the Mitsubishi X-2 Shinshin) made its first flight.

By July 2018 Japan decided that it would need to bring on-board international partners to complete this project. Three companies have so far been reported as possible candidates: Lockheed Martin, BAE Systems and Northrop Grumman.

The ATD-X program is for development of a fifth generation fighter, but it is expected that the ATD-X program will then lead to an F-3 fighter based on sixth-generation technology.

Already in 2010, the Japanese Ministry of Defence exposed the concept of sixth-generation national jet fighter. A foreign partner in the ATD-X fifth generation fighter program will probably also take a strong position for partnering up for a possible sixth-generation fighter as well.

## Russia

On 26 August 2013, Russia revealed it would proceed with development of a sixth-generation jet fighter. They said the aircraft will most likely be pilotless. However, they would not stop completing development of fifth-generation fighter projects, like the Sukhoi Su-57.

The Mikoyan MiG-41 is a sixth-generation jet fighter interceptor aircraft currently being developed by Mikoyan. The project starts in 2019, and if purchased by the Russian Air Force, the first production of MiG-41 could be completed in 2025, to enter service after 2027.

## China

The J-20, China's first fifth-generation combat aircraft, made its maiden flight in January 2011. Recently, Yang Wei, a deputy director at the Aviation Industry Corp of China, said to Chinese media: "We will develop the J-20 into a large family of fighters. At the same time, we will think about our next-generation combat plane to meet the nation's future requirements."



The two Chengdu J-20s that made its first public appearance at Airshow China 2016. The J-20, China's first fifth-generation combat aircraft, in 2017 became the third stealth fighter to enter service, after the American F-22 Raptor and F-35 Lightning II. Photo: Wiki

## GENERATION OF FIGHTERS

**A fifth-generation jet fighter** is a jet fighter classification used around the world that encompasses the fighter technologies developed during the first part of the 21st century. As of 2019 these are the most advanced. The exact characteristics of fifth-generation jet fighters are controversial and vague, with Lockheed Martin defining them as having all-aspect stealth even when armed, low-probability-of-intercept radar (LPIR), high-performance airframes, advanced

avionics features, and highly integrated computer systems capable of networking with other elements within the battlespace for awareness. Typical fifth-generation fighters are US F-35, F-22, the Russian SU-57 and the Chinese J-20. The definition of the term fifth-generation fighter from Lockheed Martin has been criticized by companies whose products do not conform to these particular specifications, such as Boeing and Eurofighter.

It took China roughly 20 years to develop J-20, and assuming a similar development timeline, a Chinese sixth-generation fighter could be ready by the late 2030s.

In addition to the twin-engine J-20, China is testing the FC-31, which is similar

in size to the American F-35. FC-31 is another fifth-generation combat plane, and China wants the FC-31 to compete on the international market for advanced fighter jets. The Chinese Air Force has made it clear that it will not allow exports of the J-20. ■■



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# MALE RPAS: A KEY PROJECT FOR EUROPEAN AUTONOMY

The MALE RPAS drone system will be the prestige project for the European Union to contribute to greater European security political autonomy and increased military capability. Backing the project are Germany (Airbus Industrie), France (Dassault) and Italy/Spain (Leonardo-Finmeccanico) with equal shares.

**Text and photo: Tor Husby**

The project was launched into its definition phase in 2016 and is now entering its development phase. According to the plan, the prototype will take to its wings in 2023, to achieve operational status in 2025. The virile abbreviation stands for “Medium Altitude Long Endurance Remotely Piloted Aircraft Systems”. Strategic autonomy has made a full entry on the European security-political agenda, particularly after the USA under president Trump is showing less of an inclination to assume an international leadership role. The first consequence of the American leadership no longer being a given, is that the European allies must collaborate to exercise the necessary leadership.

## European deficiencies

However, more autonomy is not just something that can be decided by the organs of the Union. Europa is sorely lacking in systems for (joint) ISTAR assignments, that is Intelligence, strategic target data and reconnaissance. In a recent report by FFI, the Norwegian Defence Research Institute, penned by chief researcher Bjørn Olav Knutsen, it is emphasised that the EU in 2013 was referring to drones, most often called RPAS in Europe, as the biggest strategic inadequacy of the European defences. Advanced drones are important strength multipliers, with their ability to provide the defence with reliable data. RPAS are even being called a revolutionary means – effectively a game-changer. They also reduce the need for personnel on the ground, in both civilian and military operations. The global Hawk system, for example, is being serviced by a crew of 600 persons.

The FFI report says that the MALE RPAS should not be landing as a solitary swan. Other critical shortcomings of the European defences should also be rectified, particularly in areas such as air-to-air fuelling, satellite communication and cyber defence. The development of MALE RPAS will have a tremendously positive influence on the competitiveness of the European defence industry base, and its ability to stay at the cutting edge of technology, while contributing to the technology gap between Europe and the USA being reduced rather than growing larger. The resultant effects of the RPAS development project will also help Europe in its ability to make and produce war planes and managed air systems. The German, French and Spanish/Italian industry group firmly believes that the project could lead to the European defence industry through MALE RPAS being able to assume a leading role in RPAS development, through eliminating its dependence on US and Israeli technology, while at the same time providing European defence organisations with operative systems of great quality. Most types of RPAS are without weapons, while the technology development is increasingly pointing towards the arming of military units. In recent years, RPAS have been very successful in protecting own forces and reducing civilian fatalities in military operations.

The RPAS are classified according to weight, range, operational altitude and endurance. The smallest, with less than 150 kgs and a range of 5 kms, are intended for a single troop, company or battalion. The next class up, for brigade level, is the tactical units with weights of 150 to 600 kgs and an operational altitude up to 18,000 meters (60,000 feet). The biggest



Chief researcher Bjørn Olav Knutsen, FFI.

class of more than 600 kgs with unlimited range is for strategic levels and Joint Task Groups. This biggest class is where the MALE RPAS will belong.

## Increasing trans-Atlantic distance

The ability of the European Union to act independently is a recurring theme in the EU's global strategy, which was presented in 2016. In order to realise the ambitions, more defence collaboration and more extensive defence integration are among the requirements. Behind this development is the increased trans-Atlantic political and military separation in the wake of Brexit and Donald Trump's victory in the Presidential election.

The threat evaluations of the USA are increasingly focussed on meeting the challenges from China and North Korea. The basis for the modernisation of the US defence is to maintain the nation's military and technological advantage over China and Russia, and to identify new technology and concepts to form a part of the defence.



Art impression of MALE RPAS drone.

Ill. Airbus

In the European threat evaluations, China does not feature as a future military danger, but instead as a promising economic opportunity. Europe is particularly worried about the ongoing and long-lasting war in the Ukraine and the Russian annexation of the Crimea, about Islamic terror, about government collapse and civil wars in Libya and Syria, with their significant contributions to the migration crisis. Finally, there are deep-rooted economic and political crises in many European countries. The European challenge is to find relevant and effective responses to the threats that are worrying the populations. Each and of their own, the European nations are lacking the economic resources to handle the defence and security political challenges. Or, as it has been said: “Peace without money, war without America”.

### Reduced Defence Research a Danger

The FFI report states that Brazil, Russia, India and China (the BRIC nations) are investing more than twice as much into

defence research as the combined efforts of Great Britain, Germany and France. After the year 2000, European defence research has dropped significantly – such as from 10.6 bn euro in 2006 to 7.5 bn in 2013. The amount invested by the USA is seven times greater. The defence industry on the European continent of today has fewer development projects going on than what was the case 20 years ago.

The defence industry remains strong, however. Revenues total more than 100 billion euro. The industry directly employs half a million people, and generate a further 1.2 million jobs indirectly, contributing a great deal to technology and innovation. Until now, the defence industry has been at the forefront of radar, missiles, conventional submarines and armed personnel vehicles, because of earlier smart investments. The industry has been consolidating from the 1990’s, and several European defence concerns are among the ten greatest in the world.

But if the negative trend persists, Europe will be off the world leader

board in the next hot segment: Robots, autonomous systems, machine learning, artificial intelligence and lasers. In the final reckoning, the European defence industry may be reduced to a niche activity. This will impact hugely on the long-term ability of the European Union to be an autonomous security political player. The FFI is warning that if the member countries continue to prioritise national sovereignty, the ability to mount a credible defence will suffer in the long run. This is particularly true for the smaller and medium-large countries. It is generally acknowledged that the defence industry’s industry base will no longer be sustainable on a solely national level. The cure is a general re-orientation towards a common European technology platform. This is one thing.

The other thing is that the future depends greatly on whether the USA will accept a European influence on American defence modernisation, by opening up its defence market in a way that may reduce the technology gap between the USA and Europe. ■■

# KNM HELGE INGSTAD READY TO BE RAISED

The work on raising the sunken frigate, KNM Helge Ingstad, has now commences. The salvage operation is likely to take a few weeks, depending on the weather conditions.

When the frigate is raised, it will be transported on barge to the naval main base at Håkonsvern near Bergen.

The Accident Investigation Board Norway is working on clarifying the cause of the casualty, and has submitted a preliminary report as of 29 November. It will probably be another year before the final report is ready.

Further to this, the Navy will conduct its own internal investigation of the events.

## Operative challenges

The fact that the Norwegian Navy has now been reduced from five to four sailing frigates will naturally have an impact on the operational deliveries from the defence, but



The Norwegian frigate KNM Helge Ingstad sank following its collision with the tanker Sola TS on the morning of the 8th of November last year. Photo: FMS

the Defence Chief, Haakon Bruun-Hanssen, considers that all commitments are well in hand, at least until the end of 2019.

– We are resolving much of the challenge by keeping a double crew on one frigate, letting the crews alternate on sailing the vessel. On the other hand, the vessel cannot be in two places at the same time, so there will be limitations in effect. We must fulfil our commitments as well

as possible, while at the same time doing all we can to make sure something similar doesn't happen again, says the Defence Chief.

Just how the situation will be resolved in the longer view remains to be seen, and depends on the state of KNM "Helge Ingstad" after the salvage is complete. A firm decision has to be deferred until a later time.

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# NORWEGIAN DEFENCE AND SECURITY INDUSTRIES ASSOCIATION (FSi)

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## FORSVARET MÅ SATSE PÅ FOU

**G**jennom mange tiår har Forsvaret og industrien samarbeidet for å finne de riktige løsningene som styrker forsvarsevnen. Kreativitet og innovasjonsevne har preget mange av de, kanskje dristige, satsningene på utvikling av nasjonale løsninger, som har resultert i gode produkter og systemer, slik som bl.a. missiler, luftvern, kommunikasjons-, kommando- og kontrollsystemer, avansert ammunisjon og undervannssystemer. Mange av disse satsningene har også resultert i store eksportkontrakter som både kommer Forsvaret og storsamfunnet til gode.

Felles for så å si alle de vellykkede nasjonale utviklingsprosjektene er at de har blitt gjennomført innenfor rammen av den såkalte trekantmodellen, som har gjort det mulig å kombinere kompetanse hos brukerne, i forskningsmiljøene og i industrien på en effektiv måte. Det har gjort det mulig å ta frem materiell og systemer i Norge som det, gitt tilgjengelige ressurser, ikke er selvsagt at skulle kunne la seg realisere nasjonalt. Det tette samarbeidet og evnen til å tenke nytt, kombinert med vilje hos alle parter

til å ta kalkulert risiko, har i det lange løp vist seg å gi resultater som i mange tilfeller langt har oversteget hva forventningene i utgangspunktet var.

Den teknologiske utviklingen går imidlertid stadig hurtigere. Det innebærer at mulighetsrommet for å ta frem helt nye konsepter og løsninger blir stadig større, men det forutsetter handlekraft og evne til å gå fra ide til utvikling mye hurtigere enn i dag for å utnytte dette rommet. Samtidig er den sikkerhetspolitiske situasjonen og den globale økonomiske balansen i rask endring. Aktører som tidligere ikke var teknologisk på nivå med Vesten haler raskt innpå og vil med stor grad av sannsynlighet være minst på samme teknologinivå i løpet av noen få år. Enkelte av disse aktørene har samfunnssystemer som gjør det mulig å handle svært hurtig i forhold til å ta i bruk ny teknologi uten å gjennomføre konsekvensanalyser og uten å hensyn ta etiske og juridiske problemstillinger på samme måte som i Vesten. Det betyr sannsynligvis at vi kommer til å se helt nye anvendelser av teknologi hos aktører som ikke har verdier og ambisjoner som er sammen-

fallende med våre. Det kommer til å påvirke brukerkravene til Forsvarets materiell og systemer.

Dersom de tradisjonelle modellene for utvikling og anskaffelse av forsvarsmateriell videreføres uten endring er derfor risikoen stor for at Forsvaret i fremtiden kan få levert materiell og systemer som både er teknologisk utdatert og irrelevant i forhold trusselbildet. Derfor må noe gjøres for å legge til rette for å nyttiggjøre seg den stadig raskere teknologiske utviklingen, som i stor grad er drevet av kommersielle krefter, og for å sikre at Forsvaret forblir relevant. For industrien er dette også selvfølgelig helt vesentlig. Uten relevante løsninger som kommer ut i markedet tidsnok til at de er teknologisk på høyden har norsk forsvarsindustri ingen fremtid. Derfor er det helt avgjørende at nye modeller for samarbeid som gjør det mulig å arbeide tettere og hurtigere sammen med brukerne og forskningsmiljøene blir implementert.

Nylig presenterte Forsvarets forskningsinstitutt (FFI) en rapport om «Forsvarssektorens innovasjonsmodell – Trekantmodellen v. 2.0» som er utarbeidet

i samarbeid mellom FFI, Forsvarsmateriell og Forsvars- og sikkerhetsindustriens forening. Rapporten er et viktig innspill i arbeidet med å skape ytterligere moment i implementeringen av den nasjonale forsvarsindustrielle strategien som Regjeringen presenterte i Stortingsmelding 9 (2015-2016). Særlig i relasjon til Stortingets klart uttrykte forventning om at strategien skal innebære en satsning på forskning og utvikling innenfor de åtte teknologiske kompetanseområdene som det er enighet om at skal videreutvikles og styrkes i norsk forsvarsindustri. Dette er viktig fordi det har liten hensikt å utvikle nye samarbeidsmodeller uten at de fylles med innhold. I denne sammenhengen er det viktig å minne om at mange av de løsningene som i dag er helt avgjørende for forsvarsevnen, og som utgjør en stor andel av forsvarsindustriens eksport, har sitt utspring i FOU-satsninger som ligger langt tilbake i tid, i noen tilfeller 20-30 år. Skal forsvarsindustrien fortsette å bidra til forsvarsevnen og til betydelige inntekter til Staten er det helt avgjørende at det fortsatt satses på FOU i forsvarssektoren.



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# NORWEGIAN-UK DEFENCE INDUSTRY SEMINAR

On November 7th and 8th, the FSI and ADS held the “Norwegian-UK Defence Industry Seminar” at Holmenkollen Park Hotel in Oslo. Some 50 delegates had turned out, from both Norwegian and British commerce and industry, armed forces and ministries.

## ADS

ADS is the Premier Trade Organisation for companies in the UK Aerospace, Defence, Security and Space Sectors. Membership is made up of over 1000 UK registered businesses.

The conference was opened by Tone Skogen, state secretary for the Ministry of Defence, who in her opening statement emphasised the close relations between Britain and Norway, pointing to the common value basis shared by both countries.

Further emphasis of the common ground between Norway and Great Britain came from Mark Butler of the British MoD:

- From the British side, we see Norway as a key partner, with a lot of commonality with Great Britain. For one thing, as of next spring, both countries will be outside the EU, while both remain active members of NATO. Similarly, both nations have interests in the North Atlantic, and here there are wide opportunities for collaboration. This is not least true for the P-8 aircraft, where we see possibilities for co-operation on training and maintenance.

- The British Defence also has a long-standing tradition for exercising in Norway, and for the time ahead, we do not merely want to exercise in Norway, but we wish to exercise together with Norwegian units.

Aimee Spriggs from the DIT DSO (Department of International Trade - Defence and Security Organisation) presented the overall view of the British defence industry, while informing listeners that over the last ten years, Great Britain has been the world's second largest exporter of defence materiel, with only the USA in front. The Middle East

is the most significant market for the British defence industry, counting for in excess of 50 % of the British defence export value. In the ranking of customers for the British defence industry, Norway is holding the 8th place, said Spriggs, adding that the purchase of helicopters and related materiel counts for an important share hereof.

Insofar as the opportunities for the Norwegian defence industry in Britain are concerned, Dominic Guinnes of the DIT DSO reported that the British defence budget is some 35.3 billion pounds, making it the fifth largest in the world. The British Defence is planning to spend some 178 billion pounds on defence materiel procurements over the next ten years. Further to this, Great Britain stands for about 40 percent of the total European expenditure towards research and development in the defence sphere.

From the industry side, Rachel Edwards from BAE Systems Maritime Service and Øyvind Røtevold from the Norwegian Metronor AS presented the British Sting Ray Torpedo project, which has been conducted by BAE systems. Metronor has been an important subcontractor to this project. Metronor is located just outside Oslo, and to the military market, the

company delivers products and solutions for bore sight systems, helmet tracker alignment, helmet tracking, and for lightweight position and orientation tracking for sensors and weapons. Metronor has previously had deliveries to and been a sub-supplier to BAE Systems. ■■



The Oslo-based company Metronor AS has enjoyed several important contracts with the British BAE systems over the years. From the left, Rachel Edwards from BAE Systems and Øyvind Røtevold from Metronor AS. Photo: MilitærTeknikk



From the British side, it was emphasised that Norway is regarded as a key partner for Great Britain. From the left; Mark Butler, Aimee Spriggs and Dominic Guinnes. Photo: MilitærTeknikk

# PROGRAM CONFERENCE LAND

This year's Program Conference Land was held at the Holmen Fjord hotel in Asker, with a record attendance of 138 delegates.

Following input from a number of participants at the previous Program Conference Land Systems, many of this year's discourses were focused on the technological possibilities and opportunities of the future.

LT. Col. Jens Inge Hyndøy gave a presentation on how experimentation into new technology was done during the exercise Trident Juncture this autumn.

- On the harbour of Stjørdal, not far from the international airport Værnes, the FFI was able to show its concept for the base defence of the future. Our demonstration showed how we for instance envision that the base defence of the Air Station Ørland can be done. Based on information from drones, autonomous vehicles and boats, as well as deployed sensors, various threats can be detected

and verified. Counter-measures against the threats could be deployed weapons stations or ground forces.

During Trident Juncture, we were also able to show our solutions to a number of decision makers among our allies, which happened to be one of the main purposes of the demonstration under Trident Juncture.

Trident Juncture also afforded Norwegian industry the opportunity to test out some of its products. Christian Dun Norberg from Fieldmade AS presented production of spare parts in the field. Fieldmade AS has developed various container-based solutions for e.g. 3D printing of replacement parts. During Trident Juncture, one of these container solutions, designated NOMAD02, was deployed for testing.

- During the exercise, we manufactured temporary

## FACTS AND FIGURES

### NOMAD02 IS AN 8x10 FOOT DUAL EXPANSION CONTAINER MODULE

The Fieldmade NOMAD02 module enables soldier driven in-field Additive Manufacturing intended for prototyping and production of temporary spare parts in or near real time. Like all units in the NOMAD series, it is built on MILSPEC principles and can be equipped to operate fully self-sustainably in extreme conditions.

The NOMAD02 includes one modular printing cell, one CAD design working station in addition to tools and fixtures needed to perform part testing and inspection. The unit's light weight and efficient space utilization enables use in a Forward Operating Base setting. Other units in the NOMAD series includes the NOMAD 1 for production of lighter and smaller spare parts, and the NOMAD03 for larger spare parts.

replacement parts in the course of a few hours – spares that would otherwise have taken days to have delivered from central supplies. This meant that the weapons system that was missing a part could be kept operational, rather than being taken out of commission until a permanent replacement part could be delivered. We also made replacement parts for materiel from the other countries, and in some cases, we took just a short time to create temporary spare parts that would otherwise have taken weeks to provide through ordinary channels.

- In our view, it will be more valuable for the defence to keep a weapons system in operation using a temporary 3D-printed spare part than to leave the weapons systems inactive until an original replacement part comes through the pipeline, Dun Norberg explains.

Dun Nordberg also described how Fieldmade is testing out 3D printing under various conditions. We have among other things have a system deployed to the coast guard vessel KV Barentshav, for the purpose of testing our ability to make parts on a moving platform. ■■



Lt. Col. Jens Inge Hyndøy presented experiences from testing of new systems under Trident Juncture.

Photo: MilitærTeknikk



Christian Dun Norberg from Fieldmade AS presented experiences from 3D printing of spare parts during the Trident Juncture exercise.

Photo: MilitærTeknikk

FSi SMB CORPORATE PRESENTATION:

# Axnes

Axnes develops and supplies advanced and highly durable wireless intercom solutions designed to perform under extreme conditions. Axnes intercom solutions provide increased mission capabilities, enhanced situational awareness and improved crew safety. Axnes wireless intercom solutions are today being installed in fixed wing aircraft, helicopters, military vehicles and artillery units, and used in a number of Special Forces programs. In addition, Axnes has been supplying wireless intercom to a number of civilian projects.

### History

Axnes was established based on a need voiced by the Royal Air Force (RAF) in the late 90's to enhance crew safety during SAR operations. The RAF soon teamed up with the Norwegian company Helikopterservice and Canadian Helicopter Company (CHC) who had similar requirements. This resulted in a RAF requirement specification to which Axnes replied, and which formed the basis for establishing the company. Axnes successfully developed a communications system adapted by the RAF, CHC and soon by Bristow, Bond, and several other helicopter operators. In 2008 the company had a solid customer base in Northern Europe but needed help to expand further. The company was acquired by Ugland, a Norwegian ship-owner family.

### Customer case

The SAR helicopter winchman has for decades been depending on hand signals to communicate with the winch operator or to the pilot for being hoisted into position and avoiding obstacles such as rocks, powerlines, trees etc. In darkness, fog and poor sight conditions, hand signals obviously have a reduced effect, and over the years, winchmen have been injured and in some cases killed, due to lacking communication with the helicopter crew.

The Axnes solution was to develop radio communication between the winchman and the pilot and winch operator. To be viable, the solution required hands-free operation, and protec-

tion capable of coping with environmental impacts, such as noise, seawater, snow and cold weather, bumping and beating etc.

The solution gave better safety for SAR helicopter personnel and has increased operational capability significantly. After maturing over 2

decades in the SAR world, Axnes has added secure communications capabilities to our system giving military users access to the capability and applications not only for Combat SAR, but also military transport aircraft, Special Operations, boats, armored vehicles and artillery. ■■



### ABOUT AXNES:

Axnes was founded in 1995, and is a privately owned company headquartered in Grimstad, Norway with offices in the United Kingdom, Austria and the United States of America, and worldwide distribution through its partner network. The company name, Axnes is derived from the name of the creative engineer, John Gunnar Aksnes, one of the founders of the company. Today Axnes is widely recognized as the industry leader within its field, and

a certified supplier to international companies such as Airbus, Leonardo, Sikorsky, and Bell. Furthermore, Axnes is an EASA Part 21 and Part 145 approved quality organization. The company has a worldwide customer base and has been supplying its wireless intercom systems for two decades. Axnes' products are developed and manufactured in Norway. Axnes is heavily expanding into military markets, and is currently

active in four US Department of Defence/ Department of Homeland Security programs. Axnes if offering its equipment widely throughout NATO.

**Owners:** The company is owned by Knut Axel Ugland Holding  
**Number of employees:** 24 - 18 in Grimstad, 4 in the US, and 2 in Europe, most of whom are engineers and technicians.  
**The company's standing as a member of the FSi:** Since 2010

**Why maintain the membership in FSi?**  
 Access to networks, and an effective meeting point with the DoD and the Defence, a valued sparring partner and advisor regarding defence policies and regulations.

**How does the company make use of its membership in the FSi?**  
 By participating in different forums and conventions, we achieve a broader reach and higher visibility, on the domestic as well as international arenas.

# KONGSBERG AND PATRIA WILL ACQUIRE AIM NORWAY

**Kongsberg Defence & Aerospace (KDA) and Patria have entered into an agreement with the Norwegian Ministry of Defence for the purchase of Aerospace Industrial Maintenance Norway AS (AIM Norway).**

**A**im Norway is the Norwegian armed force's business for maintenance, overhaul and upgrade of the Air Force's aircraft and helicopters. KDA and Patria have entered into agreement for a shared ownership where KDA's ownership is 50.1% and Patria's 49.9%.

AIM Norway has played a major role in the Norwegian aviation industry since 1916, and has 440 employees and revenues of 113 million euros (2017). AIM Norway also owns Belgium Engine Center (BEC), with its main operating base in Herstal, outside of Liege in Belgium.

BEC is a one-stop shop for engine maintenance, repair and overhaul services. The AIM Group conducts advanced and heavy maintenance, overhaul and upgrades, primarily within air military operations. Important priorities are engine maintenance for the new F-35 aircraft and for Norway's new search and rescue helicopters.

AIM has its main operating base at Kjeller and an operative unit at Rygge air station. AIM has 100% ownership in the Belgium Engine Center SPRL(BEC) in Herstal outside of Liege in Belgium.

- KDA has worked for a long time to become a strategic partner to the Norwegian armed forces in the maintenance field, and the acquisition of AIM is an important part of this effort. We are also noting that on many key areas of competence. Patria and AIM are very complementary, says Eirik Lie, President of Kongsberg Defence & Aerospace.

AIM Group is expected to have revenue of around NOK 1 billion and an EBITDA margin of 8-9% for 2018. The parties have agreed an enterprise value of NOK 151 million, on a cash and debt free basis, and with normalized working capital. This value reflects i.e. a commitment for AIM to invest around NOK 540 million in the new F-35 national facility at Rygge over the next 2-3 years. ■■



From left, President International Support Partnership, Jukka Hölkeri from Patria; Defence Ministry Expediting Manager Anders Melheim; Defence Ministry State Secretary Tone Skogen; Kongsberg Group CEO Geir Håøy; KDA CEO Eirik Lie, and Aim Norway CEO Ove Haukåsveen. Photo: MilitærTeknikk



A Finnish F-18 Hornet takes fuel from a US Air Force KC-135 Stratotanker during training in Tampere, Finland.

Photo US Air Force

# FINLAND TO CHOOSE FIGHTER PLANES IN 2021

In 2021, the government of Finland will make a decision on which fighter aircraft will be procured as replacement for the F-18 Hornet. A total of 64 new multi-role fighters are to be phased in during the period of 2025 to 2030, in parallel with the existing fleet of F-18 Hornet gradually being taken out of service. This renewal of the fighter force will have a cost of 7 to 10 billion euros.

**Text: Tor Husby**

The candidates include the two American fighters, the Boeing F/A Super Hornet and the Lockheed Martin F-35, and the three European contestants of Dassault Rafale (France) Eurofighter Typhoon (Great Britain), and the Swedish Saab Gripen. Any stretching of the life span of the Hornets, which were

licence built in Finland and entered service in 1995 to 2000, is not regarded as a viable option.

## The main requirements

Decisive points for winning the contract will not merely be the fighters' air combat superiority, effectiveness against sea and land targets, and the capacity for reconnaissance and intel-gathering.

Equally important is the issue of whether Finland can afford to buy, use and develop the planes over their expected service life. One general requirement is for the new fighters to be at least on a par with the enemy's aircraft. And because the planes will be in service until around 2060, a great deal of development potential must be a feature of the design. This is actually ranked higher than their current capabilities in order of importance. On the industrial side, the price must be right, Finnish defence industry must be assigned at least 30 percent of the contract value, while the supply security, spare parts and support must be guaranteed.

Testing of how the different aircraft types manage under Finnish conditions will start in 2019.



Finnish F-18 coming in for landing. In 2021 Finland will decide on a replacement for the F-18 Hornet.  
Photo: Airwolfhound from Hertfordshire/Wiki

Weapons and equipment are to be procured under a separate contract, while the decision on this remains a part of the fighter selection process. The goal is to sign the contract on this supply during the spring of 2021. Because the estimated total cost of the new fighter planes includes weapons and sensors, negotiations on these are to run in parallel. It will be possible to use some of the systems in several different multi-role fighters, and this will be an important factor to evaluate in the contract

negotiations. Finland has requested information on weapons and other equipment from these seven countries: France, Germany, Great Britain, Israel, Norway, Sweden and the USA.

### A Key Role

The defence administration has concluded that there are no other systems that can replace multi-role fighters, because they are playing a key military role. The Defence is tasked with the protection of the entire

Finnish territory, and accordingly, this is the area that the fighters must cover. This calls for the number of aircraft and their speed, range and fire-power to be of an order capable of operating all over Finland – even during extended periods. Multi-role fighter aircraft will be the most effective replacement to assume and expand on the current role of the Hornets. Ground-based air defence is useful for the protection of important assets, and is a valuable supplement, but quite unable to provide national protection against airborne threats. The procurement of unmanned aerial vehicles (UAV) will come up for consideration later on. Neither air defence weaponry nor UAV's, however, can replace fighter aircraft. Control over the national air space is an absolute MUST. The lack thereof would leave the society vulnerable to enemy air attacks.

A procurement such as this cannot be financed via the regular defence budget. A special allocation is required. Maintenance and operations, however, will be covered through the normal annual defence budgets. The Ministry of Defence holds that the maintenance costs will be on a par with the current F-18. ■■

# Den beste løsningen

AW101

Helikopteret AW101 er klasseledende i den mellomstore til tunge kategorien helikopter, og har fløyet mer 420.000 timer, i oppdrag over hele verden, fra Arktis til Antarktis.

Helikopteret er designet for å tilfredsstille de strengeste kravene til rekkevidde, nyttelast, ytelse og sikkerhet under de aller mest krevende forhold. AW101 har oppvist en effektiv rekkevidde på over 900 nautiske mil, kan etterfylle drivstoff i luften, kan frakte opptil 38 soldater på kollisjonssikre seter, og er utstyrt med det nyeste av instrumentering for å minimalisere pilotenes arbeidsbelastning og oppnå maksimal sikkerhet.

Kostnadseffektiv, livsløpsdekkende support er tilgjengelig sammen med omfattende brukeropplæring basert på bred operativ erfaring, for å oppnå effektiv drift og operativ suksess.

Inspirert av visjonen, kreativiteten og skaperevnen til den store mesteroppfinneren - skaper Leonardo morgendagens teknologi.

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1948 • 2018

## GRIPEN FOR THE PHILIPPINES?

The Philippines has identified the Saab Gripen as the best candidate for the nation's fighter requirement.

The government-owned Philippine News Agency recently quoted defence secretary Delfin Lorenzana as saying that the Swedish fighter is the best option in terms of price and capability.

-Apart from being cheaper to purchase and less expensive to maintain, Gripen has also proved to be an excellent fighter aircraft, Lorenzana told the news agency in an exclusive interview this week.

He is reported as saying that the inclination to acquire Gripen follows thorough research into the matter.

The Philippine Air Force has for more than a decade been looking for what aircraft will be the replacement for its US-made F5A/B jet interceptors that were



The Philippine government states that Gripen is the best option for their future multi-role fighter. Should the Philippine Air Force acquire Gripen, it would be the second operator of Gripen in the East Asian region. Thailand operates 11 Gripens. Thailand had 12 Gripen fighters, but one was lost in a crash in 2017. The photo shows Gripens from the Thai Air Force during a sunset flight. Photo: Saab

retired in 2005 because of old age and lack of spare parts.

In 2014, Manila signed a \$420 million deal with Korea Aerospace Industries for 12 FA-50s, all of which have been delivered. The capability of the FA-50 however, is limited compared with the Gripen.

In the 2000's, Manila's focus was primarily on counterinsurgency missions in the southern Philippines, but China's

growing presence in the South China Sea has forced Manila to rethink conventional capabilities.

According to reports, the Philippines are looking at acquiring two squadrons of fighters, although the total number of aircraft that will be procured and the value of finances set aside for the procurement have not yet been confirmed by the Philippine government. ■■

## RAFALE PULLS OUT OF CANADA'S FUTURE FIGHTER COMPETITION

In February this year the Canadian government reviled the five candidates for the upcoming competition to provide Canada with a new fighter jet.

The aircraft to be offered to Canada include Lockheed Martin's F-35, Boeing's Super Hornet, the Eurofighter Typhoon, the Dassault Rafale and Saab's Gripen.

As of this November, Dassault Aviation has officially confirmed to that the company has pulled out of Canada's future fighter program. Dassault decided not to offer the Rafale fighter to Canada, because of the extensive Canadian requirements for interoperability with U.S. forces, according to a number of news reports.



French Air Force Rafale fitted with 6 AASM and MICA missiles.

Photo: A. Jeuland/French Air Force

Canada plans to buy 88 jets at an estimated cost of CA\$19 billion (U.S. \$15 billion).

A request for proposals for the new fighter jets will be issued in 2019, Canadian government officials say. A winning bidder

is expected to be selected in spring 2021. The first aircraft would be delivered sometime in 2025. Deliveries could take place between then and 2031. The new aircraft would replace the Royal Canadian Air Force's existing CF-18 fleet. ■■

## – BULLETIN BOARD FOR DEFENCE, INDUSTRY AND TRADE –

### Protective vests inserts for German Police

Rheinmetall has won an order to supply the German Federal Police with ballistic inserts for protective vests.

The framework agreement lasts 36 months and is worth a total of around 10 million Euro. Representing roughly 1 million Euro in sales, a first batch con-

sisting of over 5,000 ballistic inserts will be shipped in spring 2019. The contract encompasses an option for the supply of an additional 36,000 inserts.

The inserts are among the lightest of their kind, and withstand shots fired from an AK-47 assault rifle.

### Finnish Army tests GMLRS AW ammunition for long-range effects

The Finnish Army has conducted testing of the guided multiple launch rocket system alternative warhead's (GMLRS AW) new ammunition in Rovajärvi training exercise area, Lapland, Finland.

The test firing was conducted to validate the new ammunition's long-range capability and precision.

During testing, the heavy rocket launcher's ammunition demonstrated the desired capability requirements, increasing the Finnish Defence Forces' sustained readiness for long-range fires.

In 2016, Finland Defence Minister Jussi Niinistö approved a proposal to procure munition for a heavy rocket launcher system under a foreign military sale from the US.

The munition procurement was for both GMLRS AW to engage area targets and for GMLRS UNITARY for precision fire.

The GMLRS ammunition and heavy rocket launcher system are manufactured by Lockheed Martin.

Each rocket is packaged in a multiple launch pod and is fired from the launcher, with a range of approximately 80km.

Last month, the Finnish Defence Forces' Logistics Command received a mandate to conclude a contract with the US Government to procure upgrade kits of the Universal Fire Control System (UFCS).

The upgrade kits will allow using new munitions with the heavy rocket launcher. The Finnish heavy rocket launcher system was procured in 2006.



The test firing of the heavy rocket launcher's new ammunition.

Photo: Finnish Defence Forces



Polish MiG-29. MiG-29's (30 in service) and Su-22's (18 in service) are to be replaced by the new aircraft. To replace them one-for-one, it would be required to procure around 48 jets. Photo: J.Herzog/ Polish MoD

### Poland; New Fighter Aircraft Programme Accelerates

As the Polish Air Force's remaining Russian-supplied MiG-29 and Su-22 fighters become more dangerous and more costly to operate, Poland's defense minister has decided to accelerate plans to replace them with 48 to 64 new fighters.

The head of the Polish MoD, Mariusz Błaszczak, issued a recommendation addressed to the Chief of General Staff to accelerate the new generation fighter aircraft programme. This is to lead towards speeded-up introduction of a successor of the MiG-29 and Su-22 fast jets in the Polish Air Force.

The Polish Ministry of Defence probably referred to the Harpia [Harpy Eagle] new fighter aircraft programme. The analytical work concerning the multi-role new generation aircraft began towards the end of last year. Two tasks have been defined, within the framework of the Harpia programme.

The market analysis concerning a multi-role combat aircraft is going to involve the following entities:

- Saab AB;
- Lockheed Martin;
- Boeing Company;
- Leonardo S.p.A.;
- Fights-On Logistics.

Four of the listed companies - Saab, Lockheed Martin, Leonardo and Boeing - are international companies manufacturing multi-role fighter aircraft. Fights-On Logistics, on the other hand, was working in the area of introducing the F-16 jets in Poland, when they have been acquired. Now it offers services that are related to introduction and support of operations of the fighter aircraft.

Details of the offer have not been disclosed now. We know that Saab may offer Gripens (in the NG variant), Lockheed Martin may propose the F-16 and/or F-35 platforms, while Boeing may offer its F-15 or F/A-18 designs, and Leonardo is primarily offering the Eurofighter Typhoon. M-346FA Masters have also been promoted as a potential Su-22 replacement.

## Moore AMRAAMs to Japan

The Government of Japan has requested the sale of 32 units of the AIM-120C-7 advanced medium-range air-to-air missile (AMRAAM) weapon systems from the US.

With an estimated cost of \$63m, the possible sale has been approved by the US State Department.

The new AIM-120C-7 missile systems will help Japan develop and sustain a strong and effective self-defence capability.

The AMRAAM weapons will be deployed into service with the Japan Air Self-Defense Force. The enhanced capability will assist the nation in the

defence of its homeland, as well as US personnel stationed in the region.

Raytheon Missile Systems will serve as the principal contractor for the sale.

Manufactured by Raytheon, AMRAAM is an air-to-air missile that has been designed to meet troop requirements and can be used to operate in a wide range of scenarios, including air-to-air and surface-launch engagements.

In October last year, the Japanese Government requested a potential sale from the US to purchase 56 AIM 120C-7 AMRAAMs for an estimated cost of \$113m.



An AIM-120 AMRAAM being loaded onto an F-16fighter. Photo: USAF/V.Parker

## ONYX exoskeleton for US Army?

The US Army Natick Soldier Research, Development and Engineering Center (NSRDEC) has awarded the ONYX exoskeleton development agreement.

Awarded to Lockheed Martin, the two-year, sole-source \$6.9m agreement will see the company optimise components of the ONYX exoskeleton for future soldier demonstrations.

The enhancements will be assessed by the University of Florida prior to NSRDEC soldier demonstrations, which are scheduled to take place next year.

ONYX is a powered, lower-body exoskeleton that uses electro-mechanical knee actuators, a suite of sensors, and an artificial intelligence

(AI) computer to boost human strength and endurance.

Lockheed Martin Missiles and Fire Control exoskeleton technologies programme manager Keith Maxwell said: “Innovative human / machine technologies like ONYX can improve human performance, decrease injury and reduce fatigue to help soldiers accomplish physically demanding tasks.

The ONYX exoskeleton uses B-Temia’s Dermoskeleton technology to counteract over-stress on the lower back and legs, as well as reduce fatigue and increase endurance.

In November 2017, the University of Michigan Human Neuromechanics Laboratory



A US Army Apache helicopter.

Photo: US Army

## AH-64E Apache attack helicopters for Egypt

The US Defense Security Cooperation Agency (DSCA) has notified Congress of a possible foreign military sale of AH-64E Apache attack helicopters to Egypt for an estimated cost of \$1bn.

Under the potential deal, the Government of Egypt has requested the acquisition of ten AH-64E helicopters, in addition to 24 units of the 1700-GE-701D engines with containers, 12 modernised target acquisition designation sights / pilot night-vision sensors, and 24 Honeywell embedded global positioning systems (GPS) with inertial navigation system.

In addition, the sale includes the possible delivery of 24 M299 Hellfire launchers, 135 Hellfire missiles, five

M36E9 captive air training missile AGM-114R and 12 AAR-57 (V) common missile warning systems.

Delivery of the AH-64E Apache aircraft and other equipment will enable the country to expand its existing fleet of multi-mission heavy attack helicopters to address US-Egyptian interest in countering terrorist activities emerging from the Sinai Peninsula region, as well as to further improve interoperability between Egypt, the US and other allies.

Boeing, Lockheed Martin, General Electric Company, Lockheed Martin Mission Systems and Sensors, and Raytheon will serve as the primary contractors for the proposed sale.

in the US conducted an independently funded study on Lockheed Martin’s exoskeleton.

The study found participants who wore the exoskeleton and carried an 18 kg backpack showed a statistically significant reduction in exertion.

The exoskeleton has been designed to support and boost leg capacity for physically demanding tasks that require walking up steep inclines and stairs, as well as lifting or dragging heavy loads.



ONYX boosts leg capacity for physically demanding tasks such as lifting or dragging heavy loads, walking with load, or walking up or down hills.

Photo: Lockheed Martin

## Unmanned helicopter for European Maritime Safety Agency

Schiebel has been awarded the coveted maritime surveillance service provision contract by the European Maritime Safety Agency (EMSA).

Schiebel's CAMCOPTER S-100 UAS was selected based on its service record in the



Schiebel's CAMCOPTER S-100 UAS.  
Photo: Schiebel/ German Navy

maritime domain, as well as its proven maritime surveillance expertise. Payload capabilities and VTOL abilities from shore and from vessels were further qualifying factors.

In fulfillment of this contract, Schiebel will be able to provide simultaneous maritime surveillance services at several sites. The S-100 Unmanned Aerial Vehicles (UAV) will be equipped with an L3 Wescam MX-10 Electro-Optical/Infrared (EO/IR) camera gimbal and an Overwatch Imaging PT-8 Oceanwatch payload, as well as an Automatic Identification System (AIS) receiver.

## Scorpion robot design for US Army?

The US Army's Common Robotic System-Individual (CRS-I) programme finalist Endeavor Robotics has unveiled the design details of its new multi-mission, 'back-packable' unmanned ground vehicle (UGV).

Known as Scorpion, the Endeavor robot weighs approximately 11 kg and features advanced mobility and manipulation capabilities.

Endeavor is one of the two finalists chosen to share the \$429m engineering, manufacturing and development contracts under the US Army's CRS-I programme.

Under the final contract, scheduled to be awarded early next year, the selected firm will be required to produce up to 3,000 robots.

In the same way every army unit has long had a soldier designated to carry a radio on his or her back, fighting units will soon include a robot operator with a Scorpion-like UGV carried in their rucksack.

The rugged robot can be reconfigured to suit different mission requirements, with the ability to navigate rough terrain, climb stairs, and operate in wet or submerged environments.



Scorpion's arm is designed for improved reach and can extend 0.6m, lift up to 6,5 kg, and rotate 360° while its cameras provide the operator with high-definition day and night situational awareness. The operator can repair the robot in the field using 3D-printed parts.  
Photo: Endeavor Robotics

## F-16 fighter jets for Slovakia

The Slovak Ministry of Defence (MoD) has signed three separate preliminary Letters of Offer and Acceptance (LOAs) for the purchase of 14 F-16 fighter jets from the US.

The aircraft will be deployed to protect the Slovak airspace and provide close air support to its land forces.

In July, the Slovak Republic Security Council and Cabinet approved the purchase of F-16 Fighting Falcon Block 70 / 72 fighter jets.

The F-16 Block 70 is the newest generation of the Fighting Falcon featuring im-

proved radar systems, advanced weapons capabilities and enhanced battlespace awareness.

All fighter jets are due to be delivered by the end of 2023. The estimated value of the purchase is 1.58 billion euros.

Slovakia intends for these aircraft to replace its current fleet of MiG-29s. Slovakia's current fighters are not interoperable with U.S. forces or regional allies. Purchase of the F-16V will provide Slovakia with fourth generation fighter aircraft capability that is interoperable with the United States and NATO.



F-16 fighter

Ill. Lockheed Martin

## Tactical Communication System for Austria

Bittium Corporation's Tactical Backbone Network Selected as Part of the New Austrian Defense Forces' Tactical Communication System

Finish company Bittium announces that its partner, Austrian information technology company Kapsch BusinessCom AG was informed by the Austrian defense administration (Bundesministerium für Landesverteidigung BMVL) that it should be selected as the provider of the new IP-based tactical communication system for the Austrian defense forces. The signing of the contract is scheduled to December 2018.

Bittium's products for tactical communications are a significant part of Kapsch BusinessCom's winning bid,

including the Software Defined Radio based Bittium Tactical Wireless IP Network™ (TAC WIN) system, which will be the core of the new communication system, as well as Bittium Tough Comnode™ and Bittium Tough VoIP™ products.

Bittium's share of the total value is around EUR 30 million (excl. VAT). The product deliveries are expected to take place during the years 2019-2021 and the majority of the net sales are estimated to realize during the years 2020 and 2021.

Bittium specializes in the development of reliable, secure communications and connectivity solutions leveraging its 30 year legacy of expertise in advanced radio communication technologies.

## No investigation of Indian Rafale jet deal

In December, India's Supreme Court dismissed calls for an investigation into a French military jet deal that was threatening to damage Prime Minister Narendra Modi ahead of elections next year.

India's Supreme Court refused to intervene, saying it had "no doubt in the process".

Dassault initially won the contract to supply 126 jets to India in 2012, with 18 to be built in France and the rest in India in collaboration with the state-owned Hindustan Aeronautics Limited (HAL).

However, during a visit to France in 2015 Modi scrapped the deal, signed by the previous government led by the Congress party, and ordered instead 36 jets, all to be built in France, for an estimated \$9.4 billion.

Under Indian defence procurement rules, foreign companies winning contracts must "offset" or reinvest half the

total value in joint ventures or purchases with Indian firms.

But the new agreement, formally signed in 2016, raised eyebrows because Dassault chose as its local partner Reliance, a massive conglomerate owned by billionaire Anil Ambani.

Ambani is believed to be close to Modi and Reliance had no previous experience in the aviation sector.

The Modi-led right-wing ruling Bharatiya Janata Party (BJP) and French company officials have throughout denied any wrongdoing.

The first Rafale will be delivered in 2019 and the 36 jets will form two new squadrons of the Indian Air Force.

It currently has around 32 squadrons of 18 aircraft each, but has said it needs at least 42 to protect its northern and western borders with Pakistan and China.

## Canada to retire CH-124 Sea King helicopter fleet

The Royal Canadian Air Force (RCAF) is set to officially retire the CH-124 Sea King helicopter fleet after serving for 55 years.

New CH-148 Cyclone maritime helicopters will replace the Sea King ship-borne maritime helicopter by the end of this year.

Sikorsky is under a contract to deliver 28 CH-148s as part

of the RCAF's \$5.7bn Maritime Helicopter Project (MHP).

Originally procured by the Royal Canadian Navy for anti-submarine warfare in 1963, the Sikorsky-built twin-engine amphibious helicopter has been deployed to participate in a wide range of mission roles both at home and around the world.

## Last of Eight Black Hawks for Tunisia

The U.S. Army Security Assistance Command (USA-SAC) completed a foreign military sales (FMS) case to deliver eight UH-60M Black Hawk helicopters to partner country Tunisia this summer.

The Black Hawks will provide Tunisia with cargo/personnel transport, medical evacuation and combat

operations capabilities. The case value is more than \$338 million. Army Contracting Command at Redstone Arsenal, Alabama, awarded the contract.

Delivery started in June 2017 with the delivery of four of the helicopters. Delivery of four additional helicopters this past June completed the FMS case.

## HUGIN SUPERIOR AUV

Kongsberg Maritime has unveiled their new HUGIN SUPERIOR AUV (Autonomous Underwater Vehicle) System introduces significantly enhanced data, positioning and endurance capabilities that together will stimulate a positive step-change in subsea survey operations for commercial, government, and naval users.

Leveraging and improving on the power of the standard HUGIN technology platform, Kongsberg Maritime has created a new AUV generation that places data quality and its reliable and cost-effective collection front and centre.

The HUGIN SUPERIOR is equipped with the new HISAS 1032 Dual Receiver Synthetic Aperture Sonar (SAS) which generates approx. 1000 meters swath at 2.5 knots for SAS imagery, real aperture and SAS bathymetry, with consistent

resolution over the entire swath (typically 5x5 cm in mission imagery). The system also features the de facto industry standard EM2040 mk II multi-beam.

Configurable for diverse applications, a class-leading data suite with upgraded SAS processing, sidescan sonar imagery, bathymetry, sub-bottom profiler, camera, laser, magnetometer, turbidity and diverse environmental sensors for i.e., methane and CO2 measurement, ensure that the new HUGIN is as ready for field development surveys and pipeline inspection as it is for environmental monitoring or wreck searches.

Contributing to improved data confidence for users at sea and ashore, the HUGIN SUPERIOR utilises latest positioning technology, with in mission standard

navigation rated twice as effective as other AUV platforms, including current HUGIN models. Operating HUGIN SUPERIOR now costs less with fewer external updates needed, and with new potential for concurrent revenue generation, further economic efficiencies can be achieved.

The new HUGIN SUPERIOR also comes with a 30% increase in energy capacity on board, without changing form factor or size. While raising mission endurance, the extra power available can also be used

to maintain current levels of endurance while adding more sensors.

The new HUGIN SUPERIOR AUV System is designed to deliver superior data, positioning and mission endurance, enabling users to do more with a single asset than ever before. Ultimately, it can generate much more data for less operational expenditure, all while offering the best survey class data quality, achieved through advanced techniques such as in-situ navigation processing and data cleaning.



HUGIN SUPERIOR AUV

Photo: Kongsberg Maritime

## Aerial Refueling from Lockheed Martin and Airbus?

Lockheed Martin and Airbus have agreed to market the Airbus A330 MRTT tanker, which had won the original USAF tanker competition, to US military customers, giving Boeing's troubled KC-46A Pegasus a serious run for its money.

The two companies have signed an agreement to jointly explore opportunities to meet

the growing demand for aerial refueling for U.S. defense customers.

The companies will seek to provide aerial-refueling services to address any identified capacity shortfall and to meet requirements for the next generation of tankers capable of operating in the challenging environments of future battlespace.



An Airbus A330 MRTT tanker refueling two F-18 Hornet fighters at Military Aviation 2014 Air Show in Australia. Photo: RAAF/ C.Phutulley

## Danish support contract to Safran

Denmark's Defence Acquisition and Logistics Organization (DALO) has awarded a contract to Safran Helicopter Engines to support the Royal Danish Air Force's (RDAF) fleet of AS550C2 Fennec helicopters.

Under the contract, the company will provide support services to Arriel 1D1 engines that power 11 Aerospatiale Eurocopter-manufactured AS550C2 Fennec single-engine helicopters.

Arriel 1D1 engine support will be covered under the global support package (GSP) contract, and the company will deliver services until the

AS550C2 Fennec fleet retires in the mid-2030s.

The seven-year GSP contract was signed in 2016 to fulfil the RDAF's engine availability requirement during military operations, both at home or while on international deployment.

It included support for 14 RTM 322 turboshaft engines that power the RDAF's Agusta-Westland-built EH101 Merlin aircraft.

Since July 2016, Safran GSP has supported a total of 75 engines. The GSP is part of Safran's range of EngineLife Services solutions for helicopter engine operators.

Safran Helicopter Engines Germany manages the GSP, which commits to offer serviceable engine availability and guarantees a fixed price per engine flying hour, as well as a technical partnership with the original equipment manufacturer.

Currently, Safran Helicopter Engines Germany supports more than 280 operators across Europe and Central Asia.



Soldiers emerging from Danish Fennec helicopters. Photo: Danish Armed forces

## China Flight Tests New Submarine-Launched Missile

China carried out a flight test of a new submarine-launched ballistic missile that will carry multiple nuclear warheads capable of targeting most of the United States, according to American defense officials.

The launch in late November was the first time the Chinese military flight tested the

Julong-3, or JL-3 missile that will be deployed with the next generation of ballistic missile submarines.

The test was closely monitored by U.S. intelligence agencies that detected the launch with missile warning satellites.

## Australian Navy's first Future Submarine to be named HMAS Attack

Australian Defence Minister Christopher Pyne has announced that the first of the Royal Australian Navy's (RAN) Future Submarine will be named HMAS Attack.

The RAN's \$50bn Future Submarine programme, also known as SEA1000, is intended to provide the country with a regionally superior submarine capability.

Under the programme, 12 Attack-class submarines will

be built domestically by local shipbuilders for the RAN.

The first submarine under the programme is expected to enter service in the early 2030s.

On 30 September 2016, the design and mobilisation contract was signed between the Australian Government and Naval Group to begin the Future Submarine programme's design phase.

## Bridge simulator contract to Kongsberg Digital

Kongsberg Digital has been selected to deliver and support a suite of sophisticated K-Sim Navigation ready ship's bridge simulators for the Royal Australian Navy. The contract will enable the Royal Australian to significantly increase its training capacity and reduce costs associated with qualifying bridge watch keepers and other staff before going to sea.

The simulators will be delivered for installation in a new training facility at HMAS Stirling in Perth starting May 2019, with existing bridge simulators at HMAS Watson in Sydney being upgraded from December 2018. The new simulation centre in Perth and extensive upgrades in Sydney will ease pressure on the Navy's existing facilities and provide sophisticated bridge simulation training capabilities on

both coasts of the Australian continent.

The contract also includes a Long Term System Support Program (LTSSP), designed to ensure high operational availability and easy access to new KONGSBERG simulator developments. The Royal Australian Navy has already benefited from an existing LTSSP, which enabled fast track upgrading of its capabilities at HMAS Watson with new KONGSBERG ship's bridge simulators in 2016/17.



K-Sim Navigation ready ship's bridge simulators. Photo: P.Y. Ramsey/ Australian Navy

## Modification of Four S-80 Submarines

The Council of Ministers on Nov. 30 authorized the modification of the execution order awarded by the Ministry of Defense to Navantia for the construction of four S-80 submarines, for an estimated value of 1,7 bn euros, as the basic conditions were altered essential aspects of the contract, both in terms of the technical characteristics and in terms of compliance and price.

It subsequently suffered various modifications and vicissitudes in the execution, in such a way that the Navantia company in November 2012 communicated to the Navy the non-viability of the design due to a critical deviation in the weight control of the ship.

This situation forced us to focus all our efforts on finding the technical solution that would solve this problem and allow us to return the project to viability. This solution has already been reached, so it is necessary to implement it, and the modification of the Order of Execution of March 25, 2004 is required for this purpose.

The modification which has now been authorized has as precedent the agreement of the Council of Ministers of July 27, 2018, that modifies the limits of the acquisition expenditure commitments charged to future years and authorizes the increase of the Special Program of Modernization of the Armed Forces corresponding to the S-80 submarines.

## MBDA's Sea Venom-ANL missile marks further trials milestone

Conducted on 14 November from a Direction Générale de l'Armement (DGA) Dauphin test helicopter at the DGA Missile testing range of Ile du Levant range, the trial was the final development firing for the missile prior to the start of qualification trials in 2019.

This latest trial highlighted Sea Venom-ANL's lock on before launch (LOBL) capabilities, with images from the missile's infrared seeker being used by

the operator to designate the target prior to launch.

Sea Venom-ANL is capable of being launched from a wide range of platforms, and will be used on the UK Royal Navy's AW159 Wildcat and French Navy future HIL (Hélicoptère Interarmées Léger) helicopters. This 120 kg sea-skimming missile is designed to enable navies to deal with a range of threats including fast moving patrol boats, corvettes and coastal targets.



MBDA's Sea Venom-ANL anti-ship missile has conducted a firing trial

Photo: DGA

## Follow-on order for NH90 maintenance in Norway

Patria Helicopters AS has received an order for NH90 helicopters heavy maintenance taking place in Bardufoss, Norway as the Norwegian Defence Logistics Organisation (NDLO) has released the first option of one year from April 2019 onwards.

Patria and the NDLO signed an agreement in 2017 on the support of the Norwegian Defence Forces NH90 helicopters' maintenance in Bardufoss. The agreement was for two years and included an option for extensions. Estimated value of the agreement, including options, was approximately 100 million NOK.

## Five export customers for Turkish company Nurol Makina

Nurol Makina, one of the Turkish defense industry's manufacturers of armored land vehicles, continues the success achieved with its unique Ejder Yalçın 4x4 Armored Combat Vehicle design to new destinations.

The last customer for Ejder Yalçın was an African country. Previously, Qatar, Senegal, Uzbekistan and Tunisia had chosen the Ejder Yalçın.



Nurol Makina has delivered a total of 500 Ejder Yalçın 4x4 up to today.

Photo: Nurol Makina

## Russian Arctic military presence

Russia will build up its military presence in the Arctic over the next year, said Russian Defence minister Sergei Shoigu and added that Moscow seeks to assert its influence in the strategic region.

The announcement comes after years of increased activity in the Arctic, which Moscow has declared a top priority due to its mineral riches and military importance.

"We'll finish building infrastructure in 2019 to accommodate air defence radar units and aviation guidance points on the Sredny and Wrangel Islands, and on Cape Schmidt" in the Russian Arctic, Shoigu continued.

He said accommodation for military personnel and further aviation infrastructure had been completed elsewhere in the Arctic, at a defence ministry

meeting also attended by President Vladimir Putin.

Russia has opened a string of military and scientific bases in the Arctic in recent years, with interest in the region growing as rising temperatures open up shipping routes and make hitherto inaccessible mineral resources easier to exploit.

Putin has made several trips to the Arctic and last year said further exploration and extraction of raw materials from the area was "extremely important".

NATO this year held its biggest military exercises since the end of the Cold War near Russia's Arctic border with Norway. Finland accused Moscow of jamming GPS signals in the region during the manoeuvres.

At a Victory Day military parade this year, Moscow displayed a new snowmobile used by Arctic units.

## 500th VT4 vehicle from Arquus

Arquus has delivered the 500th VT4 vehicle to the French Army. The light and non-armoured VT4 is a 4x4 vehicle designed for command and liaison purposes. It can be used to transport five soldiers or four operators equipped with the FELIN fighting system. The French Army is expected to be equipped with a total of 4,380 VT4 vehicles by 2025, which will replace the P4 liaison vehicle.



Photo: Arquus

## “Aircraft carrier” for Japan

The new National Defense Program Guidelines were approved Dec. 18 along with the Mid-Term Defense Program, laying out Japan's defense policy and weapons purchases over the next five years.

The program estimated weapons purchases over the next five years at a record 27.4 trillion yen (\$242 billion).

The main focus was the inclusion of wording that would allow for the retrofitting of an Izumo-class destroyer (helicopter carrier) to give it aircraft carrier capabilities.

Underscoring the sensitivity of the issue in light of Japan's long-held stance of assuming an exclusively defensive posture for the Self-Defense Forces, the terminology for the upgraded destroyer was kept the same as in the previous document,

with the updated vessel being described as “a destroyer with multifunctional capabilities.”

The retrofitted ship will be capable of deploying short take-off and vertical landing (STOVL) aircraft. Defense Ministry officials are planning to use F-35B stealth fighter jets on the vessel.

The Cabinet also approved a plan for the Air Self-Defense Force (ASDF) to eventually have a total of 147 F-35s.

The ASDF is in the process of acquiring 42, with an additional 105 to be purchased from the United States. Of the new aircraft, 42 will be the F-35B STOVL aircraft, while the other 63 will be F-35As. The total cost of the additional aircraft is expected to be about 1.2 trillion yen (\$10.6 billion).



The Izumo-class helicopter destroyer is a helicopter carrier that in the future will be “a destroyer with multifunctional capabilities”.

Photo: K. Jieitai / Japan Maritime Self-Defense Force



An illustration depicts Falcon hypersonic test vehicle emerging from its rocket nose cone. Ill. DARPA

## US to accelerate development effort for hypersonic weapons

The US Department of Defense (DoD) is considering accelerating the effort to develop hypersonic weapons in a bid to combat potential advanced threats.

Hypersonic weapons are missiles that have the capability to cruise at speeds more than five times faster than of sound.

The US Army noted that countries such as China and Russia are actively involved in the development of hypersonics and reports suggest that these nations have made significant progress.

In the last year, China has tested more hypersonics weapons than the US have in a decade.

The DoD has already received approval to proceed with hypersonics development and is seeking competing responses from the industry.

Currently, the US has the capability to develop air-breathing boost-glide hypersonics systems.

Using boost-glide technology, the US Army has also tested an advanced hypersonic weapon demonstrator in 2011 and 2014.

## Patriot Missiles for Turkey

The State Department has made a determination approving a possible Foreign Military Sale to Turkey of 80 Patriot MIM-104E Guidance Enhanced Missiles (GEM-T) missiles, 60 PAC-3 Missile Segment Enhancement (MSE) missiles and related equipment for an estimated cost of \$3.5 billion.

Turkey will use Patriot to improve its missile defense capability, defend its territorial integrity, and deter regional threats.

The prime contractors will be Raytheon Corporation in Andover, Massachusetts, and Lockheed-Martin in Dallas, Texas. The purchaser requested offsets. At this time offset agreements are undetermined and will be defined in negotiations between the purchaser and contractors.

A few years ago, Turkey asked the United States to

supply Patriot missiles, but Washington declined.

Turkey then announced it would instead buy Chinese HQ-9 missiles, but subsequently switched to Russia's S-400.

Contracts for the S-400 have been announced several times, and their delivery is scheduled for 2019.

By now offering to sell Patriot, the US hopes to avoid introducing a Russian-made system into NATO's air-defense network, as well as major disruption to the F-35 program by expelling Turkey – which it threatened if the S-400 sale went through.

The result, today, is that the United States has given in to Turkey's original request for Patriot, without knowing whether the S-400 purchase will go through nonetheless.



Photo: Embraer

## Kazakhstan's Air Astana receives "snow leopard" jet

Air Astana presented its first Embraer E190-E2 jet. The airline will receive four additional E190-E2s next year.

Air Astana's first E190-E2 features a "snow leopard" livery, designed and hand painted by Embraer. For

Air Astana the paint scheme is designed to draw global attention to the threat of extinction faced by the wild cat. The snow leopard is an official symbol of Kazakhstan and is native to the country's southern mountain ranges.

## Putin lays out plans to develop missiles if US leaves treaty

Russian President Vladimir Putin has laid out plans for Moscow to develop mid-range missiles banned under a Cold War treaty with the United States if Washington abandons the deal.

Tensions have raged over the fate of the Intermediate-Range Nuclear Forces treaty (INF), with US President Donald Trump promising to walk away from the agreement and Putin threatening a new arms race.

Washington this month said it would withdraw from the INF within 60 days if Russia did not dismantle missiles that the US claims breach the deal.

The bilateral agreement forbids ground-launched short- and intermediate-range missiles, but not those launched from the air or sea.

Speaking at a defence ministry meeting, Putin said Russia's seaborne Kalibr and air-launched Kh-101 cruise missiles – as well as cutting-edge hypersonic Kinzhal (Dagger) missiles – would be converted for ground launch

if Washington ditches the INF treaty.

Putin once again touted the Kinzhal missile, which he first unveiled as part of an array of next-generation nuclear weapons in his annual state-of-the-nation address earlier this year.

Putin also suggested he was open to the idea of other countries joining the INF treaty or to starting talks on a new agreement.

Signed in 1987 by then US president Ronald Reagan and Soviet leader Mikhail Gorbachev, the treaty bans ground-launched missiles with a range of between 500 and 5,500 kilometres.

The deal resolved a crisis over Soviet nuclear-tipped ballistic missiles targeting Western capitals, but put no restrictions on other major military actors like China.

Military expert Vasily Kashin said it would be fairly easy to convert Kalibr and Kh-101 cruise missiles for ground launch, though the Kinzhal hypersonic missile would need more work.

## France Orders Three More Airbus A330 MRTT Tankers

Airbus Defence and Space has received a firm order from the French Defence Procurement Agency (DGA) for a further three A330 MRTT Multi-Role Tanker Transport aircraft.

The aircraft, known as Phénix in French service, constitute the third and final tranche of the multi-year contract for 12 A330 MRTTs signed by the French Ministry of Defence in 2014.

The first of the fleet was formally handed over in October and the remainder will

be delivered by the end of 2023 under an accelerated timescale requested by France.

In French service the A330 MRTT will be powered by Rolls-Royce Trent 700 engines and equipped with a combination of the Airbus Refuelling Boom System and underwing hose-and-drogue refuelling pods. The A330 MRTT has been ordered by 12 nations which have now placed firm orders for 60 aircraft, of which 34 have been delivered.



A330 MRTT

Photo: DGA

## Lithuania receives first upgraded PzH2000 howitzers

The Lithuanian Armed Forces has received the first two upgraded heavy self-propelled artillery systems, Panzerhaubitze 2000 (PzH2000) howitzers.

Delivered to the Lithuanian Artillery Battalion, the heavy artillery systems were procured from the German Armed Forces.

In September 2015, Lithuania signed a contract with the German Armed Forces to acquire 18 upgraded howitzers in combat setup mode.

Featuring upgraded control battlefield control, and fire control software, the new PzH2000 howitzers will enhance the firing range of the battalion by up to 40km.

The battalion has been using the 105mm howitzers with a firing range of roughly 11km.

The remaining PzH2000 howitzers will be delivered to the Lithuanian Armed Forces by the end of next year.



Bilde 3 Lithuanian PzH2000 howitzer

Photo: Lithuanian Army

## Laser range finder Vidar for Arafura-class OPVs

Saab has revealed its latest laser rangefinder for installation on the Royal Australian Navy's new Arafura-class offshore patrol vessels (OPV).

Named Vidar, the laser rangefinder is currently undergoing production and combines compact size with powerful performance, the company stated.

Laser rangefinders use a laser beam to determine the distance to the target.

The company noted that Vidar can be used in anti-aircraft and anti-ship operations and is capable of generating

highly accurate tracking data even at long ranges.

Saab has been manufacturing military lasers since the early 1960s and has delivered approximately 5,000 units to more than 30 countries to date.



Vidar laser range finder. Photo: Saab

## Nansen-class frigates to receive upgraded sonar domes

The Norwegian Defence Material Agency (NDMA) has awarded a contract to Unitech Aerospace's Tods Defence to provide upgraded sonar domes for the national navy's Nansen-class frigates.

The company will deliver the solutions to NDMA for installation on the navy's four anti-submarine warfare frigates currently in-service.

The frigates feature an integrated weapons system from Lockheed Martin based on the Aegis combat system. Thales Underwater Systems is the prime contractor for the sonar suite installed on the frigates.

Australia signs deal for Hunter-class frigates

The Australian Government has awarded a contract

to BAE Systems subsidiary ASC Shipbuilding for the Royal Australian Navy's Hunter-class frigates.

The contract includes the design and construction of nine vessels and is part of Australia's A\$35bn (\$25.29bn) SEA 5000 Hunter-class frigate programme.

To be developed based on BAE Systems' Type 26 frigate, the RAN's Hunter-class frigates will replace the Anzac-class warships.

Australia Defence Minister Christopher Pyne said: "The A\$35bn programme will provide the navy with a world-class anti-submarine warfare capability, create thousands of jobs and contribute billions of dollars to the national economy."



ASC Shipbuilding Hunter-class frigates. Construction of the first ship is expected to begin in 2022. Ill: BAE Systems

## Brazilian Navy Launches National Anti-Ship Missile

The Brazilian Navy corvette Barroso has carried out the first development test firing of the

The Brazilian Navy has launched the first prototype of the National Anti-Ship Missile (Missil Antinavio Nacional de Superficie, or MANSUP), 300 km off the coast of Rio de Janeiro. MANSUP anti-ship missile is developed by Brazil's national industry. It is broadly similar to the Exocet Block 2s presently in service.

The test confirmed the correct functioning of several subsystems, and the need for

improvement in some others. Data of its in-flight behavior were recorded by telemetry, also developed in Brazil and, after it is analyzed, will guide the next development steps and launches.



The MANSUP is 5.6 meters long, weighs about a tonnes and accelerates to a speed of 1,000 km/h in less than seven seconds.

Photo: Brazilian Navy

## First Scorpene-class attack submarine for Brazil

The Brazilian Navy has launched its first Scorpene-class attack submarine at the Itaguai Navy base in the state of Rio de Janeiro.

Named Riachuelo, the Brazilian-built submarine was developed by French firm Naval Group and is a modified version of the Scorpene-class diesel-powered submarine.

Scorpene can be deployed in a range of missions, including shallow water operations, anti-surface and anti-submarine warfare, special operations, offensive minelaying, and intelligence gathering.

The Brazilian Navy awarded a contract to Naval Group in 2009 to design and transfer the technology for four conventional Scorpene submarines as part of a R\$35bn (\$8.9bn) programme.

The company is also responsible to provide design and manufacturing assistance for the non-nuclear part of Brazil's first nuclear-powered submarine.

According to Naval Group, Riachuelo will begin sea trials next year and is expected to be delivered in 2020.

The company will deliver the remaining three submarines as part of the contract every 12 to 18 months.

The new Scorpene submarine has been named after the Battle of the Riachuelo, where the Brazilian Navy defeated the Paraguayan Navy in 1865.

Naval Group noted that the submarine will be slightly longer than other Scorpene variants, which are operational or being built for the navies of Chile, Malaysia and India.

The Riachuelo will have an overall length of 72m and can carry 35 crew members.

When the fifth submarine is received in 2029, Brazil will join the list of nations with nuclear-powered submarines, which includes the US, Russia, France, the UK, China, and India.

The Brazilian Navy will deploy the new submarines to patrol the country's offshore deepwaters that host vast oil and gas reserves.



Launching of the new Scorpene-class submarine.

Photo: Leo Lemos/Naval Group

# RAMJET:

## MISSILE AND PROJECTILE RANGE CAPABILITY WILL BE GREATLY INCREASED

The ramjet offers significant advantages, in terms of speed as well as range. NAMMO Raufoss recently unveiled a prototype artillery grenade with ramjet propulsion. Missiles are another arena where the ramjet principle offers multiple benefits.

— **A** conventional rocket motor carries both fuel and oxidizer (oxidisation agent) for the combustion, and with a conventional rocket motor, the oxidizer mass fraction is approximately 80 percent of the total propellant mass, says Erland Ørbekk, head of ramjet development at NAMMO.

A ramjet is a form of air-breathing jet engine that uses the engine's forward motion to compress incoming air. The combustion in a ramjet resembles that of a jet aircraft engine, in that the oxygen used in the combustion process comes from the external air.

This means a saving of about 80 percent of the fuel volume relative to a conventional rocket motor, or conversely, that the actual fuel capacity can be approximately five times greater within the same volume.

An aircraft jet engine has a centrifugal air compressor in front of the engine. The compressor takes in the air and compresses it before it is further heated in the combustion chamber, whereby the air volume is expanded. The air or "the combustion gas" is then expanding through a nozzle, and thrust is generated. With an aircraft engine, a turbine is used to drive the compressor.

With a ramjet engine, however, neither a turbine nor a compressor is used to achieve enough pressure through the air inlet. Instead, the ramjet uses the travel speed to force air at high pressure through the inlet and into the combustion chamber. This means that a ramjet must reach a speed of Mach 2+ before it will start producing thrust, but on the other hand, the ramjet gets by without the turbine and compressor of the aircraft jet engine.

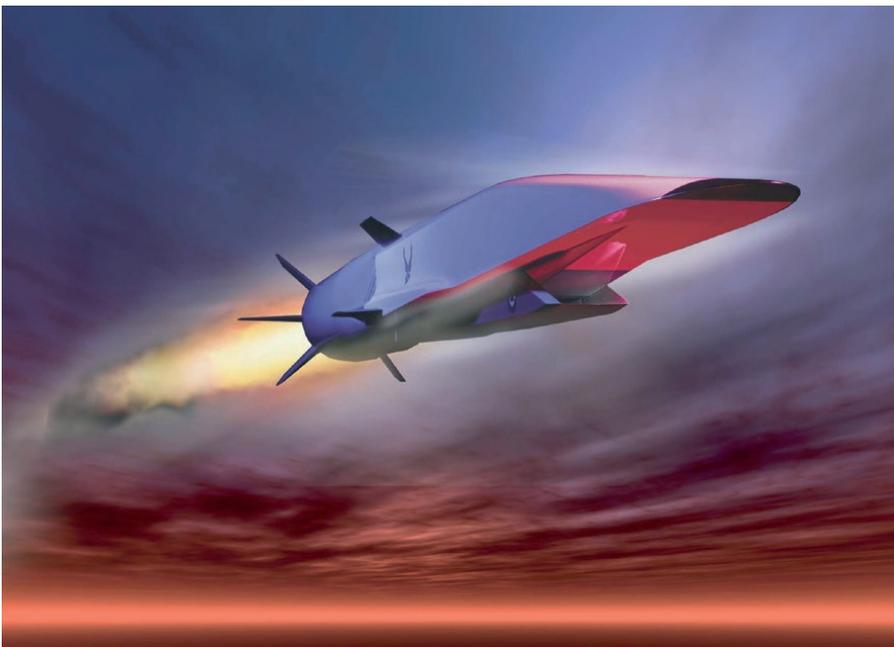
### Self-adjusting at high altitudes

The ramjet is designed to operate at a defined Mach number and will produce thrust as long as there is a supply of oxygen within certain limits. The missile drag and the ramjet thrust are lower at higher altitudes since the air density is lower. Hence, the ramjet will be able to sustain the same speed (or Mach number) with lower fuel consumption at higher altitudes. This means that a missile based on ramjet technology will be able to cruise to longer ranges at high altitudes.

### The ramjet missiles of the future

— The hurdle facing ramjet-based missiles is obviously that of the ramjet having to reach a speed of Mach 2 or more before the ramjet motor will start producing thrust. Thus, a booster is required to accelerate the missile to a sufficient speed before the ramjet can take over. At that point, the advantages of a ramjet-based missile will have been achieved. The range of a ramjet missile can with the technology NAMMO is developing be up to 5 to 6 times the range of a missile using a conventional rocket motor, with comparable size and weight. The ramjet technology makes it possible to push the maximum speed of a ramjet missile up beyond Mach 6, but our current estimate is that Mach 3-3.5 will be the optimum speed for maximum range, Ørbekk continues.

— It is our view that we will have the option of adjusting the thrust in-flight, and thereby accelerating the ramjet missile on



Art impression of the X-51 Waverider. The Boeing X-51 Waverider is an unmanned research scramjet experimental aircraft for hypersonic flight at Mach 5 (3,300 mph; 5,300 km/h) and an altitude of 70,000 feet (21,000 m). The aircraft was designated X-51 in 2005. It completed its first powered hypersonic flight on 26 May 2010. After two unsuccessful test flights, the X-51 completed a flight of over six minutes and reached speeds of over Mach 5 for 210 seconds on 1 May 2013 for the longest duration powered hypersonic flight. A scramjet (supersonic combustion ramjet) is a variant of a ramjet. Ill. USAF/ Boeing



The BrahMos is a medium-range supersonic ramjet cruise missile that can be launched from submarines, ships, aircraft, or land. It is the fastest cruise missile in the world. The missile travels at speeds of Mach 2.8 to 3.0, which is being upgraded to Mach 5.0. BrahMos is a joint venture between the Russia and India. The name BrahMos is a portmanteau formed from the names of two rivers, the Brahmaputra of India and the Moskva of Russia. The land-launched and ship-launched versions are already in service, with the air and submarine-launched versions currently in the testing phase. Photo: BrahMos consortium

command through the missile computer. This may typically be required of a ramjet missile tasked with the taking out of an incoming missile. The ramjet missile will then towards the end of its flight path be able to increase its speed, in order to cut off another missile flying a crossing path.

Regarding the booster component itself, we are envisioning both integrated boosters and boosters that can be dropped. Boosters that can be dropped, means that when the booster has burnt its on-board propellant, and the missile has reached

ramjet takeover velocity, the booster rocket motor is ejected. Ejectable boosters are typically used with missiles for ground launched applications.

Integrated boosters, on the other hand, are designed and integrated into the ramjet combustor volume. Integrated boosters are typically used with missiles fired from aircraft, where it could be a problem that the missile fired out in front of the fighter aircraft might drop off a booster that could in a worst case be rammed by the host aircraft.

### Test facility at Raufoss

Here at the NAMMO test centre at Brandalsmyra, near Raufoss and some 100 kms north of Oslo, we have built a unique test facility for development and flying ramjets in the atmosphere. The test facility allows us to simulate flights from Mach 2 all the way up to Mach 5. The air is pre-warmed from 300-400 degrees C up to approximately 1000 degrees C.

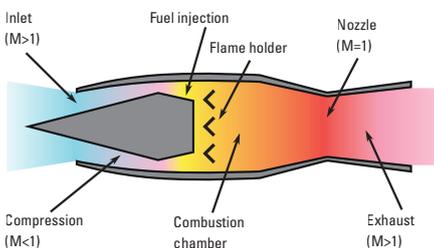
– It takes a good deal of energy to heat the air, and for this purpose, we are using a propane heater producing up to 12 megawatts, says Ørbekk, noting that this corresponds to about a thousand gas garden grills with three burners each.

In our facility, we can then simulate ramjet flights at various altitudes.

### The future

Given the appropriate financing, I believe it would be realistic to develop an operative ramjet-based 155 mm artillery projectile which we could have ready to market by 2023.

On the missile side too, we should be able to develop a ramjet over the course of five years, while this would be dependent on collaboration with a missile manufacturer to develop the missile component. In this case, we may therefore be looking at a time-line of ten years before we have anything we can take to the market. ■■



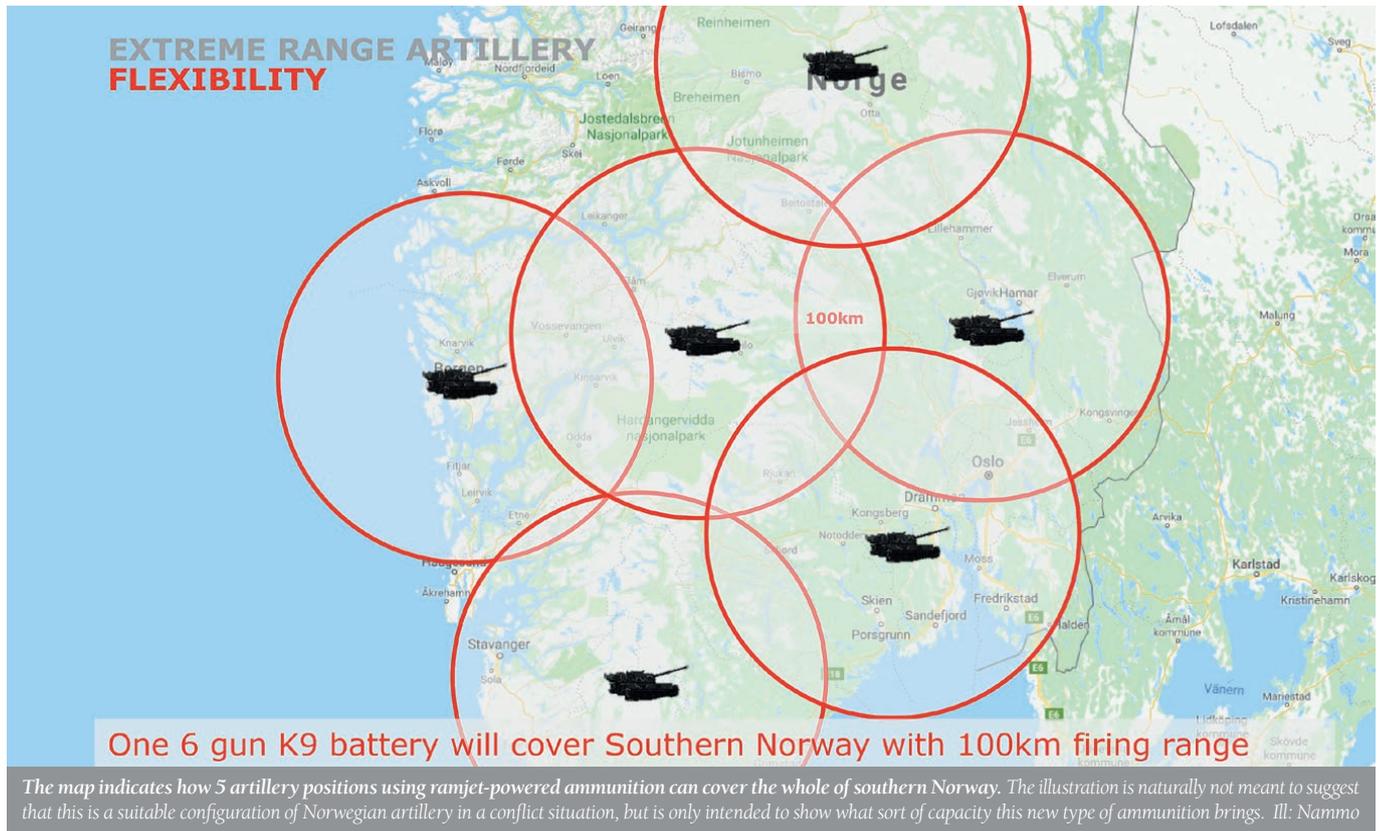
Ill: Emoscopes/wolfskeeper/wiki

## RAMJET

The ramjet technology has been around for quite some time, and the first tests of ramjet propulsion date back to before the second World War.

The photo displays a Lockheed D-21 supersonic ramjet-powered reconnaissance drone developed in the 1960ties. The D-21 had maximum speed in excess of Mach 3.3 (2200 miles per hour; 3600 kilometers per hour) at an operational altitude of 90,000 feet (27,000 meters). Four operational missions with the D-21B were conducted over China from November 1969 to March 1971. But the missions were no success; the drones either crashed or fell into the sea, where they sank, and the reconnaissance photos were lost. In 1971 the D-21 program was terminated. Photo: USAF





## NEW RAMJET POWERED 155MM ARTILLERY AMMUNITION CONCEPT

This summer, NAMMO presented a mock-up of its new ramjet powered 155mm artillery ammunition. The ammunition will enable any standard L52 155mm artillery tube gun to launch precision strikes against targets more than 100 kms away.

**T**he technology in a ramjet-propelled artillery grenade is the same as that in a ramjet missile; it's just that it all needs to fit into a much smaller package, says Thomas Danebolt, vice president for Large Caliber Ammunition at NAMMO.

- At NAMMO, we are calling this technology HE-ExR (High Explosive Extreme Range), and Nammo's goal is to develop artillery ammunition with extreme range without adding any additional load to the gun. This means that our HE-ExR ammunition will be used effectively in existing 155 mm artillery systems, without modification or adaptation. This again means that we must fit the ramjet technology within the confines of today's 155 mm artillery grenade shell.

In many ways, a ramjet powered 155 mm artillery grenade is comparable

to a missile fired from a cannon. And while the missile requires a rocket booster in order to reach the speed that the ramjet requires to start generating thrust, it is the propellant in the cannon which must ensure that the ramjet-driven artillery grenade reaches the requisite Mach 2 to 2.5.

### Long range, same accuracy

The maximum range of a regular 155 mm shell is up to a maximum of 30 kms, or 18 miles, and has been so for more than 50 years. Using the NAMMO Base bleed technology, the range can be extended to over 40 kms. But with this new ramjet-powered shell, artillery could reach a range of up to 100 kms – 60 miles – or maybe beyond.

When a ramjet driven grenade is fired, it will reach its maximum altitude of about 16,000 meters or 50,000 feet in just about 50 seconds. This corresponds to

about twice the height of Mont Everest. Or to make another comparison, most civilian airliners have a maximum cruising altitude of 13,000 meters or 41,000 feet.

A ramjet powered grenade will maintain its speed right up to the apex, to a much greater extent than a conventional grenade. At this altitude, the air is thin, with minimal air resistance, and the glide fin-equipped grenade will glide towards the target.

A glide path like this is comparable to the performance of the American/Swedish artillery ammunition Excalibur. The apex speed of this grenade, however, will be much lower than that of the ramjet-powered ammunition, giving the ramjet grenade a much longer reach. The Excalibur has a maximum range of about 50 to 60 kms, or 30 to 36 miles.

- These long ranges call for a capability to steer the grenade in order to achieve acceptable accuracy, says Danebolt, explaining that wind in particular may shift the grenade considerably from its intended path unless corrections can be made in-flight.

There are currently guidance kits available to equip artillery grenades with glide fins, and the use of these systems will achieve the same accuracy as what is required today, which is that 50% of the grenades will hit the target within a circle of 10 meters in diameter. This kind of precision will also be a firm requirement of a ramjet-based grenade, since the explosive load of the grenade will have to be reduced to about half that of a conventional artillery grenade in order to make room for the ramjet motor.

There are currently artillery grenades in existence using conventional rocket engines, but since a conventional rocket engine carries both fuel and oxidizer (oxidisation agent), the range of these grenades are limited to a maximum of 55 to 60 kms, when the ammunitions size is the same as a normal 155 mm artillery grenade.

### Greater range, new tactical possibilities

Ramjet driven artillery ammunition is not intended to replace other types of ammunition, but will instead be an addition to the ammunition types available on the market today. Artillery will still have a need to engage targets at a distance of 10 to 40 kms, and at these ranges, today's ammunition types work very well, not least when fired in sequence from several cannon units, whereby a greater number of grenades hit the target area simultaneously.

Ramjet-based artillery ammunition will be a supplement that affords greater flexibility, and opens up whole new tactical opportunities for the artillery. The ramjet ammunition will in particular be a valuable option against smaller pinprick targets at very long range. Typical targets may include air defence batteries, command posts, communication hubs et cetera. These are targets that will often have a forward role and may often be too small to target effectively by fighter planes



*A ramjet-powered artillery grenade. The grenade is designed for use in today's modern 155mm L 52 artillery cannons without needing adaptations. Our goal is to provide the systems we already have with greater capacity and more flexibility, says Thomas Danebolt of NAMMO, adding that the new ramjet-powered shell obviously can and will also be a key asset from an overall cost perspective.*

Photo: Nammo

and larger missiles. And not least from a cost point of view, both financially and with the limited military resources at hand in a combat situation, there will be advantages to being

able to attack smaller targets with the artillery, saving the fighter jets and heavier missiles for bigger targets that lie further back from the enemy front lines. ■■

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# ANTI-SHIP MISSILE SYSTEM RBS15 GUNGNIR

This summer, Saab presented the RBS15 Gungnir next generation anti-ship missile system.

**R**BS15 Gungnir is offered in both air-launched and surface-launched configurations that offer greatly improved capabilities, compared to other missile systems on the market.

The aerial variant of Gungnir is designated as RBS 15 Mk4 Air. In the air-launched configuration, RBS 15 Mk4 air missiles can be propelled from the Saab Gripen multi-role fighter aircraft. The air system can also be integrated with other similar aircraft.

In the ship-launched configuration, the Mk4 missiles are launched from

the deck of a naval vessel. It is compatible with the ships of various sizes and shapes.

In the Swedish armed forces the missiles will be deployed on-board the Visby-class corvettes of the Royal Swedish Navy and JAS Gripen E multi-role fighters of the Swedish Air Force.

## Background

The next generation version of the RBS15 development and production programme was first contracted in March 2017 with the Swedish Defence Material Adminis-

tration (FMV). The contract amounted to SEK 3.2 billion with deliveries to take place during the period 2017-2026. Additional production of missiles was contracted with FMV in April 2017 for MSEK 500, with deliveries to begin in the mid-2020s.

The RBS15 missile family is jointly produced by Saab and Diehl Defence GmbH & Co. KG and serves with various navies, coastal batteries and air forces from Sweden, Finland, Germany, Poland, Croatia, Thailand and an undisclosed country.

## RBS15 Gungnir

The RBS15 Gungnir integrates with pre-existing RBS15 infrastructure. The system is backwards compatible, so an



investment in Mk3 today opens a smooth path to transition into Gungnir tomorrow. Gungnir can be seamlessly integrated into the existing infrastructure of forces such as trucks, aircraft and ships.

The airframe of the missile is made of composite materials and has mounts to enable its installation on aircraft. The composite structure offers defence penetration and protection against electronic threats.

The J-band active radar target seeker on-board the Gungnir is integrated with a highly accurate inertial navigation system (INS). The target seeker offers all-weather operational capability. It provides a greater degree of precision while discriminating targets and engaging them even in the most adverse conditions.

A new data link installed in the missile system enables the operators to retarget the missile during the flight. The missile is also equipped with an anti-jam global positioning system (GPS) and other advanced autonomous technologies that enhance its survivability.



RBS 15 Mk4 air missiles can be launched from the Saab Gripen multi-role fighter

Ill. Saab

The warhead placed in the middle of the missile weighs approximately 200kg.

The missile is powered by a turbojet engine, while the land and sea configurations of the RBS 15 Mk4 are also attached with two booster motors for a high amount of thrust in the initial boost phase. ■

## RBS 15 GUNGNIR

- ▲ **Missile Type:** Anti-ship missile
- ▲ **Speed:** 0.9 Mach
- ▲ **Weight In-Flight:** 650kg
- ▲ **Weight with boosters:** 810kg
- ▲ **Length:** 4.35m
- ▲ **Wingspan:** 1.40m
- ▲ **Range:** More than 300km

RBS 15 Gungnir is the next-generation missile in the RBS 15 family of all-weather anti-ship missile system. The range is more than 300km, which is greater than that of other missiles in the RBS 15 family.

The name Gungnir is from Scandinavian mythology and refers to the Norse god Odin's spear which never missed its target Ill. Saab



First flight with the new Norwegian police helicopter. The Norwegian Police has ordered a total of three AW 169 helicopters, at a cost of approximately 313 million NOK. The total contract value however is 670 million NOK, including maintenance, service and training for the next ten years. Photo: MilitærTeknikk

## FIRST FLIGHT FOR THE NEW NORWEGIAN POLICE HELICOPTER

In November this year, the first of a total of three AW-169-helicopters ordered by the Norwegian Police made its maiden flight at Leonardo's helicopter factory in Vergiate just north of Milan in Northern Italy.

For about 15 years, the Norwegian police have been operating two EC 135 T2+ mainly used for surveillance. Of the three new AW-169 helicopters, one is planned for surveillance, while two will mainly be used for emergency transport missions. In addition to one more helicopter than today, the AW-169 offers significant higher capacities than the EC 135. In comparison, the EC-135 has a maximum take-off weight of 2910 kg, while the AW 169 has a maximum take-off weight of 4800 kg. Maximum endurance of the AW169 is approximately 4 h 20 min, while the endurance of the EC-135 is a

bit more than 2 hours. For these reasons, the Police Force has declared the new helicopters to represent a revolution in the police standby alert readiness.

The first of the three AW169-helicopters is expected to come to Norway in late February next year, and the next two within the summer of 2019. The three helicopters will be stationed at the new Police training and emergency centre at Taraldrud, approximately 10 kms south of Oslo. The Taraldrud centre is expected to be finished within two years' time, and until then the helicopters will be based at Gardermoen Airport some 40 kms north of Oslo. ■■

### AW169

- ▶ **Length:** 14,65 m
- ▶ **Passengers:** crew of 2 plus up to 10 persons (depending on seating configuration)
- ▶ **Maximum take-off weight:** 4800 kg
- ▶ **Maximum/cruising speed:** 165/140 knots (306/260 kph, 190/152 mph)
- ▶ **Maximum endurance:** 4 h 20 min
- ▶ **Maximum range:** 426 nautical miles (790 kms, 490miles)



The Norwegian police are also purchasing a training simulator for in-house flight training. In the photo, the screens display the terrain surrounding Gardermoen Airport. Photo: MilitærTeknikk

■ ■ **militærTeknikk**®

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