Preliminary Assessment for Replacing the Capabilities of the Hornet Fleet
Final Report
To the Minister of Defence

Helsinki, 8 June 2015

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On behalf of the working group

Chair
Major General (ret) Lauri Puranen
# Table of contents

Summary ................................................................................................................................... 11

1. Introduction ........................................................................................................................... 12

2. Strategic planning principles ................................................................................................... 14
   2.1 The operating environment of defence ................................................................. 14
   2.2 Defence policy grounds ....................................................................................... 15
   2.3 Military-strategic grounds .................................................................................... 17

3. Development of air warfare and the operating environment .................................................... 18
   3.1 The character of air warfare and battle ............................................................. 18
   3.2 Air warfare technology ....................................................................................... 19
   3.3 Development and production of fighter aircraft ................................................ 28
   3.4 Situation in Finland’s neighbourhood .................................................................. 30

4. Replacing the Hornet fleet’s capabilities as an element of the overall defence system ............. 32
   4.1 The significance of air power to the defence system ........................................... 32
   4.2 The role of the Hornet fleet as an element of the defence system ....................... 33
   4.3 The need for a multi-role fighter as an element of the defence system in 2030 and beyond ...... 35
   4.4 The role of unmanned aerial vehicles and surface-to-air systems as elements of the defence system in 2030 and beyond ......................................................... 38
   4.5 The solution for replacing the capabilities of the Hornet fleet as an element of the overall defence system in 2030 and beyond .......................................................... 39

5. The possibilities of extending the Hornet fleet’s lifespan .......................................................... 42

6. The key findings from fact-finding trips and meetings ............................................................. 44

7. Cooperation with the Finnish industry, taking into consideration security of supply and EU law ......................................................................................................................................................... 46
   7.1 Industrial participation .......................................................................................... 46
   7.2 The logistics concept and industrial participation in replacing the Hornet fleet’s capabilities ......................................................................................................................... 46
   7.3 Treaty on the functioning of the European Union, and the application of Article 346 (1)(a) and Article 346 (1)(b) ......................................................................................... 47
   7.4 The possibilities of securing Finland’s military security of supply in the context of EU law ......................................................................................................................... 50

8. Organising the potential fighter procurement in the defence establishment ................................ 52
   8.1 A strategic capability project ................................................................................ 52
   8.2 Grounds for organising the strategic project ....................................................... 52
   8.3 The steering groups that manage the MoD’s programmes and procurements ............ 52
   8.4 Organising the replacement of the capabilities of the Hornet fleet in the defence establishment .... 53

9. Research needs associated with the project ........................................................................... 56

10. The procurement process and the schedule ......................................................................... 58

11. The recommendations of the working group ........................................................................ 60
The working group proposes that the capabilities of the Hornet fleet be replaced by a solution based on a multi-role fighter. The capabilities of the multi-role fighters will be supplemented with those of ground-based air defence. The need for and the possibilities of procuring unmanned aerial vehicles and other complementary capabilities must be analysed at a later date.

The project for replacing the capabilities (HX programme) must be launched in the autumn of 2015 at the very latest. Project-related decisions associated with Requests for Information and Requests for Quotation must be taken during the electoral term of 2015–2019. The decision to procure new multi-role fighters must be taken in the early 2020s. It is not possible to replace the capabilities of the Hornet fleet within the framework of current defence budget levels. Rather, separate financing must be earmarked for the project.

Replacing the capabilities of the Hornet fleet is a strategic project which is of crucial importance to Finland’s defence system. In order to properly guide the planning and implementation of the project an HX steering group, reporting to the Ministry of Defence as well as an HX programme coordination group which reports to the steering group and coordinates the planning and implementation of the project, must be set up. Other than this, the planning and implementation of the capability replacement project will be carried out in accordance with the Defence Forces’ standards.

On the basis of the preliminary assessment the working group proposes the following as regards the implementation of the project:

1. Adhere to the Hornet fleet’s original service life because, as per the preliminary assessment, there are no grounds for extending its service life.
2. Replace the Hornet’s capabilities with a solution based on a multi-role fighter.
3. Launch the HX programme no later than the autumn of 2015.
4. Set up an HX steering group, an HX programme coordination group and an HX programme secretariat, and establish their tasks, competence and composition.
6. Make use of the derogation of the EU Directive on public procurement processes pursuant to the Directive on Defence and Security Procurement are not suitable for this acquisition.
7. Draw up a defence industrial strategy and establish the project-related requirements for an independent capacity and security of supply.
8. Establish the need and possibilities for external auditing (quality assurance, QA).

Summary

The primary purpose of Finland’s defence capability is to establish deterrence against the use of military force as well as the threat thereof, and to repel attacks on Finland.

Finland’s geopolitical standing and the changes in its operating environment emphasise the importance of maintaining and developing the defence capability. The goal is to maintain a defence capability that meets the requirements of the operating environment and the tasks of the Defence Forces. Defence cooperation is increasingly important in maintaining and developing the defence capability.

A modern air power and air defence system is a key element in Finland’s defence capability. The Hornet fleet’s capabilities are a major component of the air defence and of the Defence Forces’ capability in engaging land- and sea-based targets. Furthermore, the Hornet fleet’s capabilities supplement the Defence Forces’ integrated intelligence, surveillance and command environment. Developments in the operating environment, the changing concepts of war and battle as well as the tasks of the Defence Forces, the Air Force and the air defence necessitate that the capabilities of the Hornet fighter fleet be replaced by the end of the next decade.

The planned service life of the Hornet fleet will end by 2025–2030. There are three major factors that limit the service life of the fleet: weakening comparative capabilities, structural fatigue and challenges in obtaining system support for the aircraft. Substantial additional costs would be incurred should the service life of the Hornet fleet be extended. Moreover, this would not provide additional options for replacing its capabilities. Extending the service life of the Hornet fleet is neither a cost-effective solution nor would it be sufficient in terms of Finland’s defence.

It is impossible to substitute ground-based air defence systems or the current, or future, unmanned aerial vehicles for the Hornet fleet’s capabilities. Both of the aforementioned systems encompass a part of the Hornet fleet’s capabilities. In order to maintain defensive deterrence the Hornet fleet’s capabilities must be replaced with a system based on a multi-role fighter starting from 2025. The project for replacing the capabilities (HX programme) must be launched in the autumn of 2015 at the very latest. Project-related decisions associated with Requests for Information and Requests for Quotation must be taken during the electoral term of 2015–2019. The decision to procure new multi-role fighters must be taken in the early 2020s. It is not possible to replace the capabilities of the Hornet fleet within the framework of current defence budget levels. Rather, separate financing must be earmarked for the project.

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1. Introduction

On 6 May 1992 the Government took the decision to procure F-18 Hornet fighters. The decision, taken amid security policy transformations in Europe and on the eve of an economic recession in Finland, had far-reaching effects on the future of Finland’s credible defence and on its international acknowledgment. For its part, the acquisition bolstered Finland’s standing in the western community and facilitated the internationalisation of security and trade policy relations with the United States and western European countries.

At present, the Hornet fleet forms the foundation of the air defence. During peacetime it carries out the most important tasks associated with territorial surveillance and the protection of territorial integrity. The capabilities of the Hornet fleet play a significant role in establishing deterrence against the use of pressure on Finland or, in the worst case scenario, Finland becoming the target of military force or an attack. In wartime the Hornet fleet has the key role in protecting society’s vital targets and functions, in supporting the other military services with air defence, and in repelling an attack by means of air-to-ground strikes.

The planned service life of the Hornet fleet will end between 2025 and 2030 as the aircraft reach the end of their 30 year service life. The factors that come into play then are structural integrity, unobtainability of spare parts, equipment and system support as the other countries in the Hornet user community decommission their fleets as well as the weakening comparative capabilities of the Hornets in view of the development in our security environment.

As the replacement of the fighter fleet’s capabilities takes approximately 15 years, the Ministry of Defence (MoD) saw it fit to commission a preliminary assessment so as to optimise the launching of the project. Therefore, on 8 October 2014, the Minister of Defence Carl Haglund set up a working group to start planning the project for replacing the Hornet fighter fleet’s capabilities as a part of maintaining a modern defence system. This report is a preliminary assessment drawn up to pave the way for future decision-making and formal arrangements. The working group was tasked to compile and prepare a basic analysis covering the following topics:

• The role of the successor of the Hornet fleet’s capabilities as an element of the overall defence system,
• Initial operational requirements and the matters to be included in the Requests for Information,
• The options for extending the service life of the Hornet fleet,
• Relevant research requirements outside the administration branch and possibilities for cooperation with Finnish industry,
• Organising the potential fighter procurement within the defence establishment and factors affecting the procurement schedule, and
• Other factors that arise and affect the potential launching of the project and decision-making, in accordance with case-by-case MoD guidelines.

The composition of the working group was:
• Lauri Pursunen, Ministry of Defence, Chair,
• Jari Takanen, Ministry of Defence, Vice Chair,
• Pasi Valimäki, Defence Command Finland, Secretary,
• Pertti Immonen, Defence Command Finland (until 12/2014),
• Jukka Rautalahti, Finnish Defence Forces Logistics Command (as of 12/2014),
• Samo Ekelinmäki, Finnish Air Force,
• Jouni Junttila, Finnish Air Force, and
• Sampo Eskelinen, Finnish Air Force,
• Jukka Rautalahti, Finnish Defence Forces Logistics Command (as of 12/2014),
• Pasi Valimäki, Defence Command Finland, Secretary.

In addition, the Chair invited Sami Nurmi, Ministry of Defence, to provide expert information to the working group.

The preliminary assessment was carried out as official business, led by the Ministry of Defence. The deadline for the report was 31 May 2015. The work was carried out by making available information prepared and adopted by the defence establishment for this assessment. The essence of the report is based on the results of the long-term planning of different organisations in the defence establishment, expert comments received during the working group’s fact-finding trips and meetings with aircraft manufacturers.

The report of the working group answers the questions set in its tasking. Furthermore, Chapter 3 extensively elaborates on the technical development of air warfare as it significantly affects the replacement of the Hornet fleet’s capabilities.

The working group held seven meetings, during all of which official minutes were taken. In addition, two separate workshops prepared the preliminary assessment. During its work the group talked to several experts and familiarised itself with the way Denmark, Norway and Canada have set up and implemented their respective fighter procurement projects, including the key lessons learned. Official memoranda were written of the fact-finding trips. Additionally, the working group organised a seminar in which the key persons of the previous fighter procurement presented the success stories in the Hornet programme, and its most important lessons.

The working group also arranged a four-day seminar in which Deloitte, a consulting firm that supported the fighter procurement programmes in Denmark and the Netherlands, presented the key phases, instruments, challenges and lessons learned in a fighter procurement project. Experts representing different sectors in the MoD and the Defence Forces participated in the seminar.

The working group also participated in fact-finding sessions organised by the defence establishment in which representatives of the industry and government of different countries presented their systems. Official memoranda were written of these meetings. The results of the analysis of the global fighter aircraft market, launched by the Finnish Air Force in 2013, were also made available to the working group.

The working group commissioned two research projects and one study: The models for organising the potential capability replacement project were charted under the guidance of the Chair of the working group.

The unanimous recommendations of the working group for further action to be taken are the key results of the preliminary assessment.
Maintaining Finland's defence capacity will demand sizeable capability-related projects in the 2020s. The goal is to achieve a defence capability suitably tailored to our operating envi-
ronment and the tasks of the Defence Forces.

As part of maintaining the offensive engagement capabilities of the air defence and the Defence Forces the most important capability-related project in the 2020s involves the replacement of the current version of the Hornet fighter aircraft in Finland's Hornet fleet, which is scheduled to be phased out by the end of the next decade.

Replacing the capabilities of the Hornet fighters signifi-
cantly affects Finland's security and defence policy relations and standing.

2.1 The operating environment of defence

Finland's defence is being developed in an operating environ-
ment in which the actors are increasingly interdependent and the resources available for defence finite. Military capabilities will be developed from the standpoints of Finland's military defence and political will be developed from the standpoints of Finland's military defence and political.

Military capabilities will be used in accordance with the operating environment of defence. The operating environment is increasingly fluid, unpre-
dictable and uncertain. Strategic surprises are a possibility, but the capabilities of the Defence Forces overall capacity and development are being made:

- The geographic importance of the Baltic States and the Baltic Sea region has risen and controlling the approaches to the Gulf of Finland has, yet again, become a key strategic factor. Military action against the new military force as well as the threat thereof, and to repel attacks on Finland. The main-
tenance of deterrence will remain the top priority of our de-
fence. This entails the capability of the Defence Forces to raise
defence readiness proactively and a genuine capability to meet its tasks.

Both the Government Security and Defence Policy Re-
port 2012 and the Final Report (‘Long Term Challenges of Defence’) of the Parliamentary Assessment Group state that while Finland faces no military threat at this moment, the situation may change. Change in the operating environment as well as Finland's geostrategic position, its being on the border of a military alliance and neighbouring a great pow-
er, must be taken into account as conclusions regarding the

The capabilities of air power will grow within the sphere of armed forces development. Air operations will include high readiness, flexibility and the capability to rapidly create a centre of gravity and to concentrate force. This capability is developed, including improvements in tactics, by participating in exercises. The new opportunities and the changes in training syllabi made available by the introduction of new aircraft will take effect in Russia’s Air Force in the early 2020s.

2.2 Defence policy grounds

Defence capability

The primary purpose of Finland’s defence capability is to es-
tablish the country as a deterrence power in the near future and as a

The transformation of the character of battle is influenced by,
among other things, the diminishing number of troops in
the battlefields, which underscores speed, firepower, reach and r

The focus of armed forces development lies on interoperability which encompasses comprehensive bat-
tlefield management that covers all domains of warfare

The operating environment significantly affects Finland’s security and defence policy relations and standing. Change in the operating environment affects the entire country; the Defence Forces will use its capabilities to protect the vital functions, targets and areas of society and the Defence Forces. Owing to the limited number of troops the ability to direct and concentrate key capabilities in the entire area of the country becomes highlighted.

The Air Force’s capabilities are invaluable in managing ‘renegade’ situations (e.g. a hijacked civilian aircraft), in monitoring restricted areas and flexibly utilising the available resources. The Air Force’s capabilities are invaluable in managing ‘renegade’ situations.

The development of capabilities needed in military crisis management is carried out as an integral part of developing the national defence. The key goal is to improve cost-effec-
tiveness by intensifying multinational cooperation and by enhancing the quality of capabilities. Pursuant to the deci-
sions taken by the state leadership the Finnish Air Force will participate in international military crisis management tasks and operations with the units and capabilities included in the national troop register for military crisis management. The Defence Forces’ material readiness will markedly de-
grade as early as the end of this decade. Without additional fi-
nancing it will become impossible to maintain the capabilities at the present level, or to improve them. Without sufficient investments in material the basic defence solutions – defend-
ing the entire area of the country, general conscription and military non-alignment – will have to be revaluated during
the 2015-2019 term of Government. At the very least, the ad-
dditional financing proposed in the Government Security and
Defence Policy Report 2012 will be needed to correct the mili-
tary-related shortcomings in capabilities. This was also the rec-
ommendation of the Parliamentary Assessment Group.

Nevertheless, the proposed additional appropriations do not
solve the quandary of financing the strategic capability pro-
jects of the 2020s, i.e. replacing the Hornet fleet's capabilities
and the capabilities of the Navy's ageing warships. It is not pos-
sible to cover the financing requirements of these capa-
bilities projects within the framework of current defence bud-
get levels. Rather, separate financing must be earmarked for
them. Procurement-related preparations and planning must be

Defence cooperation

Defence cooperation is a key part in the development, main-
tenance and utilisation of Finland's defence. Active defence
cooperation not only strengthens our defence capacity, it also
improves our deterrence, the ability to repel attacks, and it
safeguards the development of military capabilities. While
defence cooperation does not imply any military security
guarantees, it facilitates the provision of political, military and
other assistance in a situation where our own resources prove
inadequate. Defence cooperation also carries a strong security
and policy implication which strengthens Finland's security.

According to a guideline in the Government Security and
Defence Policy Report 2012, cooperation is carried out under
the auspices of the EU and NATO partnership, in re-
gional and bilateral. The EU and NATO play a sup-

Supplementary to this, there is an ongoing series of procurements to capabilities – i.e. to a bigger picture which encompasses instruments and their users, proficiency, perfor-
mance and effectiveness.

2.3 Military-strategic grounds

In addition to the guidelines provided by the state leader-
ship, proportioning the defence capacity builds on analyses of
the operating environment, the Defence Forces' statutory
tasks (Act on the Defence Forces) and available resources. An
appropriately suited defence capability establishes sufficient
deterrence and safeguards Finland's territorial integrity and
the ability to defend the entire area of the country. This de-
mands the ability to create the centre of gravity for defence
with high-readiness, deep-strike-capable and rapidly reoutine
Air Force in terms of operation. The perspec-
itive must be widened from materiel-related matters and joint
procurements to capabilities – i.e. to a bigger picture which
encompasses instruments and their users, proficiency, perfor-
mance and effectiveness.

The Hornet fleet's capabilities have been systematically
improved through mid-life upgrades, and its relative performance will
impact the adversary deep in his territory, as well as participate
in ground and maritime defence.

The F/A-18 is interoperable with its western partners. In
emergency conditions it must have the capability to receive
and provide external assistance. The capability which derives from
the Air Force's aircraft and equipment, expertise and op-

erating principles, is high at present, and is sufficient in rela-
tion to our surroundings.

The security of supply and cost-effectiveness of the air pow-
er and the air defence system is strengthened through defence
cooperation which, for its part, also guarantees the usability of the
system in times of crisis.

The performance of the Air Force will rapidly degrade
when the decommissioning of the Hornet multi-role fighter
fleet starts in 2025. Phasing out the aircraft becomes a reality
when they are about to reach their structural flight hour limits
between 2025 and 2030. Simultaneously, the missile arsenal of
the fleet is also able to carry out strike missions, which can im-

The security of supply, national prepared-
ness and the preservation of critical knowhow is important.
Yet, it is equally important to safeguard the functioning of the
Defence Forces' international supply channels and access to mater-
ial. Finland is dependent on multinational cooperation in
deploying and maintaining its military capabilities, and in
military security of supply. It is necessary to cooperate in
order to secure these capabilities. The goals of cooperation in
different groupings and structures are multiply augmenting and
complementary.

Defence cooperation can also help find support and up-
grades for the Defence Forces' capabilities and simultaneously
strengthen Finland's security policy position. The perspec-
tive must be widened from materiel-related matters and joint
procurements to capabilities – i.e. to a bigger picture which
encompasses instruments and their users, proficiency, perfor-
mance and effectiveness.

The manner in which the strategic capability project is

carried out will significantly impact Finland's security and
defence policy standing, and widely affect Finland's bilateral
defence relations. An example of such a project is Finland's
Hornet fighter programme which, in practice, resulted in the
United States having become Finland's most important bilateral
partner in defence-related questions. In the wake of the
Hornet procurement, in addition to the Air Force the effects
of bilateral cooperation have extended to the other military
services and functions as well. In addition to the extensive for-
eign and security policy consequences the Hornet acquisition
is also estimated to have generated positive trade policy mo-
ment for Finland. Being a militarily non-aligned country, it is
particularly important for Finland to carefully select its
partners in capability-related projects.

Material capability

The Defence Forces' material capability will be safeguarded
right from the beginning of the capability project's planning
and development phases by procuring suitably task-oriented
and internationally interoperable defence materiel and by
guaranteeing its life-cycle management. It is imperative that the
materiel be usable for each main task of the Defence
Forces. Off-the-shelf and proven products are the mainstay of
material procurement projects. Already since the end of the
1990s procurements have coherently aimed at achieving inter-
national interoperability as per NATO standards.

International defence material cooperation is a precondi-
tion for cost-effective acquisitions, international compatibil-
ity, the capability to receive foreign assistance, securing the
military security of supply and the Defence Forces' ability to
participate in international crisis management operations.

Large procurement projects facilitate the deepening of part-
nerships.

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3. Development of air warfare and the operating environment

3.1 The character of air warfare and battle

The offensive phase conducted by the coalition in the Persian Gulf War in 1991 is considered an example of a modern air campaign in which the new elements of success included the mass use of conventional cruise missiles, the suppression of enemy air defences by radar-homing and missile systems, and by electronically attacking the enemy air defences in parallel, paralysing heavily defended targets as well as using 24/7 real-time battlespace surveillance and target acquisition.

Air operations can be conducted in various environments (ground and sea) surveillance as well as monitoring of the adversary's C2 systems and networks has been augmented by situational awareness infrastructures provided by unmanned aerial vehicles (UAV) and satellites. The usability of intelligence and surveillance information has been markedly improved through the introduction of standardised joint information systems and data transfer services. This facilitates an effective and mutually complementary use of the different military services' systems, creating the preconditions for an increasingly intensive operations tempo. Normally the first phase of warfare aims at achieving control of the air to guarantee freedom of action, alongside which the aim is to destroy or paralyse key targets on land and at sea launched. Strategic bombers, strike aircraft and multi-role fighters can engage targets from a very long distance with cruise missiles and long-range PGMs in all weather, day and night conditions. These aircraft can employ both conventional and nuclear weapons. Weight of effort in the campaign can easily be readjusted through the use of multi-role fighters and air-to-air refueling.

The air defence must prepare for the aggressor's ruthless pre-emptive attacks on the adversary's offensive forces and intelligence picture capability as well as launching operations deep into the adversary's territory by active counter-air defence in areas important to one's air operation could be launched; denying the use or airspace of its airspace, protecting society's vital functions from air attacks, wearing down the airborne aggressor and repulsing all air attacks.

The biggest risk against these kinds of air missions comes from the target area's air defences, in practice, they cannot be repelled with an effective air defence in high readiness.

In an internationally tense situation the effects of the adversary's electronic attacks, anti-aircraft systems, interception and long-range weapons set limits on the use of one's own aircraft. In such cases, the airspace which is permissive for air operations can shrink considerably, with one only being able to operate in uncontested areas where the adversary cannot freely employ his weapon systems.

Operations deep into the adversary's territory are often necessary to engage his key targets and to achieve a successful result in the war effort. Targets are in areas which the adversary tries to hold by maintaining a continuous air defence that he cannot freely employ his weapon systems.

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Even though airborne platforms are expensive, through the introduction of PGMs they have become a cost-effective option at every level of warfare. As a result of the adversary's air defence, the precise locations of which need to be pinpointed in nearly real-time. In order to be able to generate this kind of target data one must, in practice, be able to monitor the area where the air force or from space.

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Fighter development

As the original purpose of a fighter was to destroy airborne targets, fighters were normally relatively small, single-seat fast jets furnished with 1-2 engines. Even though the fighters’ multi-role capabilities are continually advancing, due to physical constraints they cannot replace transport, ISTAR and C2 aircraft, or strategic bombers in other tasks assigned to air forces.

Whereas aerodynamic characteristics and powerplant technology define the fighter’s performance as an aircraft, its warfighting capability is defined on its sensor, technology, weapons, self-protection and communication systems as well as the situational awareness and decision-making systems intended to augment them. In a practical sense, multi-role fighters whose sound basic solutions have made it possible for the industry and different countries’ air forces to use and improve them for several decades.

Achieving a shooting position in air combat, in a strike against surface targets and survival in a battle situation are the primary factors driving the development of fighters, their systems and principles of use. The speed and the altitude an aircraft can reach still matter greatly when it comes to the range of its weapon system and to the possibility of defensive fire being used against it. Stealth characteristics and EW performance, correspondingly, define the observability of an aircraft, and its vulnerability to the adversary’s defensive fire within the range of its sensor and weapon systems.

Observability and stealth technology

The observability of a fighter, or any military aircraft for that matter, in a threat environment is based on vulnerability management. In the first phase the goal is to degrade the adversary’s possibilities of detecting by defeating or suppressing his air defences. In the second phase, when the characteristics of a fighter come into play, one must avoid detection, direct contact with the enemy, and becoming the target of defensive fire; evading the threat is the last option. Observability plays a central part in each of the survivability chains.

An aircraft is not invisible. The adversary, such as the pilot of another aircraft or a GRAD system operator, will inevitably react to a threat in a combat situation irrespective of the source of the observation. In beyond-visual-range (BVR) operations the estimates about the target and its actions are based on information generated by on-board sensors or other systems supporting the aircraft. Visual contact may be of great importance since the existence of a target, and the target itself, can only be positively confirmed visually. Within-visual-range (WVR) air combat and the use of supporting systems, such as helmet mounted cueing systems and close range air-to-air (A-A) missiles as well as short-range man-portable air-defence systems (MANPADS), essentially rely on the pilot’s or the shooter’s ability to continuously follow the target. Image creation technology is increasingly important in recognising air and surface targets and in solving questions associated with improving the detection range. Simultaneously, as visual detection and visual range need to be redefined as concepts due to improving sensor technology, the development of low-observability technology becomes highly important.

The primary objective in reducing aircraft observability is the prevention of becoming the target of defensive fire. Physical size, emissions and sound generated by the aircraft as well as the amount of reflected energy to an external sensor are the factors that affect an aircraft’s observability and detectability from the background. Stealth technology refers to the solutions in the design and structures of an aircraft intended to reduce its observability. Even though it is impossible to design entirely invisible aircraft, stealth technology can help delay the moment of detection or evasion to the target area or in close air combat with another fighter, shorten the time when the aircraft becomes exposed to fire, and create the preconditions for the first use of weapons.

Observability and stealth technology have been researched for decades. Most aircraft manufacturers have taken stealth factors into consideration in new aircraft design and implemented appropriate solutions in older fighters’ modernisation programmes, as applicable. It is safe to assume that several 4+ generation fighters incorporate the results of stealth research and that appropriate low-observable technology and design solutions have been retrofitted into them. The term stealth aircraft is normally only used in conjunction with such aircraft which were specifically designed and built as low-observable aircraft. Such aircraft include, among others, the US F-117, F-22 and B-2.

Solutions geared at improving air combat performance, such as increased payload, range, sensor range, and having several engines, increase the physical size and emission level of an aircraft. Since air combat performance and observability, in practice, require conflicting design solutions, modern fighters incorporate several compromises which, depending on the manufacturer, have resulted in clearly dissimilar design concepts as regards electronic attack (EA) systems and stealth technology, among other things.

A target’s detectability on radar depends on the radar system in use. The radar cross section (RCS) is a measure of how detectable an object is with radar. For example, the RCS of a legacy fighter can be estimated at 3-20 m², that of a bomber or a transport aircraft 20-100 m² and the RCS of a cruise missile less than 1 m², depending on the physical size of the target, radar frequency or the incident angle (orientation of the target to the radar source). According to some estimates stealth technology can reduce the RCS by a factor of 10-1000. As the change in RCS is not directly proportional to the change in the detection range, it is possible at best to reduce the detection range of an aircraft to less than a tenth from normal through stealth design and technology. A reduction of such magnitude makes it significantly more difficult for the adversary to employ his radar homing weapons, i.e. prevent a shooting solution. Even if the effect of stealth technology solutions used in fighters can be diminished by integrating the air defence system and by new, longer wavelength radar systems, the advantage achieved through stealth technology will not entirely disappear. Fire control radars used in weapon systems will continue to operate well into the future in the spectrum for which stealth fighters’ low-observable technology was designed. Although the capability for stealth fighter detection will improve, vulnerability to ground and air-launched radar homing missiles will not significantly increase.

It is impossible to eliminate the thermal footprint of an aircraft or its weapons. In addition to the engine plume, the friction caused by high airspeed generates an apparent temperature difference, clearly detectable from the background. Even though infrared (IR) technology incorporates certain weather-related constraints, IR systems are the most promising sensors suited to replace and complement radar systems, and to detect stealth targets and small targets such as cruise missiles.

Aerodynamics and powerplant

Improving the aircraft’s manoeuvrability, speed and range are the most important goals in fighter development. Absolute speed and a speed advantage over the adversary determine the fighter’s ability to implement its counter-air mission, engage the adversary in combat and break off from the fight. The flexible operational use of multi-role fighters depends on their range and endurance as well as survivability in the operating environment. While high airspeed is an indisputably important factor in aircraft survivability, it is challenging to
maintain from the perspective of fuel efficiency. Engine tech-
ology has improved alongside with fuel efficiency. The most
modern fighters can now maintain ‘super cruise’, which stands
for supersonic flight without the use of afterburners. These
fighters achieve approximately Mach 1.2–1.7 which, coupled
with stealth technology, remarkably decreases the fighter’s
vulnerability to anti-aircraft fire and improves its chances of
evading the adversary’s fighters. However, even this capability
comes with adverse side effects. Even though supersonic flight
can be achieved without using the afterburner, which consid-
erably raises the engine’s thermal footprint, the high airspeed
nonetheless raises the fighter’s detectability in the IR range.
Still, a super cruise capability does improve the fighter’s ability
to evade a threat or to attack the next target.

Aircraft weapons

The factors that limit the utilisation of the full capabilities of
a multi-role fighter include its maximum payload and the
strictly specialised weapons targeted against certain types of
air, land, or sea. The development of aircraft weapons has been
vigorous during the past two decades. Owing to weapon system
integration and data-link technology development a fighter can fire missiles and drop bombs in all directions without having to change its heading. Most munitions are ‘fire-and-forget’ weapons, which means that they independently home in on the target after having been released. Then the aircraft can break off from the fight without delay in order to evade a threat or to attack the next target.

Air-to-air missiles can destroy both manned and unmanned aircraft and cruise missiles. Modern IR and radar missiles can defeat airborne targets from the distance of tens of kilometres. The average turning ability, speed and range of A-A missiles can be drastically improved, among other things, by replacing the solid propellant rocket motor with a ramjet engine. As a result, it is estimated that their range will be more than double the one of present missiles. Missile agility has considerably improved through the introduction of guidance systems that utilise thrust vector control. When thrust vectoring is incorporated in long-range missiles it reduces the need to arm the fighter with several A-A missiles of different type.

Missile and bomb sensor technology development increas-
es their multi-role usability. It is likely that the weapons used against sea- and land-based targets and those used in the sup-
pression of enemy air defences (SEAAD) can, at least partly, be phased out over the next 10–15 years. Precision-guided bombs will retain their status as effective and inexpensive basic weapons against hard and soft air targets as well as against hardened bunkers and underground targets. Their accuracy in different weather and lighting con-
ditions can be improved by utilising systems that combine sat-
eellite and inertial positioning as well as pattern/shape recogni-
tion and laser homing. Laser-guided bombs can also be used
against moving targets.

Glide bombs are bombs that incorporate flight control sur-
faces for added distance. Their range is approximately 20–100
km, which is considered to be sufficient to engage targets at
distances far-enough away to evade the target area’s anti-air-
craft systems (stand-off), thereby allowing air-to-ground mis-
siles to be replaced with glide bombs. It is necessary to keep
improving the weapons’ multi-role capability and reduce the
assortment of different role-specific weapons; this is particu-
larly important from the perspective of stealth aircraft multi-
role capabilities and the optimum utilisation of their internal payload.

Even as glide bombs are increasingly becoming ubiquitous, alongside their multi-role short-range such as the MBDA Brimstone 2 and the Lockheed Martin Joint Air-to-
Ground Missile (JAGM) are being developed. Short-range missiles are eminently suitable for destroying single, station-
imobile and land-, and sea-based targets from up to 10–20
km. Because they are so small, one wing pylons can fire several of them. Short-range missiles can also be used in UAVs.

Cruise missiles are unmanned missiles furnished with jet
engines, flying most of their pre-planned route at a constant
airspeed. They are used against the adversary’s well defended and critical targets which are hard to reach by other means and are often located deep inside the adversary’s territory. Anti-ship missiles are cruise missile type weapons designed to defeat surface targets. The central objectives in long-range missile development are improvements in their multi-role us-
ability and improvements in air defence missile performance. Technology solutions that aid penetrability through air de-
fences are, among other things, stealth technology and the use
of ramjets. Examples of these include the JASSM missile, soon
to be introduced in the Finnish Air Force, and the Brahmos
missile which can reach Mach 3, a weapon of Russian-Indian
design.

Sensors

The active electronically scanned array (AESA) has become
the principal sensor of the multi-role fighter. This kind of
multi-role radar can be used in all weather and lighting condi-
tions to search for and track air-, land- and sea-based targets
at a distance of tens, even hundreds, of kilometres. As radar
performance, such as resolution and other characteristics, im-
proves, they can be used in ISTAR and EW. Because radars work by broadcasting an active signal, the signal can be de-
tected at a long distance and, hence, the radar easily becomes
a target of EW. Radar properties and methods which make
the signal more difficult to detect (low probability of inter-
cept) are continuously being developed so as to minimise
the fighter’s vulnerability.

Generators generating a picture in the visible, infrared (IR) and
ultraviolet (UV) range of the electromagnetic spectrum are
passive by design and so they do not reveal themselves to the
target. Imaging systems are used to detect, track and recogni-
tise land- and sea-based targets. Sensors are also suitable
for missile launch detection and tracking as well as navigation in
a multi-role aircraft. These sensors are designed to maintain
Sensor fusion, system integration and datalinks

W eapons system integration occurs at several levels. The in-
tegration of information generated by different sensors aims
to compiling, maintaining and clarifying the situation picture
required by decision-making, improving the quality of infor-
mation needed in curing the weapon system and preventing the
jamming or suppressing effect of the adversary's counter-
measures. In addition to individual fighters or systems, sen-
sor fusion can also be implemented among several dissimilar
systems. In this mission, the information generated by a single fighter
craft, other aircraft or actor to the other members in the
network improves the preconditions of the entire system and facil-
ates their further cooperation. Examples of highly integrated
systems include the US Navy's Cooperative Engagement Ca-
pability, which fuses data from the battle forces air defence
sensors and enables its non-platform specific use as well as
aircraft weapons' datalink guidance, which makes it possible
for some other member in the network to change the target or
the aim point of a weapon already in flight.

Unmanned aerial vehicles

The development of unmanned aerial vehicles (UAV) is in-
tensifying as technology becomes cheaper. UAVs can be
used in a flexible manner in different tasks such as intelligence,
surveillance, target acquisition, and recognition missions, in
strikes against surface targets, over-the-horizon relaying of
information, electronic warfare, combat search and rescue
(CSAR), chemical, biological, radiological and nuclear war-
fare (CBRN), logistical replenishments and counter improvised
explosive devices (C-IED) in a favourable environment or in
areas where the risk level is elevated. Thus far the UAVs have
played a supplemental role, rather than having completely
replaced any given system. This is because they can only be
used in a heavily air defended area after air supremacy has
been achieved.

UAVs are extremely suitable for long missions that strain
flight crews or put them in harm's way. Two advantages can be
gained by eliminating the flight crew: 1) performance im-
provement (CBRN), logistic replenishments and counter improvised
replacement of the flight crew or put them in harm's way. Two advantages can be
obtained by eliminating the flight crew: 1) performance im-
provements (range, endurance, increased payload and manoeu-
vrability), smaller physical size and lower observability) and;
2) the ability to take higher risks. A UAV is a complete system and
the critical factors of its operability differ from those of
manned aircraft. Even if the flight crew were removed from the
device itself, it would not make the system an unmanned
where human controllers separately approve each step, such
as a new waypoint. Increased safety and reliability and a lower
probability of human error, lighter workloads, improved
response times and performance as well as the capability
to continue operating in conditions where no radio com-
munications exist are considered to be the benefits of fully
automated UAV operations. Improved operational effective-
ness and cost savings accrued through UAV systems also
arise from the capability to reallocate the human resources
free up by the lighter workload. Even though, in theory,
an unmanned system does not eliminate the need for training,
or reduce the human effort to operate the system.

Operating a UAV always requires personnel. The fact that
the aircraft is unmanned, however, does not eliminate the need
for training, or reduce the human effort to operate the system.
The personnel must by competent in their field and maintain all
required qualifications. The air vehicle operator (AVO) and
the mission payload operator (MPO) as well as maintenance
personnel, the mission commander and the intelligence ana-
lyst get just as tired as the personnel operating manned air-
craft. The type and the purpose of the UAV system dictate the
size and composition of the crew. According to the experi-
ences of countries that use these systems in high volume, so
far no significant savings have been accrued from using the
systems suitable for the hardest combat missions.

Operating a UAV system requires a dedicated C2 system,
which may vary between dissimilar solutions. Operating the
vehicle and its systems can be done in a centralised fashion
from a single control center, or it can be done in a
dispersed manner between several mobile or fixed stations.
The simplest tasks can be automated and assigned to
one AVO. Then, for example, one AVO can fly several aircraft
while each vehicle's own MPO is responsible for using its
systems as per the requirements of the mission.

Controlling UAVs requires communications which can be
maintained through radio communications within line-of-
site ranges, or through satellite communications when
operations occur beyond the horizon. The communications
must remain continuous in order to facilitate the actual op-
eration and flying of the aircraft. It is possible to extend the
range of UAV operations from the ground control station by
rotating control responsibilities between stations. A draw-
back of radio or satellite communications-enabled flying
and operating is the possibility of becoming exposed to EW
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Many functions of a UAV can be automated to lighten the
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Ground-based air defence and missile defence

For many countries air defence is one of the paramount tasks of their armed forces. Two guiding principles can be set for organising ground-based air defences (GBAD): minimise the damage to the target being protected or maximise the damage to the aggressor. These goals are interdependent – the more enemy aircraft are shot down before they reach their targets, the more viable the targets being protected.

Weaknesses of anti-aircraft systems include the lack of operational mobility, the limited reach of ground-based weapons, the limited ability of the system to engage targets in all conditions, both at altitude and far away, and the lag time between the detection of targets and the engagement. Anti-aircraft systems suffer from the reactive nature of GBAD. Compared with fighter defence, anti-aircraft systems can only cover very limited areas. Then again, fighter defence is not an option in all situations.

Anti-aircraft systems can remain in high readiness for extended periods, respond rapidly and effectively to an air attack, and be suitable for engaging all kinds of airborne threats, which is why anti-aircraft systems are used to defend high-value assets that require permanent protection. The requirements for GBAD development arise from the airborne threat and the role of GBAD as an element of the integrated air defence. The goal of GBAD is to protect critical civilian and military assets, and to guarantee the armed forces’ freedom of action by incurring losses to the adversary’s air power.

The effectiveness of air defence stems from the performance of its systems, the depth of defence and the number of systems available for defence, i.e. defence density. The development of aircraft sensors and weapons as well as that of long-range weapons guides the development requirements of anti-aircraft systems and their operating principles.

Ballistic missiles, cruise missiles and stand-off weapons such as glide bombs as well as stealth targets are difficult to shoot down because of their low observability, trajectory or speed. Modern smart weapons make it possible for aircraft to engage targets in all conditions, both at altitude and far away from the target. Aircraft operating at low and medium altitudes, and helicopter gunships will continue to retain their strength and a more commonplace element of the air threat. Surface-to-air weapons are capable of engaging targets at very great distances, although these systems can defeat aircraft at very great distances, their self-protection coverage for radar gaps requires medium- and short-range anti-aircraft systems.

The permanent protection of high-value assets demands that GBAD be able to protect targets against manned and unmanned aircraft as well as different projectiles such as missiles and bombs. By integrating solutions based on dissimilar technologies in the same geographical area, such as surface-to-air missiles, anti-aircraft guns (AAA) of different range and sensors, it is possible to create a mutually augmenting multi-layered, jamming-resistant and robust whole capable of comprehensively responding to a variety of threats. This can be achieved through positioning different types of GBAD units in the same area and by employing hybrid anti-aircraft systems.

Due to the nature of the Army’s battles and the threat the units face, they must have available a sufficient number of highly ter-
vain-capable anti-aircraft systems, such as the RBS-70, Stinger, Grom-, Igla-S, Cristal- and Tunguska-systems. Typically, medi-
ium-range missile defence and hybrid GBAD systems, such as the NASAMS, Spyder, Tore M2 and Pustnis, are the majority of the

Army’s surface-to-air systems. These are supplemented by short-
rangle missile systems to cover radar gaps.

The relative importance of anti-aircraft artillery has declined in conjunction with the development of aircraft and the prop-
etries of their weapon systems. However, anti-aircraft artillery continues to be suitable for protecting against helicopters, UAVs and various types of projectiles. In practice, this means that AAA must maintain their capability to detect, track and destroy very small targets.

Crisis management operations have an accentuated need to protect critical targets, be it the capability to detect, track, engage and destroy targets in all conditions, both at altitude and far away, and low observability, trajectory or speed. Modern smart weapons make it possible for aircraft to engage targets in all conditions, both at altitude and far away from the target. Surface-to-air weapons are capable of engaging targets at very great distances, although these systems can defeat aircraft at very great distances, their self-protection coverage for radar gaps requires medium- and short-range anti-aircraft systems.

The reception of sufficient early warning is a challenge to missile defence. Even though most missile defence systems can also protect against air targets, the situation might require that the units be only limited to carrying out one main task at a time.

The high price tag is what limits the proliferation of ballistic missile defence systems. In addition, protecting against medi-
ium- and long-range missiles requires exceptionally widespread deployment in an area that can traverse the national borders of countries. The total price of even a short-range missile defence capability will typically run into several billions of Euros. And, although these systems can defeat aircraft at very great distances, their self-protection coverage for radar gaps requires medium- and short-range anti-aircraft systems.

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ium- and long-range missiles requires exceptionally widespread deployment in an area that can traverse the national borders of countries. The total price of even a short-range missile defence capability will typically run into several billions of Euros. And, although these systems can defeat aircraft at very great distances, their self-protection coverage for radar gaps requires medium- and short-range anti-aircraft systems.

3.3 Development and production of fighter aircraft

Multi-role capability is a clearly identifiable trend in fighter design. All countries that manufacture fighters start from the position that individual countries, even individual mili-
tary services, aspire to replace their different, single-role leg-
afighters with one multi-role fighter type which can meet the requirements of several kinds of missions. Owing to dif-
ter types of mission profiles there are still dissimilarities in the versions of 4th generation fighters that were de-
signed in the 1970s and 1980s. The most modern versions of the 4.5 + generation fighters represent genuine multi-role capability and, depending on mission configuration, they are able to carry out a variety of missions ranging from air combat to strike, intelligence and surveillance. For the most part the key performance factors of the multi-role capability stem from the more sophisticated weapon system and sensor technology in 5th generation fighters, and the technical so-
utions used in analyzing their data as well as sensor fusion.

Only a handful of countries have been able to maintain en-
during, continuous fighter development and production. The strong position of Russia and the United States is the result of their ambition to safeguard a great power-status. Because of national interests, during the Cold War and in its aftermath France, the United Kingdom, China and Sweden created and continued an independent fighter design capability. Since, in practice, fighter development continues to be run by govern-
ments as part of their defence system development, serving their national interests, it is extremely challenging to compare

his weapons and minimise the saturation of the defence capa-
bility. It is also possible to limit the options for the adversary’s air power and ballistic missiles through counter-air operations and a strike capability. GBAD is of the greatest benefit when it is integrated into the air defence c2 system. It must also be able to independently compile a situation picture and manage fire con-
trol so as to provide early warning and target designation to the firing units. Surveillance systems must be able to detect and track low-observable targets at different altitudes, and relay the track-
ing information to the command and control system. Air defence integration creates the premise of air defence, GBAD command and control, the generation and dissemination of a situation picture and coordinated offensive engagement, and for the flexible use of weapon systems in national and international operating environments alike.
different mutually supplementing types and their development versions, or to consistently categorise them in the appropriate generations. The level of system technology and the software-oriented capability development only increase the challenges. Worldwide, there are over 50,000 military aircraft in use, approximately 12,000 of which are combat aircraft. The United States is the undisputed forerunner in fighter design and production; it has approximately 2,800 fighters in operational service – twice the number of Russia and China. Most of the fighters flying in the world are manufactured by the American aviation industry. At present, the United States produces F-15 and F-16 fighters for export as well as F-22 and the F-15E will be the main fighter types in the US armed forces.

The USA’s fighter power comprises of the fighters operated by the Air Force (USAF), the Navy (USN) and the Marines (USMCM). According to estimates, by 2030 the USAF will operate more than 1,000 F-35 fighters in addition to the already procured F-22 and 200 F-15E fighters. The USMC will shift to a completely new fighter type by procuring 353 F-35B and 67 F-35C fighters. According to plans, the 368 F-18E/F, 138 EA-18G and 260 F-35C fighters will be the fighter inventory of the USN. Unmanned aerial vehicles play a similar role in the US Naval Air Force as they do in the USAF; the striking power of a carrier wing comprises of approximately 4-6 UAVs, 44 fighters and 5 airborne electronic attack (AFAE) aircraft. For the next 20 years the USAF will rely on its existing bomber fleet and 5th generation fighters. Any US decisions on a new deep penetration long-range bomber, 6th generation fighter and the role of UAVs will have no doubt have long-term effects on the other aircraft manufacturing countries’ future selections.

The United States continues to develop UAVs. So far UAVs have for the most part been used and developed for long-term ISTAR and strike missions against individual soft targets where the risk of losing the aircraft is low. The media repeatedly publishes speculations about replacing combat aircraft with UAVs, but judging by recent decisions made by the USAF, the proliferation of deep penetration UAVs will not happen anytime soon, nor is the introduction of air combat capable UAVs to be expected.

In all, the EU countries’ air forces have approximately 2,000 combat aircraft, 60% of which were manufactured in Europe, 30% in the USA and 10% in the Soviet Union. European manned combat aircraft manufacturing encompasses the Swedish Saab Gripen, the multinational Eurofighter Typhoon and the French Dassault Rafale as well as the US Lockheed Martin F-35 fighter production which is underway in Italy. As the oldest F-16, Eurofighter and Gripen C/D fighters are being phased out at the turn of the 2000s, barring new procurements, the remaining European air forces’ fighter inventory will consist of the newer Eurofighter, Rafale, F-35, F-16 and Gripen NG (Gripen E in Sweden) aircraft.

The European NATO Member States are also developing their air forces in a very independent manner. Neither the integration of the European aviation industry nor a multinational collaborative effort in fighter production is anywhere in sight. There are different estimates as regards the continued production of the abovementioned fighter types. However, each aircraft type’s production estimates hinge on finding new foreign customers as the old orders to the main customers will be completed in the coming years. The role of the Swedish industry has clearly changed during the recent decades; while the Gripen is designed and assembled in Sweden, many of its systems are outsourced.

Even though the European and modernised Russian fighter types still in use can be regarded as 4th generation fighters due to several development versions some of their features are wholly comparable with those of 5th generation fighters. The US F-22 Raptor and the F-35 Lightning II as well as the Russian Sukhoi T-50 (PAK-FA, Perspektivniy Aviatsionniy Komplek Frontovoi Aviaii, the future system of Russia’s Frontal Aviation) and the Chinese Chengdu J-20 and Shenyang J-31 are considered to be 5th generation fighters. Of these, only the F-22 is in operational service. In addition to the aforementioned types, the Russian MiG Corporation has launched a project for producing a light fighter version by 2025. Nonetheless, any closer evaluation of the fighters in production proves that it is impossible to form any explicit categorisation in practice.

The global fighter market will be reshuffled since the restrictions concerning the sale of the F-35 fighter may impact its proliferation. In spite of this, the F-35 will likely replace the lion’s share of the aging US-made fighter aircraft in Europe and the Far East. No new European fighter programme is underway and, therefore, according to present estimates there will be no European stealth fighter on the horizon before the 2040s. The European 4+ generation fighters still participate in some European, Middle Eastern and Far Eastern competitive tendering processes. Russian manufacturers are also in the same markets to an extent.

China is also looking to participate in the international market. However, the national fighter programmes of Japan, Turkey and South Korea are still in process, and so their export prospects are uncertain. Questions associated with integration and access to armaments and weapon systems impede the sales of these aircraft types. Only China has national production in place and, relying on it, China can probably deliver an entire weapon system and the required support system.

European countries have made wide-ranging assessments on the capabilities and development requirements of European air power. According to reports commissioned by the European Defence Agency (EDA) Europe, as a whole, has significant shortcomings in capabilities associated with intelligence, surveillance and recognition (ISR), air-to-air refuelling (AAR), air/air, EW, SEAD and long-range strikes. The large variety of aircraft types, for its part, has encumbered collaborative system design. The European aviation industry has been slow in launching projects intended to offer alternative choices to American weapon systems. While the fact that several European countries participate in the F-35 programme creates the preconditions for a more widespread use of European weapons as armaments for this aircraft type, thus far no coherent European approach has been identifiable.

Figure: The estimated numbers of different generation fighters up until 2040.
The air forces of Finland’s neighbouring countries are present-­‐-­‐ly implementing significant aircraft replacement programmes. Sweden will procure 60 Gripen E fighters, a planned additional-­‐ acrual program may increase the number by ten more fight-­‐ ers. While Norway will replace its F-­16s with 52 F-­35 fighters, Denmark’s fighter programme is still incomplete. Russia has undertaken a massive modernisation programme of its air-­‐ force and air defence equipment.

The Baltic States have no ongoing fighter programmes; their air defence is largely based on NATO’s air policing mission and the provision of assistance as per Article 5. The bases used in the Baltic Air Policing operation are Siauliai in Lithuania and Amari in Estonia.

The presence and activity of NATO countries’ air forces has grown in response to the events in Ukraine. So far no an-­‐ nouncements regarding permanent US reinforcements in Europe or ex-­‐ panding NATO’s action in the Bal-­tic States have been made.

In its report (Luftförsvarsutredingen 2040) the parliamen-­‐ tary Air Defence Committee, set up by the government of Sweden, analysed long term development requirements of Sweden’s air de-­­fences. The main points and con-­‐ clusions of the report reflect the need to re-establish the national defence capability. Furthermore, when it comes to surveillance and situational awareness, anti-aircraft systems, base vulnerability, cyber defence, weapon procure-­‐ment, C2 systems, modern aircraft and operational perfor-­­mance as well as missile defence the conclusions are very similar to the ones made in Finland. For its part, Finland has already resolved some key questions through projects associated with command and control, surveillance and anti-aircraft systems, and with the strike capability project achieved through the Hornet’s mid-life upgrades. It is still too early to evaluate the consequences of the Swedish Air Defence Committee’s report with regard to the development plans of the Swedish Air Force. However, in conjunction with the Gripen E procurement Sweden will likely retain its current base structure until the early 2040s.

Norway’s status in the F-­35 project, its role in the develop-­­ment of the NASAMS anti-aircraft system and the Naval Strike Missile/Joint Strike Missile programme are sizeable ef-­­ferts in view of Norway’s air defence and air operations ca-­­pabilities, and for its national industry: Even though the de-­cision to concentrate the fighter fleet to one main operating base (MOB) and one forward airfield in the north, which for the main part supports the national defence, shifts the cen-­­tre of gravity of Norway’s fighter operations southward, the Arctic dimension still continues to play an important part in Norway’s defence.

Russia’s investments in the arms industry will impact, among other things, aircraft procurement and the development of the most modernized munitions, most important of which being cruise missile programmes. Russia aims at meeting west-­ern development at every sector and it continues to modern-­ize its air force by upgrading legacy aircraft and by launching new procurement programmes.

The most important ongoing fighter programmes include the modernisation of the MiG-­31 and Sukhoi Su-­27 fighters, procuring new Su-­34 and Su-­35 aircraft as well as developing the entirely new Sukhoi T-­50 (PAK-­FA) aircraft and, possibly, a new light fighter.

Russia maintains a continuous production capability to safe-­guard the capability of its air force. The Russian Ministry of Defence announced the reopening of the Tu-­160 bomber production line, which aims at resolving the shortage of equipment until the entirely new bomber type (PAK-­DA) which will replace the Tu-­160 and Tu-­95 aircraft enters operational service.

The aircraft which were delivered in 2014 satisfy a part of the military equipment’s modernisation programme and to-­tal requirements. In 2014 the air force received 7 modernised Tupolev Tu-­160 and Tu-­95MS bombers, 53 Sukhoi Su-­30 and Su-­35 multi-role fighters, 16 Su-­34 bombers, 18 upgraded MiG­31BM fighters, 135 helicopters including 46 helicopter gunships and 72 transport aircraft as well as 179 UAVs. Also, the air force received seven new long-range S-­400 anti-aircraft systems. Current orders, options included, comprise of 48 Su-­35, 110 Su-­34, 135 Su-­30, 40 T­50 fighters and 14 Tu-­160 bombers, in addition to which the air force is preparing an order for 100 MiG­35 fighters.

The founding of Russia’s Arctic Strategic Command has so far not made any impact in weapon system design. By 2018 the air force will receive more than 50 modernised MiG­31­BM fighters. Following their modernisation the fighters will retain their main strategic roles, the Arctic included. The modernisation will include electronic suites, improved cockpit ergonomy, new radars, better fire control systems and digital datalinks.

Russia continually improves its ability to employ air power and use long-range weapons in Finland’s neighbourhood. Alongside the most important of which being cruise missile programmes. Russia aims at meeting western development at every sector and it continues to modernize its air force by upgrading legacy aircraft and by launching new procurement programmes.

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3.4 Situation in Finland’s neighbourhood

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4. Replacing the Hornet fleet’s capabilities as an element of the overall defence system

Deterrence inherently includes the capability of the state to resolutely demonstrate its capability and willingness to guard its borders, respond to an attacker’s acts of war and protect the vital functions of society and the independent decision-making capability of state leadership. The primary purpose of Finland’s defence capability is to establish deterrence against the use of military force as well as the threat thereof, and to repel attacks on Finland. Both deterrence and the ability to repel attacks necessitate a properly functioning defence system in which efficient defensive and offensive effects are achieved through the joint effect of the different military services’ capabilities.

4.1 The significance of air power to the defence system

Air power as deterrence

The deterrence created by air power consists of capabilities which utilise its special properties, especially in supporting the entire defence system’s capability, reach and effectiveness. The air power’s deterrent effect in Finland is built on the credibility of the Air Force; its foundation relies on the will of the Finnish nation, demonstrated already in peacetime, on professionalism and performance as well as completed defence material acquisitions. A significant share of the Air Force’s deterrent stems from fighter sorties implemented to monitor and protect the territorial integrity of Finland, which demonstrate the will and capability to monitor and defend the borders of an independent country even in peacetime. The manner by which Finland reacts to territorial surveillance events impacts other countries’ estimates regarding the credibility of our defence. In particular, the reaction time and usefulness of the fighter fleet comprise an invaluable part of these operations.

The significance of control of the air

Denying the adversary’s freedom of operation and access to areas as well as limiting or preventing transports are common components of deterrence and can be achieved in peacetime, in wartime and in emergency conditions alike. In all situations Finland needs to guarantee the flexible use of airspace, while denying the unlawful use of our airspace. Control of the air plays a key role in securing vital functions, and it has proven to be a crucial factor to the success and protection of one’s own operations. Therefore, achieving sufficient control of the air is often the first task assigned to air forces during conflicts.

Only in exceptional situations can control of the air be achieved through defensive operations alone. In addition to defensive counter-air operations the adversary’s capabilities must typically be limited through offensive operations to achieve control of the air. Relevant missions include, among other things, the following:

- Interception associated with territorial surveillance and the protection of territorial integrity in peacetime.
- Missions associated with monitoring restricted and prohibited airspaces and target protection in special circumstances.
- Air interdiction in emergency conditions to protect troops and targets (defensive counter-air), and
- Defeating the adversary’s aircraft in the air and on the ground (offensive counter-air) to guarantee free and safe access to airspace.

Air power and changes in the character of war

Wars between states in recent decades have undoubtedly confirmed the crucial significance of air power and technology. In recent years warfare has developed in a direction where conventional warfighting is combined with, among other things, unanticipated means. Alongside open warfare battles have been fought, for example, in networks and through the means of guerrilla warfare. The events in Ukraine and the talk of hybrid warfare have raised a new debate on the increasingly blurred concepts of war and the moment when war breaks out. Even though the operating environment and means of warfighting keep changing, air power does not seem to have lost its essence. Rather, it has remained viable even in hybrid warfare and in its prevention.

Control of the air and offensive engagement are equally important elements in the use of air power. Sophisticated navigation and homing systems also make it possible to more accurately target air-launched weapons against increasingly challenging targets in unconventional warfare. The properties of modern munitions make it possible to achieve control of the adversary’s territory comprises an essential element of the defence system’s joint effect, even as the Hornet fleet’s capabilities are being replaced.

Sophisticated sensors, command and control systems and C2 networks have dramatically shortened decision-making and reaction times, and reduced the number of weapons needed to create the desired effect in combat situations. Integration between different platforms’ sensors and offensive systems, and the nearly real-time data transfer between them does not only improve warfighting capability, it also revolutionises conventional warfare: Integration between airborne as well as land- and sea-based systems increases their effectiveness, makes it more difficult to locate individual systems and to engage them with counter-measures. System integration, timely access to relevant information, lower observability and long-range PGMs create the preconditions for successful control of the air and an effective air-to-surface strike capability.

4.2 The role of the Hornet fleet as an element of the defence system

Key grounds for maintaining and developing military prowess include the preservation of equilibrium between states and the prevention of military conflicts. Foreign countries are also continuously evaluating the credibility of Finland’s defence. The Hornet procurement and its regular modernisation efforts have, for their part, helped Finland maintain international balance and deterrence and conflict prevention in the transformed operating environment. Considering this, the development of the Hornet fleet was systematically planned and implemented from the very start of its lifespan. Development mainly focused on achieving the ability to repel the potential aggressor’s first strike and, following this, the capability to render the attacker’s efforts futile.

The context of the Hornet procurement

The Hornet acquisition, carried out in the 1990s, can be seen to be a carry-over from the 1960s when, as a result of scepticism regarding the credibility of Finland’s defence, measures were taken to boost the air defence capability. Following the Note Crisis in Finland’s import decades.

The report of the Third Parliamentary Defence Committee (1961) issued recommendations for the long-term development of defence: the focus lay on developing troops and units capable of creating deterrence and repelling an attack in order to meet the performance requirements of the 1990s. The task of these troops was to convincingly demonstrate Finland’s resolve and capability to comprehensively protect its territorial sovereignty and prevent its unauthorised use. The troops were to be relatively well-equipped in order to be ‘convincing’ and limited in numbers. In its five-year plan (1982-1986) the Committee included the first stages of setting up a third fighter squadron. Along with the third fighter squadron and air- and anti-aircraft missile projects, Finland’s air defence reached a level at which, within resources, we had a rudimentary capability to meet the requirement of securing the vital functions of society nationwide, and to defend the territory of Finland, beginning at its borders.

The preparations for replacing the three ageing MiG-21 and Saab Draken squadrons commenced at the end of the 1980s. Weapon technology development proved that Finland’s fighter aircraft were completely outdated as regards the then character of battle, the main task of the Defence Forces and the require-ments posed by the operating environment. Furthermore, in its report the Third Defence Committee had already stated that cruise missiles pose a new and significant challenge to the air defence.

When the Hornet programme started, the 4th generation fighters, developed as a result of experiences from the Vietnam War and the wars in the Middle-East, had already seen operational service for a decade. Owing to new technology fight-
ers could now operate in all weather and lighting conditions. Moreover, new electronic attack systems and anti-radiation missiles were available to counter the threat of anti-aircraft missiles. Digital computers created the preconditions for the development of new multi-role fighters, and Doppler radars as well as new radar-guided missiles could also engage targets flying at low altitudes. This development placed Finland in a situation in which the performance of the fleet in a likely counter-air scenario would have been severely inadequate. Air operations carried out at night or in adverse weather, supported by electronic warfare systems, would have resulted in substantial losses and destruction in Finland.

Monitoring and protecting Finland's territorial integrity demanded a broad flight envelope from the new fighter – the fighter had to be able to identify and, when needed, repulse targets flying high and fast. However, the most important requirement included an ‘all-weather capability’ and the ability to engage targets flying close to the deck below the fighter, i.e. a low-flying/slow-moving target. In 1992 the Finnish Air Force recommended that the F/A-18C/D aircraft be procured as the new fighter type; pursuant to evaluations it best met the readiness requirements of the Finnish Air Force and the usability of the Hornet fleet.

In the 1980s Finland had an extremely limited strike and reconnaissance capability and the character of the operating environment at that time did not facilitate correcting these capability shortcomings in the fighter procurement, even though all candidates for the procurement were multi-role fighters. This being the case, the procurement was exclusively implemented as an interconnector project in spite of the fact that the aircraft’s other functional capabilities could have greatly benefited Finland’s defence system.

**Developing the capabilities of the Hornet Fleet**

The fighter procurement, carried out amid an economic crisis, and the decision to procure the aircraft drew criticism in the media. Instead of focusing on the effectiveness of the fighter fleet in a likely counter-air scenario, there was great concern about the rollout of the Hornet fleet. In the late 1980s the Hornet was the only fighter in the fleet. The Hornet’s operational capability and the role of the domestic industry. In retrospect, the Hornet fleet was introduced on the basis of a long-term, dynamic operational scenario, which itself had been made on the basis of a long-term research-oriented process. Evaluation, exchange of information among the users, and the improvement of the fleet’s upgrade potential are an evolving process. The recommendations on the needs to upgrade the Hornet fleet, stemming from research and expert opinions, have been handled by Parliament through the Government Security and Defence Policy Reports of 1997 through 2012. According to the analyses it has been appropriate to actively and continuously improve the Hornet fleet’s air combat capability to meet the requirements of the changing operating environment. Following the experiences from the Gulf War (Operation Desert Storm, 1991) the significance of air power and air supremacy was reassessed. Since the Gulf War air power, long-range strike capability and analyses of ancillary EW capabilities have been the key themes around which technology development and the military doctrines against the use of pressure on Finland or, in the worst case scenario, Finland becoming the target of military force or an attack. In wartime the fleet has a central role in protecting society’s vital assets and functions and the battle of the other services from air attacks, and in repulsing attacks by means of air-to-surface strikes.

**The quantity and quality of multi-role fighters must be sufficient to make it possible to carry out air defence and air operations in accordance with the needs of the Defence Forces in the entire area of the country.**

Even though the Hornet fleet can be flexibly used to defend the entire territory of the nation, the number of the aircraft procured (57 single-seaters and 7 two-seaters) was not based on operational requirements. Rather, it reflected the artificial limitation imposed on Finland in the Paris Peace Treaty of 1947. During the preparations for the 1997 Report additional aircraft procurements were considered in order to remedy the aforementioned limitation. But as it was, Finland’s economic resources did not permit the acquisition of any additional aircraft during that planning period. The number of fighter aircraft continues to pose a challenge to the defence of Finland’s large geographical area. So far, through the systematic upgrades of the Hornet fleet the Air Force has managed to sustain a sufficient capability for air operations which includes a flexible counter-air capability, air combat and air-to-ground capabilities, and a long-range strike capability. As a result of these upgrades the interceptor was transformed into a multi-role fighter. The fleet plays a central role as an element of the defence system. In peacetime it carries out key tasks associated with monitoring and protecting the territorial integrity of Finland. In addition, the capabilities of the Hornet fleet play a significant role in establishing deterrence against the use of pressure on Finland or, in the worst case scenario, Finland becoming the target of military force or an attack. In wartime the fleet has a central role in protecting society’s vital assets and functions and the battle of the other services from air attacks, and in repulsing attacks by means of air-to-surface strikes.

**The main forte of a multi-role fighter is its flexibility in forming air operations, since a ‘swing role’ fighter’s mission can be changed as needed according to the situation or need, between sorties or during a mission. The multi-role fighter will likely play a more important part in the defence system because, in addition to the overall air defence system, its performance impacts ground and maritime defence capabilities, intelligence, surveillance and C2 systems and fire import.**

The operational agility of a multi-role fighter fleet creates the preconditions for the flexible use of capabilities in the entire area of the country, which in turn places a high weight of effort in critical areas. The quantity and quality of multi-role fighters must be sufficient to make it possible to carry out air defence and air operations in accordance with the needs of the Defence Forces in the entire area of the country.

Even though the use of multi-role fighters in air defence requires seamless integration with the other air defence systems, when needed, they must possess an independent first-response capability against different threats by using information generated by on-board sensors, versatile weapon configurations and the required EW capabilities.

**Defensive and offensive counter-air operations**

In the future multi-role fighters will be the single most important component in establishing Finland’s air defence capability; they also play a central role in creating freedom of action for the Defence Forces as well as in achieving and maintaining sufficient control of the air after having repulsed a first strike. Fighter defence, implemented with multi-role fighters, provides the Defence Forces’ wartime units and national high-value targets with protection against air threats, and establishes the centre of gravity for the air defence, as required by the situation. Multi-role fighters deny the enemy his attempts to take advantage of the gaps of the other active air defence components. Fighter power will continue to be a rapid, far-reaching and flexible instrument which can be tailored and adjusted to control different aggressions in accordance with the requirements of the dynamic operating environment. Multi-role fighters establish both the framework of territorial air defence and the counter-strike capability to paralyse the adversary’s offensive power.
The defensive counter-air capability, consisting of Flight-er defence and anti-aircraft defence, is reactive by nature. Fighters respond to air attacks and potentially threatening situations. When it comes to airspeed and altitude, the requirement for fighters performing these kinds of missions is higher compared to other mission types. Weapon system design is presently undergoing a transformation. As a result, the requirements of multi-role fighters must be accepted in the envelope and manoeuvrability requirements of a multi-role fighter, for example, with regard to the relationship between the envelope and manoeuvrability, the maximum weapon load and observability. Defensive counter-air operations highlight the properties of the vessel’s air-defence and combat capabilities. Air comba-t situations are typically close-range head-on situations in which the initiative and advantage hangs on who first detects the adversary and who gets the first shot. Factors affecting first detection and the shooting position include the situation picture, the performance of on-board sensors and the range of armours. The detectability of the target’s electro-magnetic emissions, stealth technology and EW characteristics play a role in observability and in achieving a firing solution. The newest an-swers associated with the range of A-A missiles and, on the other hand, missile evasion are ramjet missiles and the fighter’s super-critical observability. Helmet-mounted cueing systems and the newest genera-tion short-range A-A missiles considerably reduce the need for fighter manoeuvrability when missiles are launched in close-air combat. Simultaneously, as the envelopes and ranges of A-A missiles increase, they can be employed against targets whose airspeed and altitude differ substantially from one’s own, even in unfavourable situations. It is particularly impor-tant to be able to engage targets at great distances as well as small targets. Control of the air cannot be achieved through defensive counter-air alone as it typically requires offensive counter-air operations as well. Therefore, multi-role fighters are also used to limit, suppress and defend the adversary’s air power and air defence systems. This does not only help achieve control of the air, it also makes it possible to protect one’s own land- and sea-based and air operations.

The Defence Forces’ joint fires

The Defence Forces’ joint fires capability is paramount to the implementation of military operations and to the credibility of Finland’s defence. Engagement, such as attacks (kinetic ef-fect) and electronic jamming (non-kinetic effect), are imple-mented in the air, on land and at sea. Modern multi-role fight-ers can cost-effectively establish the backbone of nationwide offensive engagement which is employed alongside land- and sea-based offensive capabilities. Multi-role fighters engage mobile and moving land- and sea-based targets, both soft and hardened ones. Multi-role fighters are also able to carry out both kinetic and non-kinetic engagement in all dimensions during one mission, and they can rapidly concentrate defen-sive power in areas of need, or other firing missions and, when necessary, versatile fighter weaponry and on-board systems place no limitations on target selection, or the condi-tions to (joint fires) application. If necessary, the mission can be carried out by employing an electronic attack.

Independent capability and net-working are crucial mutually aug-menting properties. These make it possible for the multi-role fleet, op-erating as a detachment or within some other defence system, to mi-nimise the response time in criti-cal situations and independently fly offensive missions in challenging cyber and information warfare environments. Even though multi-role fighters can fly independent offensive missions, other systems can also be tied alongside them, or in lieu of them, to saturate the target, to optimise the weapons effect, or to maximise survival. The Defence Forces must retain the long-range strike ca-pability achieved through the Hornet fleet. Military high-value targets are often located beyond the area being defended which requires the capability to achieve the desired effect in a versatile manner and from far enough away. The way to com-pensate for the inferred penetration requirement, and to re-duce vulnerability, is to use stand-off weapons such as JSOW (Joint Standoff Weapon) and JASSM missiles (Joint Air-to-Surface Standoff Missile), both of which are in the Finnish Hornets’ weapons arsenal. The long-range missile system is the basic set-up for the Defence Forces’ long-range strike capability; it is also an important part of our deterrence. Along with the long-range strike capability the defence system’s joint fires capabilities against moving and time-critical mobile targets must be improved as the battlefield is becoming increasingly dynamic. Target acquisition in the manner required for engaging and firing at the targets demands solid sensor-to-shooter integration. A multi-role fighter is typically a link in this chain. When required, a multi-role fighter can independently detect, recognise and designate the target with its on-board sensors, and engage it with its weapon system.

Intelligence, surveillance, target acquisition, and recogni-tion (ISTAR) and C2 systems create the conditions for the multi-role fighter to be engaged in a multi-role mission system. The multi-role fighter is the only means for information-gathering in contexted areas. The multi-role fighter’s capability in intelligence, surveil-lance or offensive missions can be regarded as the fighter’s ability to succeed in penetrating the area of operations, and in achieving a position where it can acquire target informa-tion or attack the surface target without exposing itself to the weapon systems protecting the target. Among other things, the pilot’s situational awareness, the observability of the air-craft, its EW suite, and its air-to-air combat capability have an effect on its exposure to adversary’s weapons employment and survival.

The multi-role fighter’s ISTAR capability, and the sup-porting real-time information processing and data trans-fer capacity, makes the fighter more effective in an offe nsive mission. In a dynamic firing situation the Defence Forces’ joint fires capability relies on airborne target des-ignation and real-time data processing, in which UAVs and fighters play key roles. According to some estimates approximately 80% of all targets in the modern battlefield are dynamic, i.e. moving or mobile targets whose precise location is unknown beforehand, or targets which can only be detected for a fleeting moment. Such targets in clude anti-aircraft missile systems, rocket launchers and missile launchers on land and at sea. The ability to find, recognise and position these kinds of targets, and to be able to engage them, will become highlighted in the fu-ture. This is tantamount to a modern multi-role fighter is suitable for providing supplementary real-time informa-tion about particularly challenging and time-critical tar-gets – such as low observable targets as well as mobile and moving targets – to the situation picture which is compiled through other means. 

As a result of digitisation and growing computing power the new generation’s imaging capabilities and multi-func-tion radars make it possible for fighter-class aircraft to be used in supplementing the mission-specific ISR aircraft and satellites. On the other hand, the exponentiation of aircraft participating in ISR missions poses new kinds of challenges to information processing. Gathering information from in-creasingly wider areas, and for longer periods of time, formsthe basis for the target area significantly impact the situation picture and, subsequently, operational possibilities. Owing to its multi-role capability, the multi-role fighter may be the only means for information-gathering in contexted areas. The multi-role fighter’s capability in intelligence, surveil-lance or offensive missions can be regarded as the fighter’s ability to succeed in penetrating the area of operations, and in achieving a position where it can acquire target informa-tion or attack the surface target without exposing itself to the weapon systems protecting the target. Among other things, the pilot’s situational awareness, the observability of the air-craft, its EW suite, and its air-to-air combat capability have an effect on its exposure to adversary’s weapons employment and survival.

Modern multi-role fighters can cost-e-ffectively establish the backbone of en-roision offensive engagement which is employed alongside land- and sea-based offensive capabilities.

Modern multi-role fighters can cost-e-ffectively establish the backbone of en-roison offensive engagement which is employed alongside land- and sea-based offensive capabilities.
Preliminary Assessment for Replacing the Capabilities of the Hornet Fleet

Other mission types
Suppression of enemy air defence (SEAD) and electronic warfare are means for creating favourable conditions for the implementation of different air operations and for all of the Services’ long-range fire into the adversary’s air-defended area. Both SEAD and electronic attack (EA) operations epitomise the air forces’ special missions which require special technological knowledge. Typically, mission-specific aircraft, such as the American EA-6B Prowler, the EA-18G Growler and the German Tornado-ECR, are used in these missions. Their key contributions include electronic attack units and anti-radiation missiles. The new capabilities of the multi-role fighters also make them suitable for SEAD missions. This kind of mission requires rapid deployment and poses special requirements on the multi-role fighter’s sensor suite and armament. It is likely that it will remain a niche capability for a long time, as multi-role fighters are not going to be able to successfully complete this task without some limitations.

Even the latest stealth technology will not render an aircraft or missile invisible. Therefore, it is likely that stealth technology-based systems in the future will have to be supported through various means of SEAD and EW. Still, stealth aircraft have the upper hand over traditional aircraft because stealth technology allows them to retain their edge over typical weapon systems, and it is easier to protect stealth aircraft or missile invisible. Therefore, it is likely that stealth technology, in addition to which a wide-spread missile attack warning and tracking system would be needed. While the multi-role fighter is not the primary means of meeting the challenges associated with ballistic missile defence, its capabilities can establish deterrence against theatre ballistic missiles (TBRM) through its counter-strike capabilities and its ability to destroy the aggressor’s missile-launch platforms. The role of mobile and dispersed ground- and maritime units is made up of their 24/7 organic anti-aircraft defence systems, the protection provided by multi-role fighters and other means. The air threat against these units, which primarily consists of attacks carried out by helicopters and aircraft using their own sensors as well as targeting information relayed to other offensive systems by ISR aircraft and UAVs, can, for the most part be defeated by short- and medium-range anti-aircraft defence systems. For targets requiring permanent protection it must be possible to prevent the use of the adversary’s different drones in the target area. The protection of ground forces requires that the surface-to-air defence system GRAD have mobile and damage-tolerant sensors which can also detect very small targets that operate at low altitudes. Stand-off PGMs that home in on a set of coordinates and synthetic aperture radars (SAR) pose an entirely new challenge for the air defence. These elements increase the aggressor’s options for selecting the favourable conditions, altitudes and sortie profiles to evade defensive fire and improve survival. The growth of the aggressor’s operating range calls for increasingly closer air defence and defensive fire integration so as to make use of every opportunity to defeat the aggressor’s assets.

The functioning of Finland’s air defence relies on a joint, networked command and control system which must enable the flexible use of weapon systems and sensors in national and multinational operating environments alike. Anti-aircraft defence units must be able to link up with the air defence (C2) system. This weapon system must control air defence fire, the creation of a situation picture and the implementation of coordinated offensive measures.

Anti-aircraft defence systems must also be able to independently create a situation picture and manage fire control so as to provide early warning and target designation to the firing units. Active and passive air defence methods as well as defensive operations must be adapted as a whole to the overall defence system.

4.5 The solution for replacing the capabilities of the Hornet fleet as an element of the overall defence system in 2030 and beyond
The role of the Hornet fleet as the backbone of the air defence system and its improved capabilities, achieved through the MLU2 upgrade, form a versatile whole which must be replaced with a solution based on a multi-role fighter. The need for and the possibilities of procuring unmanned aerial vehicles and other complementary capabilities must be analysed at a later date.

The working group recommends that the capabilities of the Hornet fleet be replaced by a solution based on a multi-role fighter. The need for and the possibilities of procuring unmanned aerial vehicles and other complementary capabilities must be analysed at a later date. W
It would not be cost-effective to replace the capabilities of the Hornet fleet with individual alternative solutions. Furthermore, this would degrade the performance of the overall defence system. The surface-to-air defence/GBAD system, being an element of the integrated air defence, complements the capabilities of a multi-role fighter by incurring losses to the adversary’s air assets in protecting critical civilian and military targets, and in guaranteeing the freedom of the Defence Forces’ operations.

The working group recommends that the capabilities of the Hornet fleet be replaced by a solution based on a multi-role fighter. The need for and the possibilities of procuring unmanned aerial vehicles and other complementary capabilities must be analysed at a later date.

Unmanned aerial vehicles can augment the multi-role fighter’s capabilities in ISTAR-related tasks and, possibly, later as an element of the Defence Forces’ joint fires capabilities. The following table presents the possibilities of replacing the capabilities of the Hornet fleet in a simplified manner. Some of the UAV’s capabilities are based on estimates of technology development.

<table>
<thead>
<tr>
<th>Capabilities to be replaced</th>
<th>Multi-role fighter</th>
<th>Surface-to-air defence/GBAD</th>
<th>Unmanned aerial vehicle system</th>
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</thead>
<tbody>
<tr>
<td>Monitoring and protecting territorial integrity</td>
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<tr>
<td>Defensive counter-air</td>
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<tr>
<td>Offensive counter-air</td>
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<tr>
<td>Defence Forces’ long-range strike capability</td>
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<tr>
<td>Counter-land missions</td>
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<td>Counter-sea missions</td>
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<tr>
<td>Command and control, intelligence, surveillance and targeting</td>
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The working group recommends that the capabilities of the Hornet fleet be replaced by a solution based on a multi-role fighter. The need for and the possibilities of procuring unmanned aerial vehicles and other complementary capabilities must be analysed at a later date.
5. The possibilities of extending the Hornet fleet’s lifespan

According to the life-cycle plan the Finnish Air Force F/A-18 Hornet will be phased out from 2025 to 2030. The replaced capabilities must be in full operational service in 2030. There are three major factors that limit the service life of the fleet: structural fatigue, challenges in obtaining system support and the weakening comparative capabilities of the Hornets in relation to the development in our security environment. When the Hornet fleet was procured the projected lifespan of each individual aircraft was 30 years. This has been the guiding principle in acquiring upgrades as well as in planning the use and support of the fleet.

The Defence Forces Logistics Command and the Finnish Air Force have evaluated the possibilities, impacts and costs of extending the lifespan of the Hornet fleet as regards aircraft structures, obtainability of system support and operational capabilities.

Structural fatigue
The Finnish Air Force (FiAF) conducts its exercises and flight operations in training areas which are close to the main operating bases. Short transit times to training areas have made it possible to efficiently utilize the Hornet fleet’s available flight hours. In accordance with FIAF mission requirements flight training and exercises include a great deal of air combat manoeuvring which stresses the aircraft’s structures. The FiAF has studied, analysed and revised its flight training and exercise syllabi throughout the service history of the Hornet fleet in Finland. The present service life model is based on an adjusted operations profile, which allows for approximately 4–200 flight hours per individual aircraft.

The Hornet fleet’s completed and ongoing structural repair projects are optimised to serve the planned use profile. The ongoing structural modification programme was designed on the grounds of a study carried out from 2012 to 2009. Following the structural repairs, on the basis of information received from the international F/A-18 user community and damage inspections, additional structural life-limiting aspects were identified. The most critical points as regards the implementation of repairs were included in the programme in 2014. The structural repair programme for the entire fleet will be completed by the end of 2016.

To extend the lifespan of the Hornet fleet new, augmenting structural modifications would have to be implemented. The extent of needed structural repairs depends on any possible new damage detected, airframe-specific flight hours and the stress caused by flight loads.

Obtainability of system support
System support for the Hornet fleet consists of spares and Line Replacement Units (LRUs), component repair and overhaul, and software support. The technical obsolescence of components and their reduced obtainability create challenges for repair and maintenance, which can, however, be managed. The Hornet contains in all 46 equipment-specific software-driven systems. Eight of them require software updates throughout the service life of the aircraft. The costs of software support keep rising as the other user countries keep phasing out their fleets and, hence, no longer participate in sharing the costs.

The service-life-associated plans of the United States, the main user country of the F/A-18A-D, significantly impact the obtainability of system support. The United States Navy is the most important user of the aircraft type and, according to the present plans, the USN will decommission its F/A-18 C/D models by 2025. The United States Marine Corps will continue using the aircraft until the end of 2031. The USMC and Switzerland are presently upgrading their mission computers so as to be comparable with those in the F/A-18 Super Hornets. Upgrading the mission computer is a long and expensive project. Australia will phase out its F/A-18 A/B aircraft in 2022 and Canada in 2025. In the early 2020s Finland will be solely responsible for the software development of the present mission computer, as a result of which the costs of software updates and support will grow exponentially.

Operational capabilities
The F/A-18 Hornet’s comparable operational capabilities stem from the number of aircraft available, the operations environment and the ability to carry out A-A and A-G missions as well as associated JSTAR missions. When it comes to our neighbourhood Norway is replacing its F-16AM/BM fighters with F-35A aircraft during 2019–2025 and Sweden will introduce 70 JAS39E aircraft during 2023–2027. As part of its armed forces modernisation programme Russia has upgraded its fighter aircraft by the mid-2020s. The next generation multi-role fighters are capable of carrying out a variety of missions in the air, on land and at sea, as well as intelligence, even during a single mission if required. The development of Russia’s integrated air defence system is yet another change in our operating environment.

The weapon system is the mainstay of the air combat capability. The increasing ranges that missiles will have sets requirements for targeting and self-protection systems. Sensors must be able to detect and relay target information to missiles at greater and greater distances. Correspondingly, self-protection systems must be able to jam and/or prevent missile launches or missile hits in an increasingly efficient manner. The use of stealth technology and the development of sensor technologies combined with new A-A missiles and networked C2 environments make it possible for air combat capabilities to advance to an entirely new level. A substantial part of Finnish air defence matériel will become obsolete by the mid-2020s. This missile arsenal must be replenished. The challenge is that without significant system upgrades no new generation A-A missiles can be integrated into the Hornet fleet.

The possibilities, impacts and costs of extending the lifespan of the F/A-18 Hornet into the 2060s, counter to present plans, would translate into added expenses in life-cycle management and increase the cost risks of system support. The relative capabilities of the Hornet fleet will degrade in the 2020s and the most significant degradation falls on its interdiction capability. Extending its structural life and implementing a new, sizeable mid-life upgrade would make it possible to delay the decision to replace the capabilities by five years, at most. The extra costs incurred by service life extension consist of structural repairs, system support and capability upgrades. The need for additional financing for 2018–2022 would amount to EUR 1.2 billion, and the investment decision would have to be taken during 2015–16.

If materialised, a service life extension would also include a sizeable technological risk which relates to any new structural damage findings, the implementation of system integration and software updates as well as the schedules of systems in the product development phase. The already completed upgrades have shown that system upgrades and software development take several years. It is estimated that the capability would be fully available no earlier than eight years after the financial decision is taken. Extending the Hornet fleet’s lifespan would not provide additional options for replacing its capabilities. On the contrary, it would limit the options because the production lines of some of the candidates for replacing the capabilities will close.

On the basis of the total analysis, extending the service life of the Hornet fleet would not be a credible or a cost-effective solution.
6. The key findings from fact-finding trips and meetings

- Revisiting the capabilities of fighter aircraft is a major feature in foreign security, defence policy decisions, for which the support of Parliament is indispensable.
- The fighter procurement decision and the evaluation that supports it stem from the state's security and defence strategy so that the capabilities being procured optimally serve the development and maintenance of the state's security. The evaluation comprehensively covers all necessary sectors, ranging from the strategic level to details of combat technology.
- In the countries where the meetings took place the procurements were distinctly organised under one management which was responsible for the overall coordination of the programme. When it comes to programme management it is vital to determine and publicise the rights and responsibilities of decision-making and comply with them – state leadership, Parliament, Government, the Ministry of Defence and the Defence Forces. During the preparatory, planning and implementation phases of the programme close cooperation must be achieved between different administrative branches.
- Key features in the implementation of the programme are openness and traceability, reliability and credibility. Quality assurance (QA) and an all-inclusive project management information system are closely associated with each feature. The importance of third party auditing is central to the credibility and reliability of the programme.

The working group's fact-finding missions included trips to the Danish MoD's New Fighter Program, the Norwegian MoD's F-35 Program Office and the National Fighter Procurement Secretariat within the Canadian Public Works and Government Services. The key findings from the meetings are as follows:

- One method in gathering information for the preliminary assessment was to get acquainted with the fighter programmes of countries that had been or still are in a similar situation. The working group also arranged a seminar which focused on the key lessons learned from the Hornet procurement. In addition, members of the working group participated in fact-finding missions organised by the Ministry of Defence and the Finnish Air Force.

The working group's fact-finding missions and meetings are defined in a judicially proper sequence. The motivation behind the meetings stems from the state's security and defence strategy so that the capabilities being procured optimally serve the development and maintenance of the state's security. Quality assurance (QA) and an all-inclusive project management information system are closely associated with each feature. The importance of third party auditing is central to the credibility and reliability of the programme.

- Determining the evaluation process and compiling the needed data set are critical success factors, it takes time and expertise to properly plan and implement them.
- Open and clear communications play a significant role in the procurement and its preparations. Communication must be timely, proactive and systematic throughout the entire process. The goal of communications is to ensure that the state leadership, political leadership and citizens, at all times, have correct and coherent information on which they can base their opinions about what the fighter defence capability actually means to Finland, and how much it costs to maintain it.
- The purposes of the RFI and RFQs as well as the schedules of the programme and decision-making must be promulgated among prospective suppliers and decision-makers. This, for its part, guarantees the integrity of commercial preparations for the programme and the fair treatment of suppliers.
- Cost management is a key part of programme management. It underscores the ability to take into account everything that impacts cost as well as a viable cost model. The cost model comprises the total cost and it must be able to itemise the total cost structure. Communication associated with cost estimates must include the message that there are inherent uncertainty factors and that the estimates will become more precise when more information becomes available.
- It is essential to determine the level of industrial participation and security of supply in the early phase of the project so that the grounds and requirements for competitive tendering are defined in a judicially proper sequence.

The guests invited by the working group to the seminar focusing on the key lessons learned from the Hornet procurement included the following persons who held the offices as per their titles at the time of the procurement: Prime Minister Esko Aho, Director General (MoD) Eero Lavonen, Chief of Defence Jan Kleberg, Commanders of the Finnish Air Force Pertti Joikinen and Heikki Nikkiinen as well as Project Manager Jukka Rautalahti. In addition, MoD and Defence Forces leadership participated in the seminar. The key conclusions of the seminar are as follows:

- There were three great challenges in implementing the Hornet project: geopolitical changes in the global and European context and in Finland's neighbourhood, the Defence Forces' substantial material shortages, among other things, in the Army's spearhead units, and, the state of the government economy.
- Despite the political risks (attitude of the losing candidates), organising a fighter competition between the candidates was not a bad decision.
- In the implementation of the project everyone needed to know which decisions were to be taken by civil servants and which by politicians.
- The Foreign Military Sales process used in the project was a viable arrangement for a small country such as Finland.
- The Finnish Air Force was responsible for evaluating the candidates and preparing the procurement requirements on technical-commercial grounds.
- The Hornet project's success factors were the following: a flat expert organisation structure, no bureaucratic tiers, each decision-making level had sufficient expertise, well-functioning cooperation and a pragmatic approach to handling issues.
- Communications played a central role in maintaining transparent competition and in committing the candidates.
- In the practical implementation of the project the following factors became emphasised: requirements management, contract management, information management, close teamwork, long-term planning, IT instruments and working conditions, the importance of liaison offices, tacit knowledge and experience as well as the operating culture.
- The assembly of the aircraft and parts manufacturing guaranteed the following capabilities: organic maintenance competence already in place as soon as the aircraft were introduced to service (proficiency must be immediately available) and repair, modernisation and life-cycle upgrade competencies.

Members of the working group participated in several events organised by the MoD and the FiAF, the topics included, among other things, information-gathering on the potential fighter candidates and the experiences of other countries in their fighters' life-cycle management and procurement programmes. The key conclusions from these events are as follows:

- On the basis of production lines and capability maintenance the probable potential candidates for Finland's multi-role fighter procurement are the Boeing Super Hornet, Dassault Rafale, Eurofighter Typhoon, Lockheed Martin F-35 and the Saab JAS Gripen. Each potential manufacturer already has plans for upgrading the capabilities of its multi-role fighter to meet future requirements. The fact-finding events did not extend to Russian or Chinese fighters, it is therefore impossible to determine their suitability as Finland's future multi-role fighter on the grounds of the preliminary assessment.
- The aforementioned manufacturers have indicated great interest in Finland's forthcoming Hornet-replacement programme.
- The maintenance concepts and possibilities for industrial participation offered by the manufacturers are remarkably dissimilar.
- There are substantial differences in the life-cycle costs as reported by the manufacturers.
- The contract for replacing the capabilities of the Hornet fleet should be signed in 2021 or 2022. Financing the project would probably begin at the same time.
- The manufacturers' opinions as regards participating in competitive tendering differ somewhat from that of those who organised the competitions.
- Should Finland decide to procure a multi-role fighter as the successor of the Hornet fleet, the aircraft's potential and flexibility are the key factors in view of the aircraft remaining operationally viable at least until the 2050s.
- This time the technical evaluation and comparison between aircraft is more challenging than during the Hornet procurement.
- Advanced simulator and virtual reality training and exercises (synthetic training exercises) will become an important part of the flight training curriculum.
7. Cooperation with the Finnish industry, taking into consideration security of supply and EU law

7.1 Industrial participation

Industrial participation refers to offsets on defence procurements. In these agreements cooperation between the Finnish defence industry and a foreign supplier is emphasised. Responsibility for the administration of industrial participation is governed by the Ministry of Employment and the Economy and the Finnish Committee on Industrial Participation (FCIP) under the Ministry. The contracting party in industrial participation arrangements associated with a procurement contract is the Finnish Ministry of Defence.

Industrial participation in the changing operating environment

Prior to the entry into force of the Act on Public Defence and Security Contracts (1531/2011), and its underlying EU Defence and Security Procurements Directive (2009/81/EC), Parliament required that the Defence Forces’ large material procurements from abroad include offsets. From the perspective of industrial participation the European operating environment has been in flux. The Defence and Security Procurements Directive is part of wider development in which the goal is to open the European defence market to competition. Following the EU Directive’s entry into force, Member States are, in essence, required to put their defence and security contracts out to competition in accordance with the Directive. When it comes to material projects implemented by virtue of the Act, industrial participation’s (‘offset’) requirement is not imposed, as a rule, on the supplier. It is only possible to derogate from this principle if the essential security interests of the state so require. In such situations Finland, pursuant to Article 346 of the Treaty on the functioning of the European Union, and the application of Article 346 (1)(b) TFEU, can derogate from the requirements for an independent capacity in the Finnish defence industry required by the state’s essential security interests to Finnish defence and security-related industry.

The transaction must involve one of the abovementioned five focus areas specified in more detail in the rules on industrial participation which entered into force on 1 January 2012. Products outside the priority areas, traditional Finnish exports, or continuation of established business relations are not eligible, nor are transactions with an offset value of less than EUR 10 000. Additional requirements include:

- The contractor is instrumental in creating the transaction.
- The transaction significantly benefits Finnish economic interests, and
- The transaction is at least of a similar high technical standard as the procurement of the defence material concerned.

7.2 The logistics concept and industrial participation in replacing the Hornet fleet’s capabilities

National security of supply

The state sustains and supports the defence industry associated with its essential security interests as well as its knowledge and services in many ways. The defence establishment, together with the National Emergency Supply Agency, maintains an emergency stock of supply also critical for the supply of materiel for critical consumption wartime materiel such as artillery gunpowder and munitions. Sectors that are critical for national emergency stock include intelligence, surveillance, command and control, target acquisition and recognition as well as offensive operations. The defence establishment makes certain that Finland has sufficient knowhow, technology and production capabilities in the future as well.

In a similar fashion it ensures that the capacity for system integration, support and maintenance, and damage repair in emergency conditions is logistically achievable. The defence establishment ensures that Finland will continue to possess the sufficient expertise, technology and defence industrial production in the future as well. It will configure system management and support by utilising strategic partnership arrangements.

The Hornet fleet’s logistic concept

The Defence Forces’ logistic concept for the F/A-18 fleet is based on an organic ability to provide immediate logistic support for combat units, and on the domestic aviation industry’s strong commitment to EU level maintenance. The concept is based on the national objectives of security of supply: For the most part it was only possible to establish the repair and maintenance capacity in Finland through primary procurements, domestic assembly, system upgrades and associated offset obligations. It is the extensive domestic maintenance and repair capacity which has kept the fleet on the flight line. Having an extensive own maintenance capability has made it possible for FiAF to focus on the problems detected in the fleet; it has also enabled FiAF develop its own modifications or change the maintenance policy if needed.

The Defence Forces Logistics Command is responsible for the contracts, financing and planning associated with the life-cycle support of aircraft. The industrial support concept is based on the national objectives of security of supply, and its capacity has been formed along with the Defence Forces’ system procurements. The industry is an integral element of the Finnish Air Force’s peacetime and wartime structure. The most important industrial partners are Patria Oyj, INSTA ILS Oy and Finnair Technical Operations.

Logistic support arrangements of FiAF aircraft are supported by foreign services above and beyond such maintenance readiness or contractual support which is not possible or economically feasible to implement in Finland. The foreign support services are based on FMS contracts signed with the United States or direct commercial sales. Furthermore, the international Hornet user community and its forer also offer the possibility of active participation in the implementation and development of logistics. Cooperation with the United States, the international user community and the domestic and foreign aviation industry has made it possible to create and sustain a cost-effective national logistics system capable of independent decision-making.

Logistic concept and industrial participation in the Hornet fleet capabilities replacement project

In view of security of supply, it would be ideal for Finland to acquire as much Hornet capability replacement-associated maintenance, repair and overhaul expertise as is cost-effective, possible and necessary. In this way, through industrial participation, the programme would establish the vital expertise and capacity in the Finnish defence industry required by security of supply. This can be seen as a means to sustain the defence capacity of a small country such as Finland who is dependent on large weapons manufacturers.

The options for the concept of industrial participation must be determined no later than at the time the RFIs are promulgated. Moreover, the requirements for an independent capacity and security of supply must be established from national interests. In this context one must take into account the possibilities of making use of the strategic partnerships signed with the domestic defence industry as well as determine the role of the domestic industry in the preparatory phase of the programme.

7.3 Treaty on the functioning of the European Union, and the application of Article 346 (1)(a) and Article 346 (1)(b) TFEU

The Act on Public Defence and Security Contracts (1531/2011, hereafter Defence and Security Act) shall apply to contracts awarded in the fields of defence and security.

Preliminary Assessment for Replacing the Capabilities of the Hornet Fleet
The purpose of the Act is to improve the effectiveness of gov-
ernment spending without undermining the essential secu-
ritv interests of the state, to promote high-quality procure-
ments and to guarantee the non-discriminatory treatment in
awarding supply contracts, service contracts and works
contracts to businesses and other entities by contracting
authorities in public defence and security competitive ten-
dering. The Act must utilise the existing conditions of
competition, ensure the equal and non-dis-
riminatory treatment of all tenderers, and operate in accord-
ance with the principles of transparency, proportion-
ality, unless otherwise provided in Article 346 (1)(b) TFEU as
regards the state's essential security interests. National pro-
cedures laid down in the Defence and Security Act
must apply to contracts subject to Article 346 (1)(a) TFEU. However, contracts sub-
ject to Article 346 (1)(a) TFEU are completely outside the
scope of application of the Defence and Security Act.

An EU Member State can sign a defence and security con-
tract in derogation of Article 346 TFEU if it is justifiable with
regard to the essential security interests of the state. This kind of a situation may arise, for example, with such defence con-
tracts where the state's essential security interests require spe-
cial arrangements and requirements on security of supply, and
where the rules of the Defence and Security Procurements
Directive are not sufficient to safeguard its essential security
interests. A corresponding situation may also be in ques-
tion as regards procurements which are so vital to national
sovereignty that the rules of the Directive do not sufficiently
safeguard the Member State's essential security interests. This
kind of a situation may arise, for example, when some defence
equipment or service contract is strategically so critical to its
national defence that any dependency on another state, such
as an export licence issued by it, could be construed to under-
mine the state's essential security interests.

When it comes to defence contracts, security of supply
may necessitate invoking Article 346 (1)(b) TFEU especially
when the subject matter entails a key defence system which
includes detailed requirements concerning maintenance
and support. For example, preparedness for access to needed
logistics and support services, also in times of conflict, may
require that the services to be procured are also available
in Finland in normal conditions. For this purpose it may
be necessary for the service provider to establish himself
in Finland or create the needed capacity and knowhow in the
Finnish defence industry.

The Defence Forces' logistics arrangements in emergency
circumstances can require that the provider of the key systems'
support and maintenance services also prepare for emergen-
cy conditions, and assign his services to the Defence Forces
in times of crisis. Such requirements may necessitate that
the most critical service providers are Finnish citizens. The
security-of-supply requirements established to safeguard the
national defence capability often result in the realisation that
a procurement procedure pursuant to the Defence and Security
Procurements Directive does not sufficiently safeguard the
essential security interests of the state. Then, the contracting
authority has to invoke Article 346 (1)(b) TFEU. For instance,
the project of replacing the capabilities of the Hornet fleet
in so crucial to national security that the measures associated
with logistics, maintenance support and repairs have to be
implemented promptly and dependably also in emergency
conditions and the risk of there being longer response times
is simply not acceptable.

The essential security interests may require that Finland re-
tain sufficient defence industrial capacity regarding any given
critical system. Such capacity may entail technology (e.g. in-
formation technology) as well as defence equipment produc-
tion (e.g. certain ammunitions), or associated maintenance,
repair, integration and modification capability. The crux of the
matter is whether the object of the contract is so vital to na-
tional security that any undue dependency on a foreign sup-
plier could undermine our national security.

The provisions of the Defence and Security Act must not be
applied to defence and security contracts if Article 346 (1) (a)
TFEU applies to the procurement, i.e. the contract will be
classified or if the application of the Defence and Security
Act would require the disclosure of information which would
undermine the essential security interests of the state. Such a
situation may arise when the object of the contract entails
a key system for the security of the state and if already the ten-
dering process requires access to such information which is so
essential to the security of the state that, for security consider-
ations, it can only be given to those tenderers that have
thoroughly vetted and determined capable of handling highly
classified information. In practice, the Request for Quotation
will then include classified information in categories I-III.

Request for Information and charting the market
Procurement legislation does not issue provisions for the
preliminary phase of procurement. The contracting author-
ity can chart the potential market by studying the available
supply through brochures, advertisements and the suppliers'/
Internet pages, and by meeting suppliers or promulgating a
Request for Information (RFI) among tenderers. The sup-
pliers can market their products and services and present
their service supply to the contracting authority. From the
standpoint of the contracting authority it is advantageous to
remain aware of available services. While active marketing,
face-to-face meetings and presentations conducted by sup-
pliers are not prohibited, it behoves the contractual author-
ity to participate in them in a non-discriminatory manner before
launching the actual procurement process, implemented under procurement legislation, be-
gins with a tender notice and/or the promulgation of a Re-
quest for Quotation (RFQ).

Procurement process
From this outset, it is possible to imagine that the procure-
ment process for replacing the capabilities of the Hornet fleet
in Finland can be implemented in many ways: through public
competitive tendering pursuant to the Defence and Secu-
ritv Act; under Article 346 (1)(a) TFEU; or in accordance
with Article 346 (1)(b) TFEU. Should the procurement be
completed under the Defence and Security Act in a fully
open manner, it would result in a strictly regulated and
binding contractual process, built on the concepts of full
transparency, fairness, non-discrimination, proportion-
ality and the promotion of competition. Because of the
above-mentioned reasons, this alternative will probably not
be feasible. Establishing a strategic capability imposes its
own, absolute requirements which, on a case-by-case basis
and through justifications, can be prioritised over com-
mercial-legal constraints.

If the procurement is completed pursuant to Article 346
(1)(b) TFEU, it will primarily be done under competitive
tendering. A sufficient number of tenderers must be request-
ed to ensure enough competition in view of the scope and
nature of the procurement. The Defence and Security Act
does not provide for the details of procurements where Part
III of the Act applies (national procedures). However, under
the discretion of the contracting authority, the procurement
can follow the Defence and Security Act's EU procurement
procedures. The contracting authority must, in adequate
detail, describe the procedure which applies, either in the
RFQ or in the tender notice. Competitive tendering under
Article 346 (1)(b) TFEU can also be implemented as a gov-
ernment-to-government contract in such a manner where
some tenderer/tenderers will follow the framework of FMS
rules. Such a principle, which is somewhat discriminatory

The Court of Justice of the European Communities has in-
terpreted Article 346 TFEU in a measured and judicious
manner. This is because Article 346 TFEU is intended to ap-
ply in situations that involve the core of national autonomy
and sovereignty. Still, the Article is an exception to the Treaty
and it, such as any other derogation of the Treaty, must be
interpreted in a restrictive way. The defence establishment ap-
plies a four-step justification model in interpreting Article 346
TFEU. The model must include the following clarifications:

1. An account explaining why it would be impossible to se-
cure the ‘essential security interests of Finland’ in a less
restrictive manner.

2. An account describing which essential security interest
of the government of Finland is involved.

3. An account of the measures which are proposed for se-
curing the essential security interests of the government
of Finland.

4. An account explaining why it would be impossible to se-
cure the ‘essential security interests of Finland’ in a less
restrictive manner.

Essential security interests of the state, as per Article 346
TFEU, are indeed associated with the procurement to re-
place the capabilities of the Hornet fleet. These interests can-
not be protected in public competitive tendering pursuant to
the Defence and Security Act, which is why the procure-
ment will inevitably result in a situation in which classified
information must be provided to prospective suppliers.
The procurement involves classified information which, if com-
promised, could cause significant harm to national security.
Nevertheless, the provision of such information is a pre-
condition for tenderers to be able to prepare contractually
binding tenders and, consequently, supply a product which
meets its performance requirements. The prospective can-
didates will sign Security Agreements at the RFQ-level and the
selected tenderer will subsequently sign a contract-spe-
cific Security Implementing Agreement. According to the
above-mentioned justifications the data protection, security-
of-supply and other requirements pursuant to the Defence
and Security Act are not adequate in protecting the essential
security interests of Finland.

The Defence Forces’ logistics arrangements in emergency
circumstances and the selection of a subsequent procurement
contractor are always included in thejaw of the Hornet fleet
procurement. The project of replacing the capabilities of the Hornet fleet is a
national defence capability often result in the realisation that
a procurement procedure pursuant to the Defence and Security
Procurements Directive does not sufficiently safeguard the
essential security interests of the state. Then, the contracting
authority has to invoke Article 346 (1)(b) TFEU. For instance,
the project of replacing the capabilities of the Hornet fleet
in so crucial to national security that the measures associated
with logistics, maintenance support and repairs have to be
implemented promptly and dependably also in emergency
conditions and the risk of there being longer response times
is simply not acceptable.

The essential security interests may require that Finland re-
tain sufficient defence industrial capacity regarding any given
critical system. Such capacity may entail technology (e.g. in-
formation technology) as well as defence equipment produc-
tion (e.g. certain ammunitions), or associated maintenance,
repair, integration and modification capability. The crux of the
matter is whether the object of the contract is so vital to na-
tional security that any undue dependency on a foreign sup-
plier could undermine our national security.

The provisions of the Defence and Security Act must not be
applied to defence and security contracts if Article 346 (1) (a)
TFEU applies to the procurement, i.e. the contract will be
classified or if the application of the Defence and Security
Act would require the disclosure of information which would
undermine the essential security interests of the state. Such a
situation may arise when the object of the contract entails
a key system for the security of the state and if already the ten-
dering process requires access to such information which is so
essential to the security of the state that, for security consider-
ations, it can only be given to those tenderers that have
thoroughly vetted and determined capable of handling highly
classified information. In practice, the Request for Quotation
will then include classified information in categories I-III.

Case-law
The Court of Justice of the European Communities has in-
terpreted Article 346 TFEU in a measured and judicious
per se, is probably permissible under the national proce- dures described in Part III of the Defence and Security Act. Should Article 346 (1)(a) TFEU apply, i.e. Section 7(1) of the Defence and Security Act, the procurement will com- pletely remain outside of the scope of application of the Act. In that case, the procurement can be implemented as best as possible, at the discretion of the contracting au- thority. Even in such a case, in practice, the procurement will be carried out through exhaustive competitive tendering, and by following the steps of a regular procurement pro- cess and its phases. Neither a government-to-government contract nor a partial application of FMS rules in the proc- urement poses any problems. In reality, both Article 346 (1)(a) and Article 346 (1)(b) will most likely have to be applied in the procurement. Fur- thermore, a derogation of the Defence and Security Act as regards contracts between governments, at least the FMS procedure which clearly permits it, will be a central ele- ment in the procurement. These exemptions also permit the inclusion of industrial participation in the contract, should it be considered appropriate.

7.4 The possibilities of securing Finland's milita- ry security of supply in the context of EU law

The EU's legal order

The aforementioned exemption, Article 346 TFEU means that the scope of interpretation of European law is broad in the context of the EU's legal order and, hence, the legal com- petence and the means available for the EU Commission to intervene in the Member States' action limiting the market are quite overarching and versatile. During the past 20 years the prevailing case-law advancing the Single Market and, subse- quently, EU legislation have resulted in there being narrow chances of success in invoking Article 346 TFEU-exemption without presenting concrete, fact-based evidence. When it comes to offsets it is equally possible to derive from the provi- sions of the Defence and Security Act if one of the grounds for exemption applies in the procurement, or if the Member State, in its preliminary analysis, invokes the 'security exemption' permitted by Article 346 TFEU on the basis of essential security interests of the state. This also includes an exemption in a government-to- government contract. The objective takes the security inter- ests of EU countries into consideration, the objective is for the security exemption in Article 346 TFEU to be applied as seldom as possible.

PDefence industrial participation – offsets in the headwind of internal market legislation

When it comes to offsets, many changes have occurred within the last 20 years. In 1992, when the previous fighter procure- ment was topical, there was no information regarding the basic tenets of internal market legislation as one of the objectives of offsets was the generation of significant benefits for Finland's eco- nomic interests. It is no longer possible to argue for offsets with economic or employment considerations. Consequently, the Off- set Rules of 1992 are no longer a guiding principle in the present environment, due to the obligations of our EU membership. In the 2013 Joint memorandum of the Ministry of the Economy and Employment and the Ministry of Defence con- cerning offsets, it is stated that direct industrial participation is still important for the defence system because it has estab- lished the capability for life-cycle support, damage repairs and maintenance and, at the same time, the life-cycle sup- port of systems procured for domestic industrial integration. The Rules on industrial participation in defence equipment procurement in Finland, published in 2012, underscore the strategic importance of both direct and indirect industrial participation for Finland.

Offset rules and their application in some reference countries

In order to paint a picture of the possibilities for guarantee- ing security of supply in the context of EU law, the working group studied the offset rules and their application in other EU countries. Denmark and the Netherlands were selected as reference countries.

Denmark's National Defence Industrial Strategy includes the basic idea that it is not possible to sustain any given level of performance and quality without industrial participation. The strategy was drafted with the requirements of EU law in mind. It overturns the following chain of thought:

1. Denmark's sovereignty and security is Denmark's own responsibility.
2. This does not merely put increasing demands on the capability of the Danish Armed Forces, but also on the quality of Danish defence industry.
3. As a small country, Denmark is dependent on the proc- urement of competitive defence equipment from abroad. In this context the European and North Ameri- can markets are brought forward, which indicates clear political connection to the 'West'.

4. However, it is necessary for Denmark's defence sector to have certain competitive industrial competencies and ca- pabilities which are particularly important for Denmark's defence policy interests.
5. As regards the previous point, the Danish defence indus- try is expected to be competitive and supply high-quality equipment that can easily be incorporated in Denmark's international military operations.

The logic described above prepares for the fact that the 'security exemption' in Article 346 TFEU can legitimately be included in the implementation of the national strategy of the country requiring the derogation. If the essential defence interests are defined at the national level, this is directly linked with which kinds of RFQs it is possible to promulgate as regards public procurements. The Defence Industrial Strategy of the Netherlands links to- gether the Ministry of Defence, the national defence and secu- rity industry as well as information-creating institutions such as research institutes and academies. The strategy emphasises that, in practice, the industries of smaller EU Member States must get access to international defence supply chains. The following real arguments making a case for industrial partici- pation can be identified in the strategy:

1. National security is a responsibility of the government. In other words, every nation must defend itself and indepen- dently determine its security policy interests.
2. The economic crisis has prompted the West to steadily re- duce defence budgets. As a result, cooperation, both do- mestic and international, in the defence industry is neces- sary in practice.
3. The defence market as it stands is neither open nor trans- parent.
4. The market environment is highly dynamic, which con- cerns technological advances as well as regulatory changes.
5. The market is greatly fragmented and in Europe there is some overlap in production.

Guaranteeing security of supply

According to the concept of comprehensive defence, defend- ing the country implies the effective utilisation of national re- sources, both in intersectoral cooperation and civilian coop- eration. This impacts the interpretation of Article 346 TFEU in the sense that a description and clarification of national security thinking is a part of the process which can prove the suitability of a derogation of the Treaty, owing to national se- curity interests. In the interpretation of the Article Member State-specific national interests and security policy solutions will be taken into consideration, when it comes to Finland these, first and foremost, include military non-alignment and the concept of comprehensive defence. For the sake of security of supply and military defence the ‘critical infrastructure’ which must be secured in all condi- tions has to be defined. It would be beneficial for Finland to draw up a uniform defence industrial strategy, à la Denmark and the Netherlands, which would take into account internal markets for ensuring security of supply from the national pers- pective, the special conditions and the focus of procurements in the defence of Finland as well as the requirement of sus- taining the international competitiveness of Finland's defence industry. The eventual strategic decision will be made with distinct guidelines regarding industrial participation. Using Article 346 TFEU as one justification in the national defence strategy that guarantees security of supply can be seen to embody a proactive law approach, which also improves le- gal certainty. An official defence industrial strategy can help prepare for any future judicial adjudication situations so that the state can present a clear-cut strategic policy to the market and EU actors alike.
8. Organising the potential fighter procurement in the defence establishment

8.1 A strategic capability project

The role of political decision-making becomes highlighted in strategic projects and ancillary sizeable procurements. Furthermore, the decisions call for wide political consensus. Such projects include, at least, the replacement of the Hornet fleet’s capabilities as part of the comprehensive air power solution and the Squadron 2020 project as part of the comprehensive solution in which the Navy’s ageing combat vessels being phased out need to be replaced.

Strategic projects have the following characteristics:
- Defence policy impacts both at home and abroad, especially with regard to defence employment.
- Exceptionally large cost impact.
- Widespread interest both at home and abroad, and
- Possibly being of great importance to the domestic industry.

8.2 Grounds for organising the strategic project

The working group familiarised itself with the ongoing fighter programmes in Denmark, Norway and Canada. One of the key issues considered by such programmes was organising the strategic project under one management. In Denmark and Norway the projects were organised under Program Offices which directly managed the fighter projects and their implementation. The Program Offices reported to their respective defence ministries. Unlike Finland, in Denmark and Norway the Defence Command Finland is organised as part of the defence ministry which, for its part, has made it possible to organise the projects at an exceptionally high level.

In Finland the Ministry of Defence and Defence Command Finland are distinct managing authorities for whom legislation and other norms set their respective tasks and competences. This is why the model adopted by Norway or Denmark cannot be directly applied in Finland. Rather, the seamless planning and implementation of the project must be achieved through a different solution.

When it comes to the development of defence it has been determined that the MoD will establish the preconditions for the development of defence while the Defence Forces remains responsible for the implementation of the capabilities of the defence system. Cooperation between the MoD and Defence Command Finland ensures that the administrative branch material policy guidance and the material, personnel, financial, real estate, environmental, information management and legislative impacts arising from procurements will comprehensively be taken into account in a timely fashion, already in the planning phases of projects.

The Ministry of Defence is responsible for facilitating the conditions for procurements as part of the defence establishment’s resource planning. The MoD manages the material policy of the administrative branch, steers the preparations for key defence material acquisition decisions and remains responsible for the defence policy guidance of strategic projects. Moreover, the MoD is responsible for intersectoral preparations and the mutual exchange of information. With regard to development the MoD’s material policy guidance extends from the development programme level to actual procurements.

Defence Command Finland guides and coordinates the Defence Forces’ planning and development as well as procurement and material functions in line with the set guidelines and goals. The creation and maintenance of capabilities is achieved through projects included in development programmes. Such procurement activity is one of the Defence Forces’ core functions. Whereas the Defence Forces’ development programmes determine overall capability development, the sought capabilities are achieved through projects. Programmes are normally organised as projects. Procurement, for its part, ensures actions with the intent to purchase material or services.

8.3 The steering groups that manage the MoD’s programmes and procurements

The strategic capabilities steering group reports to the Permanent Secretary of the MoD. Its task is to consider and coordinate foreign policy, state economy and trade economy questions when establishing the Defence Forces’ strategic capabilities.

Material policy guidance in programmes and procurements is carried out through the defence establishment’s steering group of material policy and the commercial steering group of defence administration.

The steering group of material policy, appointed by the MoD, prepares material policy related decision-making, steers the implementation of material policy and provides material policy support to the top leadership in issues related to material policy. The group also provides guidelines and leads further action on the basis of material given to it, and on the grounds of additional information handled in meetings. The goal of guidelines and guidance is to improve effectiveness and networking in material policy planning.

The decisions on acquisition and selling that fall within the remit of the Ministry of Defence and other commercially significant matters are prepared in the commercial steering group of defence administration. The guidelines of the steering group (e.g. in favour, not in favour, table, conditional endorsement) are taken into consideration during subsequent preparations and decision-making. The commercial steering group provides guidelines and direct action on the basis of material given to it, and on the grounds of reports and additional information handled in meetings. The steering group is responsible for the delivery of a capability project from the drafting of the RFI phase or, at the very latest, from the RFI phase onwards. The steering group handles all topics that entail commercial preparations prior to presenting them for decision-making. The group provides legal guidance to capability projects, especially, as regards the application of Article 446 (1) (b) TFEU. The commercial steering group also monitors the cost-effective achievement of capability projects.

International material cooperation with the governments of the manufacturing countries of all potential candidates will play a central role. Just as in previous large programmes this, for its part, increases the role of the MoD in project guidance.

8.4 Organising the replacement of the capabilities of the Hornet Fleet in the defence establishment

A precondition for a successful strategic programme involves correctly-timed MoD material policy guidance and the creation of financial requisites as well as seamless co-operation between the MoD and Finnish Defence Forces, a joint situation picture and communications as well as the unrestricted exchange of information between the different tiers of the project. When it comes to planning and implementing a strategic programme the role of the actors outside the defence establishment must also be taken into account – more so than in normal projects. The key actors include the state leadership, the Government, Parliament, the domestic industry and the media. In addition to the MoD the participation of, at least, the Ministry of Finance, the Ministry for Foreign Affairs and the Ministry of the Economy and Employment in the planning and implementation of the programme is important.

Replacing the capabilities of the Hornet fleet is an entirety which encompasses MoD material policy guidance and the implementation of the actual material programme. Existing project structures do not alone optimally support the implementation of this programme which is why, in order to replace the capabilities of the Hornet fleet, the defence establishment must create an organisation which can concentrate on the planning and implementation of the replacement project.

Hereafter, the replacement of the Hornet fleet’s capabilities is known as the HX programme. By using the HX programme designation it will be ensured that the grouping and project-specific concepts defined in the Defence Forces’ set of norms remain unambiguous. The HX programme refers to the planning and implementation of the procurement under the Defence Forces’ leadership.

The grounds for the HX programme and organising the possible fighter procurement are as follows:
- Decisions will be taken in accordance with established competencies,
- Activities will follow the existing rules of procedure, norms and regulations of the defence establishment,
- When needed, programme, procurement and project plans will specify the procedures required by activities, and
- Best practices and sound professionalism will be used in procurement and project activities.

It is recommended that an HX Programme Steering Group (which can be the already existing steering group at the Baracks Square2, augmented with the Commander of FiAF and the HX Programme Coordinator) be established as an instrument of the defence establishment’s HX programme guidance. Its task is to coordinate the views of the MoD and the Defence Forces and the shared situation picture during the different phases of the project, and provide guidance and support for project planning and implementation. Its composition should be as follows:

- Director General, Resource Policy Dep’t (chair)
- Director General, Defence Policy Dep’t
- Deputy Chief of Staff, Strategy, Defence Forces
- Deputy Chief of Staff, Logistics and Armaments, Defence Forces
- Commander, Finnish Air Force
- HX Programme Coordinator, (secretary)

2 The physical location of the Ministry of Defence and Defence Command Finland
In order to be able to direct the HX programme with sufficient expertise the steering group must remain sufficiently small. Its members must be persons that are directly involved with managing the planning and implementation process of the strategic project. The steering group is not an instrument of informing the leadership for this purpose, other steering groups must be used.

It is recommended that an HX Programme Coordination Group be established under the HX steering group. Its task is to coordinate the planning, preparations and implementation of the HX programme, and to maintain a shared situation picture. The HX Programme Coordination Group will coordinate intersectoral cooperation and support the commercial steering group of the defence administration in providing guidance for the preparations. The coordination group prepares the HX programme plan. This plan determines the goals, tasks, responsibilities and modes of operation of the programme, and defines the capability project’s materiel and defence policy grounds (= materiel and defence policy requirements). The programme plan also establishes how the HX programme situation picture, communications and Quality Assurance (QA) supporting the project as well as cost management and risk management will be implemented. The coordination group comprises the following members:

- HX Programme Coordinator (chair), MoD
- Representative from the MoD’s Materiel Unit
- Representative from Defence Command Finland (as required)

In order to prepare the guidance for the HX programme at MoD-level a separate unit (an ‘HX Programme Secretariat’) shall be established. The secretariat will report to the Director General, Resource Policy Department (MoD). Its task is to prepare the material policy guidance, the implementation of intersectoral preparations, the planning of defence industrial participation, communications, the required QA activities, risk management and cooperation outside the defence establishment. The HX Programme Coordinator shall lead the secretariat. The proposed overall organisation is presented in the figure below.

Other than this, the implementation of and guidance for replacing the capabilities of the Hornet fleet will be carried out in accordance with the regular norms of the Defence Forces. The key grounds for taking a decision on the HX programme are security and defence policy, operational capabilities, life-cycle costs and security of supply which also includes industrial participation. The planning responsibilities for these decision-making grounds shall be assigned in the HX programme plan. Owing to the impact of strategic projects their decision-making processes also differ from those of other acquisitions.

Bodies participating in the HX programme

- Ministry of Defence
- Defence Command Finland
- Finnish Air Force
- Finnish Defence Forces Logistics Command

The procurement consists of introduction into service and a materiel project. Air Force Command is responsible for the introduction project and the Defence Forces Logistics Command for the materiel project. These projects include sub-projects and work phases which, together, achieve the materialisation of the programme. Development programme guidance as well as procurement and project management will be carried out in accordance with prevailing norms and regulations.

Owing to the impact of strategic projects their decision-making processes also differ from those of other acquisitions.
9. Research needs associated with the project

In order to identify the future procurement related-needs for conducting research outside of the defence establishment the working group charted the completed and ongoing research projects on the project's subject matter. The focus of this endeavour was on the research projects of the Finnish Defence Research Agency, research findings and theses of the Finnish National Defence University, and research conducted by Finns at foreign academies. On the basis of charting the research the working group commissioned two research projects, deemed urgent, and one study to serve the implementation of the project.

The first research project addresses the future significance of stealth technology in view of the evolution of possible counter-technologies and counter-measures. It analyses the stealth performance of 4++ and 5th generation fighters vs spatially distributed radar systems that may use multiple frequencies in an agile manner. The salient research question involves characterising differences in 4++ and 5th generation multi-role fighters’ detectability from the perspective of an advanced radar system. The study will be completed in 2015.

The second research project addressed safeguarding Finland’s military security of supply in the context of European law on materiel acquisitions. The study was completed in April, 2015. It analysed the legal base and possible solutions for safeguarding security of supply. In addition, the study assessed Finland’s leeway in this matter within the constraints of EU law. The study was carried out by Juha Rautio, Professor of European law at the Aalto University. The study focused on the following topics:

1. Possibilities of also safeguarding military security of supply through direct and indirect defence industrial participation; the offset rules of certain reference countries and their application – legal analysis,
2. Evaluation of the previous fighter procurement’s offset rules in light of modern legislation; what has changed and what is the impact of the new framework, and
3. Article 346 TFEU and the compelling reasons for derogating from EU law because of the essential security interests of the state: What could these reasons be in Finland’s security environment?

The final product of this study is a set of recommendations for preparations in defence acquisitions, especially from the perspective of security of supply. The key results of the study are presented in sub-chapter 8.4.

The working group also commissioned a study of the forthcoming project’s life-cycle costs, including a comparison of the life-cycle costs of different options. Life-cycle costs typically include all costs associated with the operation of any given capabilities or a system, ranging from investments to operations. There are many models by which costs can be calculated. Different countries calculate costs in their own way and from their own standpoint. This makes it challenging to come up with a uniform calculation model and to estimate and compare the life-cycle costs of different alternatives.

The purpose of this study is to create a suitable calculation model for Finland which can reliably evaluate the life-cycle costs of the future project, and compare the life-cycle costs of different options. The model will also be validated by calculating the life-cycle costs of the Hornet fleet as reference material in such a manner that the results correspond with the true and known costs of the Hornet fleet. The study will be implemented under the leadership of the Finnish Defence Forces Logistics Command. The calculation model, i.e. the result of the study, will be completed by the autumn of 2015.
10. The procurement process and the schedule

Topics to be included in Requests for Information

- The goal of the HX programme is to replace the capabilities of the Hornet fleet in the most cost-effective manner to Finland's state economy. The capability which will be created through the procurement must be viable for at least 30 years, and it must be constantly sustained and developed. Material procurements will create the required material capabilities for normal and emergency conditions, and security of supply.

- In conjunction with initiating the programme a material project will also be launched which, on the basis of established capability requirements and concepts, commences the drafting of Requests for Information (RFI). During the RFI phase the requirements and the concepts will be further adjusted. By the time the Requests for Quotation (RFQ) are promulgated the requirements and concepts will be frozen except for minor details which can be specified up until signing the procurement contract.

- RFIs can be sent directly to manufacturers or to the authorities administering the defence industries in their countries. When it comes to the HX programme the air vehicle and its systems comprise the products of several companies. In order to guarantee that the complete weapon system will be addressed it is better to send the RFIs to the governments as well as the commercial and contractual principles of the procurement process.

- The planned content of the RFI is as follows:
  - Introduction: The goals of the programme, schedule, phases as well as the commercial and contractual principles of the procurement process.
  - Concepts: A description in coherent terminology of the present modes of operation as well as a presentation of ideas for future possibilities.

The objective is to provide the correct idea to each tenderer:
- Where and how do we operate at present.
- How do we wish to operate in the future.
- What functionalities and systems are worth preserving so that the tenderers can propose:
  - How should one operate in different sectors in the future.
  - What functionalities and systems are worth preserving and developing, or replacing.

- Capability requirements: The key requirements and, possibly, those still in the process of being completed.

The HX programme must be initiated no later than the autumn of 2015. The final selection, i.e. the procurement decision, must be made in such a timetable that the preconditions for signing the procurement contract are in place by the end of 2020. The following figure illustrates the rough schedule of the programme.

The HX programme schedule

The completed fighter procurement schedules of other countries as well as the completed schedules of the Defence Forces' previous aircraft procurements were utilised in creating the programme schedule. As part of the preliminary process the RFIs are presently being drafted. The goal is to be able to send the RFIs in February 2016. After that, the procurement process will proceed as follows.

- Responses to RFIs 10/2016
- Promulgation of RFQs 02/2018
- Tenders 02/2019
- Contracts 02/2021

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  - How should one operate in different sectors in the future.
  - What functionalities and systems are worth preserving and developing, or replacing.

- Capability requirements: The key requirements and, possibly, those still in the process of being completed.

- System requirements: Only in major detail and to the extent that they create critical constraints to the completion of the procurement.

- System architecture: A preliminary system architecture description:
  - The functional and physical elements to be included in the system.
  - The functional and physical elements that belong (or need to be developed) to this programme, or the functional and physical elements that belong to other programmes.

- Requirement management and selection criteria: A description of the Defence Forces’ requirement management regime and requirement hierarchy, capability requirements, functional capability and system requirements as well as commercial and contractual requirements. The tenderers will be given information on how the information received through RFI and RFQs is handled, and how the final selection will be made on the grounds of said information and evaluations. The actual requirements are not included in this item. Rather, the point is to illustrate the process of requirement management as a whole.
  - The requested information: An itemised list of the information which must be included in the response to the RFI. As regards concept descriptions, the tenderers are asked to provide feedback and recommendations for improvements.
  - Release issues: The tenderers are asked to provide an account of the issues that require release requests in order to make it possible to proceed to the RFQ phase.
11. The recommendations of the working group

On the basis of the preliminary assessment, the working group issues the following recommendations for the implementation of the procurement:

1. Adhere to the Hornet fleet’s original service life because, as per the preliminary assessment, there are no grounds for extending its service life.
2. Replace the Hornet’s capabilities with a solution based on a multi-role fighter.
3. Launch the HX programme no later than the autumn of 2015.
4. Set up an HX Steering Group, an HX Programme Coordination Group, and an HX Programme Secretariat, and establish their tasks, competencies, and compositions.
6. Make use of the derogation of the EU Defence and Security Procurements Directive, permitted by Article 346 TFEU, because the procurement processes pursuant to the Directive are not suitable for this acquisition.
7. Draw up a defence industrial strategy and establish the project-related requirements for an independent capacity and security of supply.
8. Establish the need and possibilities for external auditing (quality assurance, QA).
<table>
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<tr>
<th>Terms and definitions</th>
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<tr>
<td><strong>Protection of Finland's territorial integrity</strong></td>
<td>The use of force or other means adopted by the Defence Forces and other territorial surveillance authorities to prevent or repel territorial violations.</td>
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<td><strong>Surveillance of Finland's territorial integrity</strong></td>
<td>The activity of the territorial surveillance authorities which is carried out primarily at Finland's borders to prevent, expose and investigate territorial offences and territorial violations.</td>
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<td><strong>Life-cycle</strong></td>
<td>The timespan which begins when the requirement for a system or an item is initially determined until the time when said system is decommissioned.</td>
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<td><strong>Programme</strong></td>
<td>The functional entirety through which the capability of a unit or system is created and/or supported, and for which the content, objectives and resources are explicitly defined.</td>
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<td><strong>Security of supply</strong></td>
<td>The capability to sustain such vital economic functions of society which are critical to the living conditions of the population, the functioning and security of society and safeguarding the supply of materiel to national defence in the event of severe disruptions and emergency conditions.</td>
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<td><strong>Offensive counter-air</strong></td>
<td>Air operations intended to destroy, disrupt, or limit the adversary's air power as close to its source as possible.</td>
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<td><strong>Control of the air</strong></td>
<td>The actions and preconditions which, for their part, guarantee freedom of action to one's own operations by limiting the adversary's air power and air defence capabilities, or by nullifying his operational energy. Sufficient control of the air is a precondition for the success of land, sea and air operations. Offensive counter-air operations are typically used to gain control of the air.</td>
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<td><strong>Air supremacy</strong></td>
<td>The degree of air superiority wherein the opposing air force is incapable of effective interference.</td>
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<td><strong>Air operation</strong></td>
<td>Such military measures or missions which are primarily carried out using aircraft to attain the goals of a battle or a military operation.</td>
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<td><strong>Air defence</strong></td>
<td>All actions of the Defence Forces and the other authorities implemented in monitoring Finland's airspace and adjacent areas, protecting the integrity of its airspace, protecting society's vital functions from air attacks, wearing down the airborne aggressor and repulsing all air attacks. All military services, the Border Guard and the civil authorities participate in air defence.</td>
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<td><strong>Air defence system</strong></td>
<td>An integrated system in which all air defence sensors (radar, visual air surveillance and other technical methods) and weapon systems (anti-aircraft guns and missiles, and fighters) are placed under one centralised command and control system.</td>
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<td><strong>Air power</strong></td>
<td>The ability to project force from the air and space to impact the actions of humans and to shape events.</td>
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<td><strong>Unmanned aerial vehicle</strong></td>
<td>Military unmanned aerial vehicles are used, for example, in intelligence, surveillance, target acquisition and recognition (ISTAR).</td>
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<td><strong>Multi-role fighter</strong></td>
<td>A combat aircraft which can perform both air-to-air and air-to-ground missions. A multi-role fighter's tasks can be changed, as required by the situation, between sorties or, when necessary, during a sortie. Air operations can flexibly be formed by using multi-role fighters.</td>
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