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November 2018

Masthead

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This report is a part of Centre for Military Studies' policy research services for the Ministry of Defence and the political parties to the Defence Agreement. The purpose of the report is to analyse the challenges and risks to be faced as the Danish Defence integrates the F-35 by reflecting upon Denmark's experience with the F-16, the plans of United Kingdom, the Netherlands, and Norway, and the broader security environment.

The Centre for Military Studies is a research centre at the Department of Political Science at the University of Copenhagen. The Centre undertakes research on security and defence issues as well as military strategy. This research constitutes the foundation for the policy research services that the Centre provides for the Ministry of Defence and the political parties to the Defence Agreement.

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Kolofon

Integration af F-35 i det danske forsvar

Denne rapport er en del af Center for Militære Studiers forskningsbaserede myndighedsbetjening for Forsvarsministeriet og de politiske partier bag forsvarsforliget. Formålet med rapporten er at analysere de udfordringer og risici, dansk forsvar står overfor i forbindelse med integrationen af F-35-kampflyet, ved at sammenholde erfaringer fra F-16 implementeringen med planerne for F-35-integration i Holland, Norge og Storbritannien, og set i lyset af det bredere sikkerhedsmiljø omkring Danmark.

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Denne rapport er et analysearbejde baseret på forskningsmæssig metode. Rapportens konklusioner er ikke et udtryk for holdninger hos den danske regering, det danske forsvar eller andre myndigheder.

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Abstract and Recommendations

In June 2016, the Danish Parliament approved the procurement of 27 F-35 fighter aircraft to replace the Royal Danish Air Force's remaining fleet of 30 operational F-16s. Scheduled for delivery between 2021 and 2026, the F-35 acquisition is only the first of a number of decisions to be taken in the coming years. Previous fighter aircraft acquisitions reveal three sets of risks and challenges inherent in such decisions.

The first set of risks concerns the building of a sufficient organizational structure around the aircraft so that they can perform the set of tasks expected by the Parliament. Adequate numbers of pilots, technicians, and flight engineers must be trained in time to fly and maintain the aircraft to meet the schedule for their delivery accepted by the Parliament. The facilities at Skrydstrup Air Base must also be ready to house, service, and protect the aircraft.

The second set of risks concerns the integration of the new aircraft into the Royal Danish Air Force (RDAF) and the Danish armed forces more broadly. In the past, new aircraft enabled the RDAF to expand the types of tasks that it could perform, including how it interacted with the forces of the Royal Danish Navy and Army, and the forces of Denmark's NATO allies.

The third set of risks arise from the possibility that the aircraft can be used in new ways to address currently unforeseeable security challenges. The F-16 fleet played a substantial role in enabling Danish leaders to respond to changes in the international security environment after the Cold War. The F-35 will likely play a similarly fluid role over the course of its 40-year life expectancy.

This report analyses these risks and challenges in light of Denmark's experience with the F-16, the plans of its North European partners in the F-35 programme, and the broader security environment for Danish defence policy. The report concludes with potential considerations for Danish policy makers.

- Consider the risks inherent in recruiting, educating, training, and retaining sufficient numbers of pilots and maintenance personnel.
- Consider retaining very experienced pilots as US-based instructors for a number of years in order to populate the new F-35 squadron with experienced pilots to the extent possible.
- Consider the risks inherent in managing the flight hours remaining in the F-16 fleet in relation to potential demands for additional deployments to international operations, air policing missions, exercises, and the increased training requirements inherent in the transition to a new aircraft.

- Consider contingencies to remedy potential shortfalls in F-16 fleet flight hours.
- Consider the possibility that additional aircraft may be required in the future.
- Consider expediting the construction of new and refurbished facilities at Skrydstrup to avoid further delays in the acceptance of F-35s to Danish territory.
- Consider a thorough risk assessment of the physical, electromagnetic, and cybersecurity measures planned for F-35 storage and information at Skrydstrup.
- Consider the requirements for adjusting maintenance structures, processes, and labour agreements to accommodate the cooperative multinational maintenance system of the F-35 programme.
- Consider the geostrategic position of Skrydstrup Air Base relative to potential contingencies in the Baltic Sea region and implement appropriate capacities relative to national and NATO requirements, including options for ground-based air defence (GBAD) systems.
- Consider increasing participation in Red Flag training exercises to develop pilot competencies in high intensity, multinational air contingencies.
- Consider developing a regional exercise in the airspace over the North Sea to enhance training opportunities with other F-35 users in northern Europe.
- Consider the requirements for the integration of future Danish maritime and air power capabilities, including communications, sensors, command and control, and coordinating the firing of munitions.
- Consider requesting Danish participation in multinational exercises involving the United Kingdom and Norway to practice integrating air and maritime capabilities.
- Consider future F-35 command and control (C2) arrangements together with other European F-35 user nations to ensure the agile, flexible, and effective employment of the F-35 aircraft with its sensors, sensor fusion, and communication capabilities.
- Consider including an air-launched strike missile that can be carried in the internal weapons bay of the F-35 in the investigation of ‘a potential future acquisition of long-range precision-guided missiles’ recommended in the 2018 Defence Agreement.

Dansk resumé og anbefalinger

Folketinget godkendte i juni 2016 anskaffelsen af 27 F-35 Joint Strike Fighter-kampfly til Forsvaret. F-35-flyene leveres i perioden 2021-2026 og skal afløse Flyvevåbnets aldrende F-16-kampfly. Men beslutningen om anskaffelsen er kun den første af en række beslutninger, som skal tages i de kommende år. Forsvaret forventer, at F-35-flyene er fuldt operative i 2027. Danmarks tidligere anskaffelse af kampfly har dog vist, at der er tre overordnede udfordringer forbundet med at integrere nye kampfly i Forsvaret.

Første udfordring er at sikre en tilstrækkelig robust personelstruktur til at vedligeholde og flyve flyene. Forsvaret har tidligere haft udfordringer på dette område, og netop i overgangen fra F-16 til F-35 vil Forsvaret være særligt sårbar over for personelmangel inden for pilot- og teknikerområdet. Tillige skal basefaciliteterne på Flyvestation Skrydstrup tilpasses og ombygges til de nye fly.

Anden udfordring er integration af de nye kampfly i Forsvarets struktur. F-35 er et såkaldt femtegenerations-kampfly, som har en række nye, avancerede egenskaber, som Forsvaret skal arbejde med for at udnytte fuldt ud, ligesom da F-16-flyene blev integreret i 1980'erne.

Tredje udfordring er, at F-35-flyene giver nye anvendelsesmuligheder for kampfly i nationale og internationale operationer, hvilket også giver Danmark nye sikkerhedspolitiske muligheder. F-16-flyene blev opdateret og fik nye opgaver, da det danske forsvar blev omstillet efter ophøret af den kolde krig. Sandsynligvis vil F-35 også få nye opgaver igennem de ca. 40 år, flyene forventes anvendt i dansk forsvar.

Denne rapport analyserer disse udfordringer på baggrund af Danmarks erfaringer med F-16-kampflyet samt under hensyn til de erfaringer, Danmarks tre nordeuropæiske nabolande Norge, Holland og Storbritannien allerede har gjort i deres F-35-implementering, som er tre til fem år forud for Danmarks. Rapporten afsluttes med en række anbefalinger til F-35-implementeringsprocessen i Danmark og et antal sikkerhedspolitiske overvejelser.

- **Piloter og teknikere:** Flyvevåbnet har historisk været udfordret af længere perioder med mangel på piloter og/eller teknikere. Særligt i overgangen fra F-16 til F-35 vil Flyvevåbnet være sårbart over for pilot- og/eller tekniker mangel. Derfor bør et fortsat fokus være fastholdelse af erfarent personel og rekruttering samt uddannelse af nyt personel til Forsvarets kampfly.
- **F-16-flyvetimer:** F-16-strukturen skal kunne opretholdes, således at nationale opgaver – herunder afvisningsberedskabet – kan løses, indtil F-35-flyene er operative. Desuden skal træning kunne udføres på F-16 for at fastholde evnen til opgaveløsning. Dette betyder, at flyvetimer i de tilbageværende F-16-fly kan blive en kritisk ressource. Der bør der-

- for udarbejdes planer for at opretholde et tilstrækkeligt antal F-16-flyvetimer, hvis der skulle opstå forsinkelser i F-35-integrationen.
- Antal F-35-kampfly: I den politiske beslutning om kampflyanskaffelsen lægges der op til en politisk drøftelse omkring anskaffelse af de sidste seks fly, forud for indgåelse af kontrakt på disse fly. På dette tidspunkt kan det også overvejes, om Danmarks evt. bør anskaffe yderligere F-35-kampfly for at sikre en mere robust kampflystruktur.
 - Faciliteter på Skrydstrup: Forsvarsministeriet har besluttet at opføre nye faciliteter til F-35-flyene på Flyvestation Skrydstrup. Disse faciliteter – inklusive fysiske og elektromagnetiske sikkerhedsforanstaltninger til at beskytte flyene – skal være færdiggjort, inden de første F-35 kan operere fra Skrydstrup. Færdiggørelse af disse faciliteter er derfor kritiske for rettidig integration af F-35.
 - Vedligeholdelse: Vedligeholdelsen af F-35 er radikalt anderledes end i relation til F-16, idet en række vedligeholdelsesopgaver vil blive gennemført på internationale værkstedsfaciliteter i bl.a. Norge, Storbritannien, Holland og Italien. Derfor må den nationale kampflyvedligeholdelsesstruktur tilpasses fra F-16 til F-35.
 - Skrydstrup som forstærkningsbase: Flyvestation Skrydstrup ligger centralt som F-35-operationsbase i forbindelse med en krise og/eller NATO-krisestyringsoperation omkring Østersøen. Derfor bør der udarbejdes planer for evt. modtagelse af udenlandske F-35-fly på flyvestationen i en sådan situation.
 - International F-35-træning: Der eksisterer et stort potentiale for forstærket internationalt trænings- og øvelsessamarbejde mellem nordeuropæiske F-35-brugernationer. Luftrummet over Nordsøen er velegnet som trænings- og øvelsesområde for F-35-fly fra Norge, Storbritannien, Holland og Danmark. Desuden bør Danmark søge deltagelse i de planlagte norske og britiske træningsaktiviteter mellem fly- og flådestyrker. Endvidere bør det overvejes at øge dansk deltagelse i Red Flag-øvelser for at træne multinationale luftoperationer i et højintensitetsmiljø.
 - Værnsfælles integration: F-35-flyet har potentiale til at kunne integreres tættere med enheder i Søværnet og Hæren end F-16-flyet pga. de omfattende sensorer og muligheden for elektronisk informationsdeling. Tiltag til en sådan integration og dens praktiske effekter for de to andre værn bør derfor indtænkes tidligt i integrationen.
 - Kommando og kontrol: I F-35-flyet vil piloten – pga. flyets avancerede sensorer – have et væsentligt bedre situationsbillede, end tilfældet er i F-16. Derfor bør gennemførelse af luftoperationer analyseres med henblik på – sammen med andre F-35-brugernationer – at undersøge mulighederne for at delegere en større grad af ansvar til piloten. Vedkommende vil ofte sidde med det bedste situationsbillede over operationsområdet.
 - Længererækkende præcisionsmissiler: I aftale på forsvarsområdet 2018-2023 er det anført, at der skal gennemføres et analysearbejde for at undersøge behovet for anskaffelse af længererækkende præcisionsmissiler. En sådan undersøgelse bør også omfatte en analyse af muligheder for at bevæbne F-35 med længererækkende præcisionsmissiler, som f.eks. vil kunne medbringes internt i flyets våbenrum.

1

Introduction

On 9 June 2016, the Danish Parliament authorized the acquisition of 27 F-35A *Lightning II* Joint Strike Fighter (JSF) aircraft.¹ But parliamentary approval is only the beginning of the process to replace the military capability hitherto provided by Denmark's ageing fleet of 30 operational F-16AM/BM *Fighting Falcons*. Before the first Danish pilot climbs aboard a Royal Danish Air Force F-35 at Skrydstrup Air Base to carry out the first mission, a number of related initiatives will be implemented. The purpose of this report is to identify and discuss the risks and challenges inherent in these decisions and initiatives by learning from the other countries that are acquiring the F-35 together with the historical experiences of the Royal Danish Air Force in its defence policy context.

We argue that Denmark is not acquiring combat aircraft per se, but rather a new military capability that requires more than hardware. It requires people, organization, processes, and guidance before the hardware can be used to achieve the objectives set for it by the Danish government. A previous CMS report analysed how Denmark addressed these requirements when it last acquired combat aircraft, the report finding that Denmark faced three sets of challenges: sufficiently resourcing the air force to use the aircraft effectively, mastering and adapting to the new capabilities enabled by the aircraft, and taking advantage of these capabilities to adjust Danish defence policy to the requirements of a changing international security environment.² We utilize this framework to analyse some important aspects of what can be done to integrate the F-35 aircraft into the Danish defence structure.

The first set of risks concerns building a sufficient organizational structure around the aircraft so that they can perform the set of tasks expected by the Parliament. Adequate numbers of pilots, technicians, and flight engineers must be trained in time to fly and maintain the aircraft according to the schedule for their delivery accepted by the Parliament. The facilities at Skrydstrup Air Base must also be ready to house, service, and protect the aircraft. Without such preparations, Denmark may not possess the capability to fulfil the tasks currently performed by the F-16 fleet.

The second set of risks concerns the integration of the new aircraft into the Royal Danish Air Force (RDAF) and the Danish armed forces more broadly. In the past, new aircraft enabled the RDAF to expand the types of tasks that it could perform, including how it interacted with the Royal Danish Navy and Army, and the forces of Denmark's NATO allies. These changes required subsequent adjustments in operational concepts, training regimes, and exercises. The Danish Defence will need to prepare to address these issues if Denmark is to meet its security needs in the region and effectively address the expectations of its NATO allies.

The third set of risks arises from the possibility that the aircraft can be used in new ways to address currently unforeseeable security challenges. The F-16 fleet played an important role in enabling Danish leaders to be able to respond to changes in the international security environment after the Cold War. The F-35 will likely play a similarly fluid role over the course of its

40-year life expectancy. It is unlikely that the security environment of today, and Denmark's role and aspirations within it, will remain unchanged over the next four decades. The acquisition was based on the assumption that the F-35 would perform precisely the same roles and missions as the F-16 fleet today. Changing conditions necessitate adaptation. For instance, the resurgence of Russian activity in the Baltic Sea region suggests that Denmark's geographic position has regained particular importance, and the F-35 force will likely play a key role in adapting to these changes. Furthermore, the multinational nature of the JSF programme will likely facilitate Danish action in concert with others to adapt to these changes. The government should be prepared to quickly adjust its policies and practices to best adapt to these changes.

This report analyses these three sets of risks by reflecting on Denmark's experience with the F-16 and the plans and policies of Denmark's partners in the multinational F-35 JSF programme. In the following chapter, we provide a short overview of this programme and the plans of the United Kingdom, the Netherlands, and Norway to inform readers of their efforts to integrate the F-35 into their respective armed forces. These nations are three to five years ahead of Denmark in the implementation of their acquisition, meaning that they have experience that should be considered. We then turn to the risks that Denmark is likely to be challenged to handle to integrate the F-35 into its air force, its armed forces, and its defence policy. The government has publicly acknowledged carefully considered plans to address some of these challenges.³ We analyse these plans in light of the Danish experience with the F-16, the plans of its JSF partners, and the broader security environment for Danish defence policy. The final chapter of the report considers the match between plans and requirements for each of the risks that we have identified. We then provide suggestions and recommendations that can be considered by Danish policy makers as they undertake further decisions to move beyond the type selection and integrate the F-35 into the Danish defence structure.

This report is produced in accordance with the guidelines in the Project Manual for the Centre for Military Studies and has been subjected to rigorous internal and external peer review.⁴ Our sources are publicly available documents produced by government agencies in Denmark, the Netherlands, Norway, the United Kingdom, the United States, and the multinational Joint Program Office that manages the Joint Strike Fighter programme, as well as more general analyses and news reports that provide additional detail and context to specific areas of interest. We have spoken to several officials from these countries – including civil servants and military officers – as well as employees of private sector companies and researchers based in academia to place these documents in context and to provide a fuller understanding of their import. As always, however, the arguments presented in this report are those of the authors and not those of any government agency.

2

The JSF Programme and Denmark's Partners

The acquisition of the F-35 is the largest procurement programme in Danish military history, the culmination of almost 20 years of Danish participation in a multinational programme to develop and produce the aircraft. The programme has enabled Denmark to join a group of its closest allies and concurrently acquire the newest and most sophisticated fighter aircraft operated by the United States, which will permit Denmark to enjoy the potential benefits of a large production run, cooperative maintenance sustainment programmes, and the interoperability that commonality brings over the next 40–50 years. These arrangements both enable and constrain how Denmark can implement the programme. They also provide opportunity to examine the plans and policies of partners that are further along for lessons and potential best practices.

This chapter briefly describes the Joint Strike Fighter (JSF) programme and then analyses the implementation programmes of Denmark's three northern European partner nations: the UK, the Netherlands, and Norway. We provide an overview of the number and type of aircraft that each partner has chosen to acquire; when they plan to be delivered, initially operational, and fully operational; how they have approached the training of their pilots and maintenance personnel; their plans for participating in JSF maintenance; and any changes to their air base facilities that they have deemed necessary to accommodate the new aircraft. We argue that their plans and policies can help to set expectations regarding the shape and dimensions of the Danish F-35 implementation.

2.1

The Joint Strike Fighter Programme

The United States initiated the JSF programme 25 years ago to overcome three challenges facing Western militaries. The first was the ever-increasing cost of military hardware that incorporated increasingly advanced, military-exclusive technology. The second challenge was the understanding that the affordability and effectiveness of collective defence amongst Western allied nations was undermined by the heterogeneity of military systems developed and produced by individual nations – particularly as technology increased the costs of research, development, testing, acquisition, operation, and sustainment.⁵ Commonality, it was argued, would reduce costs through economies of scale and increase interoperability amongst allies, thereby enhancing both the quantity and quality of Western militaries. The third challenge was the ever-improving capabilities of potential adversaries that would have to be overcome for Western military equipment and modalities of operations to remain viable. The JSF programme has been shaped with each of these challenges in mind.

The JSF programme drew on the lessons of the multinational F-16 programme that Denmark joined in 1974.⁶ The United States brought partners into the process earlier than in the case of the F-16 so that they could con-

tribute to defining the requirements of the aircraft, increase the likelihood that allies would acquire the aircraft, and to share the financial burden of development and production. The programme was successful in this regard. The US Air Force, Navy, and Marine Corps, partner nations the United Kingdom, Italy, the Netherlands, Norway, Denmark, Turkey, Canada, and Australia, and foreign military sales (FMS) customers Japan, South Korea, and Israel are planning to acquire and operate a total of 3197 JSF aircraft in three variants – the conventional F-35A, the vertical short take-off and landing F-35B, and the carrier-based F-35C.⁷ The number of aircraft that each country are planning to acquire is presented in Table 2.1.⁸ In April 2018, the JSF project completed the System Design and Development (SDD) phase,⁹ and 300 F-35 aircraft have been produced and delivered to eight JSF partner nations and FMS customers as of 11 June 2018.¹⁰

Table 2.1: JSF Procurement Quantities¹¹

United States	Programme of Record	Partner countries	Programme of Record	Foreign Military Sales	Programme of Record
US Air Force	1763	Denmark	27	Israel	50
US Navy	273	Netherlands	37	Japan	42
US Marines	420	Norway	52	South Korea	40
		Canada	65		
		Italy	90		
		Australia	100		
		Turkey	100		
		UK	138		
US Total	2456	Partner Total	609	FMS Total	132

The JSF Joint Program Office (JPO) provides the governing structure for the programme and includes all of the partner nations. The JPO aggregates the orders of the partners and, after negotiations with the industry consortium led by prime contractor Lockheed Martin, submits a single order for a ‘lot’ of aircraft each year. The JPO provides other governance functions, including developing sustainment arrangements with the partner nations to maintain the economies of scale that will reduce maintenance costs. The JPO will aggregate all participant procurement requests for materiel and services ‘to the extent feasible’ to achieve economies of scale¹² and coordinate the sharing of data associated with the fleets of aircraft operated by the programme partners to facilitate their efficient maintenance, modification, structural assessment, and, ultimately, disposal.¹³

2.2

Partner Plans

The commonality encouraged and enforced by the JSF programme has not precluded differences in when the partners decided to acquire their aircraft, the number that they have chosen to buy, how they are integrating their aircraft into their air forces, and the roles that they will play in securing their national security interests. Denmark’s regional partners – the UK, the Netherlands, and Norway – made their investment decisions earlier and are therefore further along in implementing them. In the following pages, we discuss these plans and their differences to identify potential lessons for Danish decision makers.

The United Kingdom is the largest partner in the programme, after the United States, and they plan to acquire two different models of the F-35: 48 of the F-35B model for the Royal Navy (RN) and likely 90 F-35As for the Royal Air Force (RAF), for a total of 138 aircraft.¹⁴ The UK received its first F-35B aircraft for testing and evaluation in 2012 and received its first aircraft in country in 2018.¹⁵ The UK will operate these aircraft jointly, with the RAF/RN's land-based F-35Bs reaching an initial operating capability (IOC) on 31 December 2018, the sea-based F-35Bs reaching IOC in conjunction with the HMS Queen Elizabeth aircraft carrier in 2020, and each are to achieve full operating capability (FOC) in 2023.¹⁶

Before the Dutch Ministry of Defence or Parliament decided to select the F-35 to replace its F-16 fleet, the Netherlands acquired two early-production aircraft to join the US and UK in its testing and evaluation.¹⁷ This investment enabled Dutch pilots and maintenance personnel to be more involved with the programme when the aircraft were delivered in 2013.¹⁸ In September 2013, the Dutch chose to acquire a further 35 F-35As at a cost of EUR 4.5 billion, with financing for their first order approved by the Dutch Parliament on 26 February 2015.¹⁹ The first eight aircraft will be delivered in 2019.²⁰ The Dutch expect to declare IOC in 2021 and FOC in the third quarter of 2024.²¹ At the same time, the Dutch will phase out the last of their current structure of 68 F-16 aircraft.

The Norwegian government selected the F-35A in November 2008.²² They decided to acquire 52 F-35As in June 2012 at a cost of NOK 71.5 billion (approximately EUR 7.5 billion; 2017 values).²³ The first two aircraft were delivered for training in the US in 2015, followed by two more in 2016.²⁴ In early November 2017, Norway received three F-35As delivered directly to Ørland Main Air Station and by the end of 2017 had a total of 10 aircraft.²⁵ The Norwegians plan to reach IOC in 2019, to receive all 52 aircraft in 2024, and reach FOC 2025 in concert with their acquisition of P-8 maritime aircraft.²⁶ At the same time, Norway will phase out the last of their current structure of 56 F-16 aircraft.

Denmark will receive its first aircraft for US-based training in 2021 and its first aircraft will arrive in country in 2023.²⁷ The remainder of the fleet will be delivered between 2022 and 2026. The partial Danish fleet of F-35s will achieve an equivalent of IOC in 2024 together with the phase-out of the last of the current 30 Danish operational F-16s. An equivalent of FOC will be reached in 2027, the year after the entire fleet of 21 aircraft intended for operations has arrived in Denmark.²⁸ These partner programme milestones are compiled in Table 2.2 and Figure 2.1.

Table 2.2: Key Milestones in F-35 partner Programmes

	Type Selection	Current F-16	Number F-35	1 st Aircraft Received	1 st Delivered in Country	IOC	FOC
UK	2001	Nil	138	2012	2018	2018/2020	2023
Netherlands	2013	68	37	2013	2019	2021	2024
Norway	2008	56	52	2015	2017	2019	2025
Denmark	2016	30	27	2021	2023	2024	2027

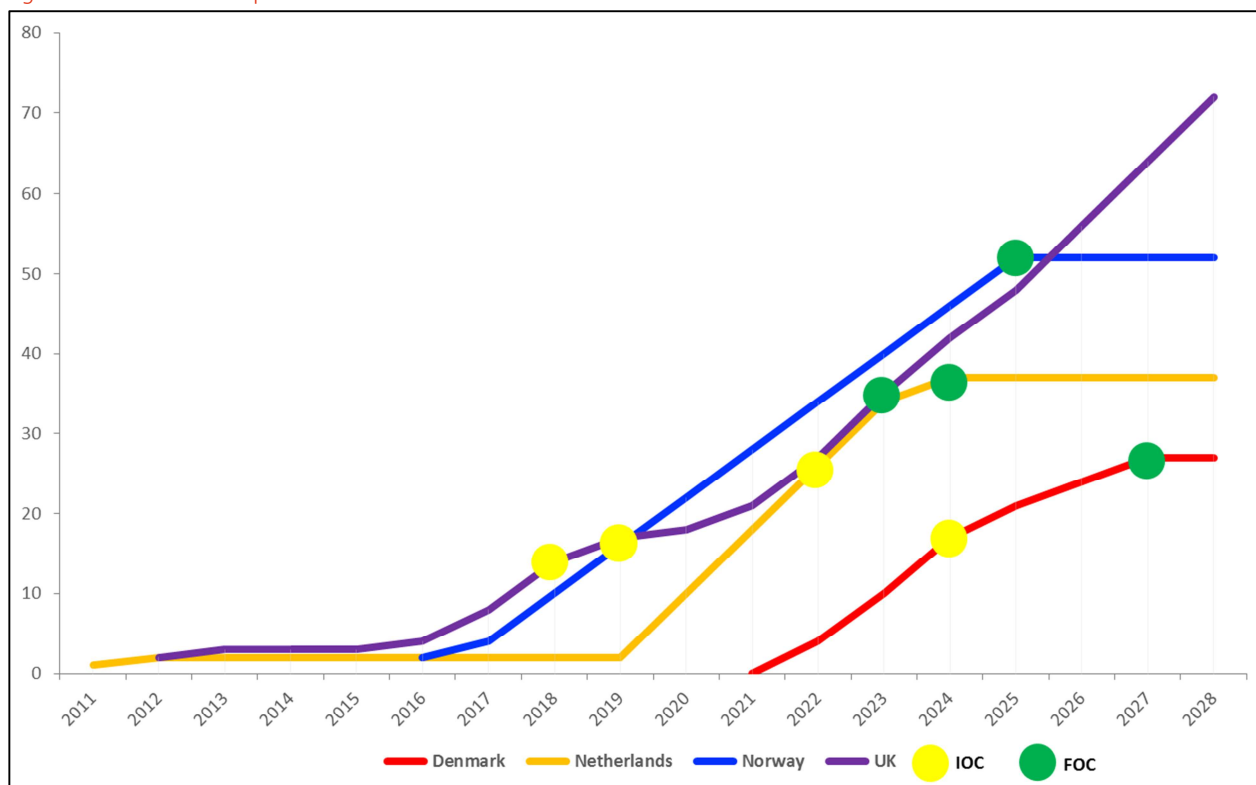
These milestones show the timeline between the acquisition and full use of the aircraft. Much must be accomplished between these two endpoints for

these nations to possess a usable military capability: pilots and maintenance personnel must be trained, facilities at air bases must be constructed, and a maintenance support structure must be established. These investments require programmatic decisions beyond the political decision to buy and pay for new aircraft. How well these countries invest in people, training, and facilities will determine the quality of the military forces that they will have available for use in military operations.

As can be seen, each partner plans to declare IOC once they possess around 20 aircraft, including those based in the United States for training purposes. These numbers are sufficient to form a squadron. Moreover, they plan to take 3–6 years to undertake the necessary steps to make that squadron fully operational. Denmark and the Dutch each plan to make this transition within three years, while the UK plans on a five-year transition and the Norwegians have given themselves six years.

Denmark’s JSF programme partners will be further along in their implementation processes. Each will declare IOC before or around the same time as Denmark receives its first aircraft, and the UK and the Netherlands plan to declare FOC prior to the Danish declaration of IOC. These countries will probably gain experience that the RDAF can draw upon to smooth its own implementation of the programme and move as planned from IOC to FOC.

Figure 2.1: Northern European F-35 Deliveries and Milestones



2.3

Partner Training

Training for pilots and maintenance personnel for the F-35 is centralized and located in the United States. The British, Dutch, and Norwegians have embedded equipment and significant numbers of personnel in American squadrons to facilitate the initial training of their personnel. Around 10

months are required to train a new F-35 pilot, whereas the instruction necessary to convert a pilot with 500 hours in another fighter jet type is approximately four months.²⁹ Countries are training personnel with mixed experience levels as they introduce the F-35 into their inventories.

The UK embedded eight F-35Bs and 140 personnel within the US Marine Corps F-35B training squadron in Beaufort, SC. These personnel formed the core of the UK's first operational F-35 squadron before relocating to RAF Marham in Norfolk, England in mid-2018 to prepare for IOC.³⁰ The remaining US-based personnel will form the core of an operational conversion unit that will redeploy to the UK in mid-2019 to assume responsibility for training RAF and RN pilots in the F-35.³¹ By 2023, the UK will have trained a sufficient number of pilots to man a second operational squadron.³²

The Dutch established their first F-35 squadron on 10 May 2014 at Eglin Air Force Base in the United States to test and evaluate the two F-35As that they had acquired.³³ The detachment of about 35 personnel works alongside American and British units, each responsible for their own aircraft.³⁴ The first four pilots and 20 maintenance personnel for the squadron began their F-35 training in November 2013.³⁵ The RNLAF are planning to have established a sufficient cadre of trained instructor pilots to man their own training squadron at the multi-national F-35A Pilot Training Center at Luke Air Force Base in the United States in 2019 and will retain that capability permanently.³⁶ The RNLAF will retain eight F-35s at Luke AFB during the conversion from the F-16 to the F-35. To facilitate this conversion, the Dutch deployed six F-16s to train with F-35s at the USAF Red Flag exercise in 2017 to prepare to integrate the F-35 into their fleet, where it will operate alongside the F-16.³⁷

Norway established a small F-35 unit at Luke AFB in the autumn of 2015 to receive the first F-35s and conduct conversion training for pilots and maintenance personnel. The Norwegian unit integrated into the American, Australian, and Italian multinational F-35 conversion unit, which pools their resources and facilitates cooperation between partner nations.³⁸ These Norwegian personnel formed the core of Norway's first F-35 squadron when the first Norwegian aircraft landed in Ørland in November 2017.³⁹

2.4

Partner Maintenance

One of the intended benefits of the JSF programme is to enable partner nations to share in common sustainment that takes advantage of the economies of scale inherent in a large aircraft fleet. The JSF JPO will aggregate all of the participant procurement requests for materiel and services 'to the extent feasible' to achieve economies of scale.⁴⁰ As the Danish *Rigsrevisionen* notes,

This means that the Ministry of Defence owns the actual combat plane while components, spare parts, and support equipment are owned by the JSF programme through a global spare parts pool. The purpose is to minimize maintenance costs, because many users may agree on a relatively smaller reserve and joint purchase of spare parts.⁴¹

In this way, the JSF programme implements the spirit of NATO Smart Defence, through which 'Allies are encouraged to work together to develop, acquire, operate and maintain military capabilities'⁴²

The JPO has divided the world into three zones – North America, Europe, and the Asia-Pacific region – and is establishing regional hubs for airframe, engine, and various component work.⁴³ By establishing regional hubs for maintenance work, the JSF programme intends to spare partners the necessity of establishing their own facilities and generate efficiencies through shared sustainment.⁴⁴ In Europe, different partners have bid for and been awarded different roles in F-35 maintenance for the region. Italy will provide Europe's heavy airframe maintenance out of the final assembly and check-out (FACO) facility in Cameri.⁴⁵ The UK will provide maintenance, repair, and overhaul and upgrade services for F-35 avionics and aircraft components.⁴⁶ Turkey, Norway, and the Netherlands will establish depots for heavy engine work.⁴⁷ The Netherlands will also house the central storage facility for all F-35 parts in Europe.⁴⁸ There are no plans to locate such facilities in Denmark.

Beyond this distributed global maintenance arrangement, each nation should prepare its own national maintenance structure at the wing or squadron level to handle day-to-day maintenance and ground support for the aircraft. Training of these maintenance personnel takes place at Eglin Air Force Base in Florida, and many partners will likely develop their own training programmes in the future.⁴⁹

2.5

Partner Basing

The acquisition of new fighter aircraft provides both the opportunity and necessity to refurbish, upgrade, and construct anew the facilities required for proper basing. Every airfield at which the F-35 will be based will undergo improvements, from resurfacing runways, rebuilding and reconfiguring maintenance bays, building secure facilities for highly sensitive technology and information, increasing the physical security of the base, to accommodating the needs of the local community.

In the UK, new management, maintenance, training, and operational facilities will be constructed at RAF Marham. Its utilities and power supplies will be replaced and upgraded, and airfield operating surfaces will be refurbished to adapt to the vertical take-off and landing capabilities of the F-35B, at a cost of over £500 million (approximately EUR 562 million).⁵⁰ Most of this work was completed by the end of 2017 to accommodate the arrival of the first F-35s. The Ministry of Defence conducted an assessment of the potential noise amelioration measures required to meet UK environmental regulations from 1 April 2011 to 1 March 2012. That assessment will provide a baseline against which to compare noise from the F-35 after the F-35Bs arrive in 2018.⁵¹ Plans for meeting the regulatory requirements are being finalized given these assessments. The USAF has also announced that it will replace the permanently deployed F-15 *Strike Eagle* force at RAF Lakenheath with two squadrons of USAF F-35A aircraft beginning in 2021.⁵² Lakenheath's facilities will require substantial effort to accommodate these aircraft, with the destruction of current facilities begun in 2018 and new construction to begin in 2019.⁵³

The Dutch plan to operate their F-35s from two air bases: Leeuwarden from 2021 and Volkel from 2025.⁵⁴ Both require significant infrastructure upgrades, including the construction of new secure facilities and an auditorium – facilities that the Dutch hope will also enable them to establish a centre of excellence for European F-35 operating nations as well as a F-35 Fighter Weapons School, perhaps in cooperation with Norway and the UK.⁵⁵ In May 2016, the RNLAF deployed their two F-35 test aircraft to Leeuwarden

to assess operations in existing hardened shelters and noise levels around Leeuwarden and Volkel.⁵⁶ The Dutch Parliament has advised the government to establish a permanent noise monitoring system for these bases.⁵⁷ In Norway, the transition from the F-16 to the F-35 involves establishing Ørland as the RNOAF's primary fighter base and using Evenes Air Base in the north of Norway as a Forward Operating Base (FOB), primarily for quick reaction alerts (QRA) in the High North.⁵⁸ Evenes will also be the main operating base for the new RNOAF fleet of five P-8 *Poseidon* maritime patrol aircraft, which are scheduled for delivery in 2022.⁵⁹ Norway plans to upgrade both bases to accommodate the F-35 at a cost of NOK 3–3.5 billion (approximately EUR 313–366 million).⁶⁰ Furthermore, the United States will invest \$10.3 million to build a QRA landing pad and shelter for four aircraft at Rygge Air Station south of Oslo,⁶¹ and Norway will invest in ground-based air defences to protect their air bases, critical infrastructure, and support areas from attack.⁶² Given its new functional missions, the Norwegian government also conducted new noise assessments at Evenes, which put an additional 29 private buildings within a zone requiring amelioration.⁶³ The Norwegians have not conducted any noise assessment at Ørland,⁶⁴ but the Institute for Transport Economics conducted a systems analysis of options for reducing noise levels to comply with Norwegian regulations.⁶⁵ As of April 2016, the Norwegian MoD decided to appropriate 35 properties at a cost of NOK 86 million (approximately EUR 9 million) and have offered to buy another 176 houses in the community around Ørland airbase and to provide sound insulation for another 800 in order to comply with environmental regulations.⁶⁶

2.6

Programme and Partners Conclusion

The JSF is the largest and most comprehensive multinational weapons system programme ever attempted, involving nine partner nations that have committed to jointly develop and then acquire over 3000 aircraft and share in a global logistics, maintenance, and sustainment enterprise over a 60-year period.⁶⁷ The programme provides for potential economies of scale and the opportunity for partners to collaborate and coordinate with one another in the utilization of their aircraft. It also provides opportunity to compare, contrast, and derive implications from the challenges facing each partner in developing an institutional structure around this new capability.

Denmark's allies – the UK, Netherlands, and Norway – made their respective decisions to acquire the F-35 some years before Denmark and have therefore already addressed many of these challenges. The UK and Norway have incorporated a maritime dimension into their basing and manning plans. They have embedded their first F-35 aircraft in US-led units to facilitate the testing and evaluation of systems, as well as the training of their pilots and maintenance personnel. These countries have also developed plans for transitioning their training units back to the home country once their initial cadre of pilots has been developed. They were able to make proposals to implement portions of the global maintenance and sustainment programmes in their nations, thereby securing jobs for their citizens and income for their economies as well as facilitating the development of expertise and comparative advantage across the partners. Finally, they have also begun the task of upgrading their air bases to accommodate the F-35, including assessing and ameliorating its impact on local communities. Both Norway and the UK have completed training of an initial cadre of pilots and technicians in the US and deployed their first F-35 aircraft to their homeland on sched-

ule to commence the build-up of their first F-35 squadron. The Netherlands plans to do likewise in the beginning of 2020.

The Dutch and Norwegian implementation plans are interesting from a Danish perspective, as they are both converting their F-16 structure to that for the F-35. Here, the Dutch choice to purchase two early production models to participate in the F-35 Early Operational Testing and Evaluation (EOT&E) allowed them to obtain early organizational knowledge and experience that enabled a more rapid 4-year transition from the F-16 to F-35 while still maintaining the full operational capability of their F-16 structure until their F-35 FOC. Furthermore, the Dutch reduction from 68 F-16s to 37 F-35s enables a robust organization that can maintain a fully operational F-16 fleet – and fully available for international operations⁶⁸ until the F-35 FOC. The Norwegians have chosen a slower implementation as they – like the Danes – will convert their entire F-16 structure to the F-35, thus having to balance the organization between two aircraft types simultaneously. The Dutch and Norwegians have also chosen to inform the public extensively about their respective F-35 programmes, the Dutch through semi-annual reports to parliament and the Norwegians through a variety of government and defence websites and social media.⁶⁹

Because these nations began their transitions to the F-35 before Denmark, their experiences and plans provide valuable input to the Danish government. The following chapter reflects on these experiences together with open source literature and our discussions with relevant stakeholders to consider the options available and to prepare tentative suggestions regarding the actions that may be undertaken in the future.

3

Danish Integration Risks and Challenges

What are the possible risks and challenges facing the Royal Danish Air Force as the F-35 is integrated into the Danish armed forces? Some of them are practical and are related to concrete implementation and project-management issues. Others are more abstract in that the new capability opens up for new forms of cooperation, such as 'increased jointness' across the armed forces or with international partners.

One of the challenges concerns how to phase out the current fleet of F-16 AM/BM combat aircraft while continuing to meet Danish national security policy requirements. Moreover, the current cadre of F-16 pilots will continue to maintain their current qualifications while some of them transition to the F-35. A new cadre of pilots will be recruited and trained to fly the F-35. This applies to maintenance as well: the current personnel will continue to work on the F-16 while some undergo F-35 training together with a new cadre of maintenance workers. The process of integrating the F-35 into the RDAF will also require modifying, refurbishing, rebuilding, and building a new hangar, maintenance, and other facilities at Skrydstrup Air Base.

The challenges involved in integrating the new aircraft go beyond these technical decisions. The Danish F-16 experience suggests that the integration of a new combat aircraft will affect more than the dimensions of the RDAF. As Lieutenant General MALT Nielsen, the Vice Chief of Defence and former Chief of the Air Staff, explains, 'our primary focus for the coming years is the successful implementation of the F-35. In this process it is essential that we do not force the F-35 to fit into the Royal Danish Air Force as is, but rather seek to make the *combined Danish armed forces* fit to benefit from the F-35'.⁷⁰ Thus the three services will likely be encouraged to capitalize on the investment in the F-35 and use its capabilities to strengthen jointness in the Danish Defence.

Finally, we argue that the multinational nature of the JSF programme provides a platform for Danish policy makers to improve international cooperation with other F-35 user nations. Such cooperation may better enable Denmark to achieve future goals in Danish defence policy together with Denmark's allies and partners, whether in defence of the Kingdom of Denmark itself (including Greenland and the Faroe Islands), its allies in Europe, or its broader interests and values in the world abroad.

In this chapter, we analyse these three sets of risks and challenges in the context of the plans and policies that the Danish government has thus far made public by reflecting on the Danish experience with the F-16 and the actions and intentions of Denmark's JSF partners, as discussed in the previous chapter. This analysis sets the stage for the suggestions and recommendations in the next chapter.

3.1

Aircraft, Pilots, Maintenance, and Facilities

Aircraft

On 9 June 2016, the Danish Parliament approved the acquisition of 27 JSF F-35s for the RDAF. The total reflected the government recommendation, which 'assumed a continuation of the current tasks and level of ambition of the Danish F-16 fighter capability' as the baseline against which all requirements would be set.⁷¹

This means ... [an ability] to conduct: National tasks involved with maintaining a permanent quick reaction alert capability which can perform tasks involving surveillance and defending sovereignty and which can be scrambled with extremely short notice ... international operations and NATO's collective defence tasks with a fighter contribution on [a] high alert state in which four fighters can be deployed for a period of up to 12 months every third year [as well as] periodic fighter contributions to NATO Air Policing missions.⁷²

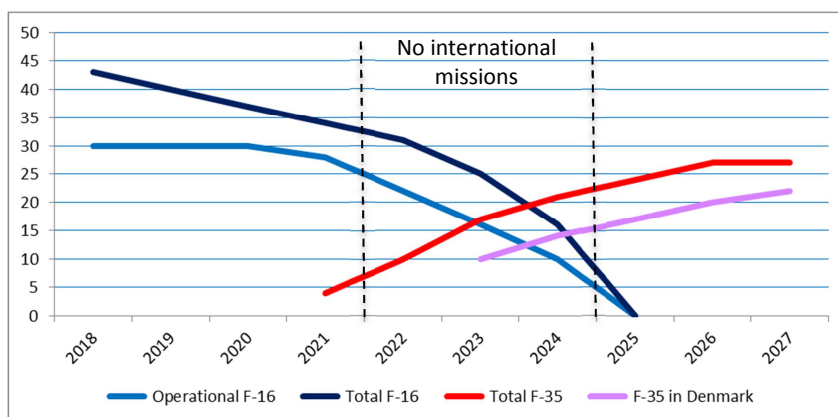
In its approval of the acquisition, the Danish Parliament indicated that it 'is expected that the last F-16 aircraft will be phased out by the end of 2024. The phasing in of the Joint Strike Fighter aircraft is expected to take place over a period of six years (2021–2026)'.⁷³ The agreement specifies the number of F-35s to be added to the RDAF inventory each year.⁷⁴ IOC will take place in 2024, when the RDAF has 11–15 F-35s at Skrydstrup and they can begin to assume responsibility for quick reaction alerts (QRAs). FOC will take place in 2027 once the full complement of 21 aircraft are in the country. Although some commentators have expressed concern that delays associated with developing component systems for the aircraft may delay delivery to Denmark,⁷⁵ such delays are unlikely⁷⁶

The current RDAF F-16 inventory numbers 43 aircraft, 30 of which are operational.⁷⁷ Between 2017 and 2024, the fleet will be reduced as aircraft are retired. The specifics of how many aircraft and when they will be retired throughout this period depend on how the fleet is used and managed. It has been recognized that the total number of aircraft and their remaining flying hours are sufficient to allow the RDAF's pilot cadre to meet their training requirements and maintain a QRA force of 2–4 aircraft to defend Danish airspace. The remaining fleet is also sufficient to conduct one more six-month deployment for an international operation (four aircraft, plus two or three in reserve) and one more air policing mission (two aircraft, plus one or two in reserve) or lesser international mission between now and 2022.⁷⁸ Although the Finance Act for the aircraft indicates that gaps in the ability to conduct these missions will occur, beginning in 2022, the government scheduled the air policing mission for the Baltic states for January– April 2018.⁷⁹ This means that from the time of writing until 2022, Denmark can choose to use its combat aircraft in only one more international operation or two international air policing deployments. After that, the RDAF will probably not have sufficient aircraft to conduct either an air policing or an international operation – at least under peacetime conditions – until 2025. Flying more would 'significantly increase risks' such that 'by the end of 2023, the number of F-16s that would be ready to fly would be so low that the national defence could not be maintained by the F-16s alone'.⁸⁰ This gap in the Danish military toolbox is significant, particularly given the frequency with which Danish po-

litical leaders have chosen to deploy the F-16 force to visibly exercise Denmark's activist foreign and security policy.⁸¹

These conditions, as well as the estimated maximum readiness rate of 70 per cent assumed in the Ministry's 2016 assessment of potential efficiencies in the F-16 fleet,⁸² suggest a drawdown curve that maximizes the number of F-16s available for as long as possible along the lines indicated in Figure 3.1a.⁸³

Figure 3.1a: Anticipated RDAF Fighter Inventory



Pilots and Technicians

Aircraft – even 5th generation aircraft – do not fly themselves. Historically, Denmark has faced shortages of personnel, particularly pilots, when transitioning from one aircraft type to another.⁸⁴ For instance, Denmark was short F-16 pilots from the mid-1980s until 2006–07, when the number of operational F-16s was reduced from 60 to 48 aircraft.⁸⁵ Without this reduction, the RDAF would have continued to lack pilots to man its operational fleet. The Defence Agreement for 2013–2017 further reduced the operational F-16 fleet to 30; and with it, the number of pilots required to man them.⁸⁶ Today, approximately 50 pilots man these aircraft.⁸⁷ Current practice, as well as the Ministry of Defence's own *Analyse af Forsvarets Kampflykapacitet*, suggests that this combination of 50 pilots and 30 aircraft is the standard for achieving the level of ambition set by Parliament for the F-16 fleet.⁸⁸ This has also become the standard for the number of F-35s and pilots required to continue to achieve this level of ambition. Beyond the number of operational pilots assigned to fly F-16s from Skrydstrup on a daily basis and to deploy on international operations when called upon, the RDAF also has a number of pilots with previous F-16 experience assigned to different staff positions. If necessary, some of these pilots could be brought back to operational status.⁸⁹ A MoD study to dimension the RDAF to 27 F-35s concluded that 70 pilots were required.⁹⁰ The MoD has since indicated that it will reduce that number to 62 to 'contribute to a smoother transition ... to the F-35 pilot structure'.⁹¹

Denmark will first be able to begin training its F-35 pilots in 2021, when the first Danish aircraft is delivered to Luke Air Force Base in Arizona as JSF nations are required to provide their own aircraft for training.⁹² To prepare for the transition, the RDAF will likely attempt to train as many pilots as the remaining flight hours in the F-16 fleet allow to ensure a large pool of qualified pilots – the required 62 and some surplus to account for regular at-

trition from retirements and other factors. Training more F-16 pilots now will enable more pilots to be trained more quickly in the F-35. Experienced F-16 pilots will be able to take advantage of their knowledge of fighter aircraft operations and transition to the F-35 by completing a four-month course.⁹³ In contrast, training a pilot on the F-35 'from scratch' requires around 10 months. Preparing a surplus of pilots in 2018–2020 would make the most of the limited number of training aircraft that Denmark will possess in 2021–2022. Sufficient numbers of JSF pilots should be available to man the squadron at Skrydstrup in 2022 to prepare for the arrival of the first aircraft at the end of that year.⁹⁴

Maintenance personnel are also required to keep aircraft operational. Denmark has historically faced challenges retaining its qualified aircraft mechanics and technicians, and a shortage led to a halt in pilot training in 2007.⁹⁵ The limitations that their capacity would have on sustaining lengthy deployments were known before Danish F-16s were deployed to support air operations against the Islamic State in October 2014.⁹⁶ This became a topic of discussion in Danish media and with top American defence officials, who were concerned about the ability of Denmark to sustain a small deployment of four fighter aircraft when they were withdrawn in September 2015.⁹⁷

According to the *Analyse af Forsvarets Kampflykapacitet* study, the two F-16 squadrons at Skrydstrup were staffed by 421 maintenance personnel, including 184 flight engineers, 52 electronics mechanics, and various other specialties.⁹⁸ A report providing possible solutions to the challenges of recruiting and retaining maintenance personnel indicates that from August 2011 to August 2014, the equivalent of 535–536 personnel were assigned to the F-16 wing at Skrydstrup, this number increasing to 625 in August 2015 when seven F-16 aircraft were deployed to support Operation Inherent Resolve.⁹⁹

While current practice for the F-16 fleet is suggestive of requirements for the F-35, it is not determinative. Changes in how the F-35s will be maintained – in particular, the establishment of regional hubs for major maintenance work that will spare Denmark the necessity of investing its resources to duplicate these capacities – may reduce the required number of maintenance personnel.¹⁰⁰

Regardless of the specific number of mechanics required, a significant cadre should be trained to maintain the F-35. This will require time. According to Jesper K. Hansen, Chairman of the Central Organization for Cadres, '[i]t takes 4–5 years to train a maintenance engineer at the level now required. Hiring more is not easy'.¹⁰¹ Given the required investment and potential training pipeline, the RDAF estimates that it will take 10 years to train 300 technicians for the F-35.¹⁰² Unlike pilot training, it is possible to begin training flight engineers and maintenance technicians before Denmark owns a single F-35 aircraft. Such training could first begin once Parliament ratified the government decision in 2016 regarding the type of aircraft to be acquired.¹⁰³ Thus, at best, the 300th maintenance technician will be fully trained in 2026, when the 21st F-35 arrives in Denmark.

Facilities at Skrydstrup

Skrydstrup has been Denmark's primary fighter aircraft base since the first F-16 squadron was stationed there in 1980. It became the only fighter aircraft base after the 2004 Defence Agreement. In 2016, the Danish Parliament agreed that the base would transition to the F-35 and that its facilities 'will

be rebuilt and prepared to receive' the aircraft.¹⁰⁴ The Ministry has indicated that this process will locate 'workshops, garages, warehouses, and logistics planning ... in one place ... in order to achieve greater integration and effectiveness of the operational activities and logistical support'.¹⁰⁵ Costs were estimated at DKK 400 million (approximately EUR 53.7 million) when the Parliament approved the acquisition. The MoD based its estimated requirements on the facilities at Luke Air Force Base, the American base where international JSF training is located.¹⁰⁶ These estimates focused on floor space and excluded areas such as refuelling systems, noise protection, and security measures. Furthermore, at the time that the proposal was approved, the MoD had yet to undertake the structural engineering feasibility study that would enable a cost estimate better tailored to Skrydstrup's existing facilities. Finally, the Ministry noted that the 'site activation process' pursued by a team from the JPO and Lockheed Martin would begin in October 2016.¹⁰⁷ This ongoing process will result in 'a detailed review of existing facilities and plans for new buildings' to ensure that all of the standards required for basing the F-35 in partner countries are followed.¹⁰⁸

The picture has become clearer as this process has been implemented and the Norwegian, Dutch, and American experiences have become known. The Ministry has twice increased the budget to address the key areas of new hangars, measures to reduce noise for the surrounding community, and increased air base security. These increases amount to DKK 460 million (approximately EUR 61.7 million),¹⁰⁹ more than doubling the initial amount approved by the Danish Parliament for this purpose.

The Skrydstrup hangar facilities clearly have to be modified, rebuilt, or constructed anew to accommodate the F-35. In Norway, the planning and construction of new hangars at Ørland was not completed on time. The Norwegians first decided in mid-2017 to construct 'robust' hangars to permanently house their F-35s at a cost of NOK 2.26 billion (approximately EUR 236 million). The hangars will not be completed until 2020, by which time 22 of the new aircraft will have been delivered.¹¹⁰ Until then, the Norwegians will house their F-35s in temporary plastic tents, having approved permanent structures late in their planning process.

On the other hand, the British, Dutch, Norwegians, and Americans¹¹¹ have taken a more pro-active approach to dealing with the potential nuisance that the noise generated by the F-35 may cause the local communities. Although studies of noise have been made in the Skrydstrup area,¹¹² no formal tests involving F-35 aircraft have been conducted. The MoD report¹¹³ released in December 2017, after significant media coverage of future F-35 noise problems in the Skrydstrup area, indicated that at least 41 private homes would be affected by increased noise levels caused by the F-35.¹¹⁴ The MoD has indicated that additional noise level assessments will be undertaken and that the initial plans for locating facilities at Skrydstrup have been reconsidered.¹¹⁵ As Danish plans have evolved, the schedule for completing modifications to Skrydstrup have also slipped by an additional 6–12 months, potentially delaying the arrival of the first F-35 in Denmark until 2023.¹¹⁶ The extent and cost of policies for complying with Danish regulations regarding noise pollution are as yet unknown.

Security measures will also be substantially increased for the areas housing the aircraft and their information systems, as they will have highly-classified mission files, sensor data, and logistics information that belong to the larger JSF programme. 'The F-35 is more supercomputer than bomb

truck – it is a flying data hub ... But that capability presents a new set of challenges: protecting sensitive technology and sovereign information shared between international operators over the aircraft's vast network'.¹¹⁷ Each F-35 and each F-35 base will be rich in classified and sensitive information that will require protection from the efforts of unfriendly intelligence agencies.¹¹⁸

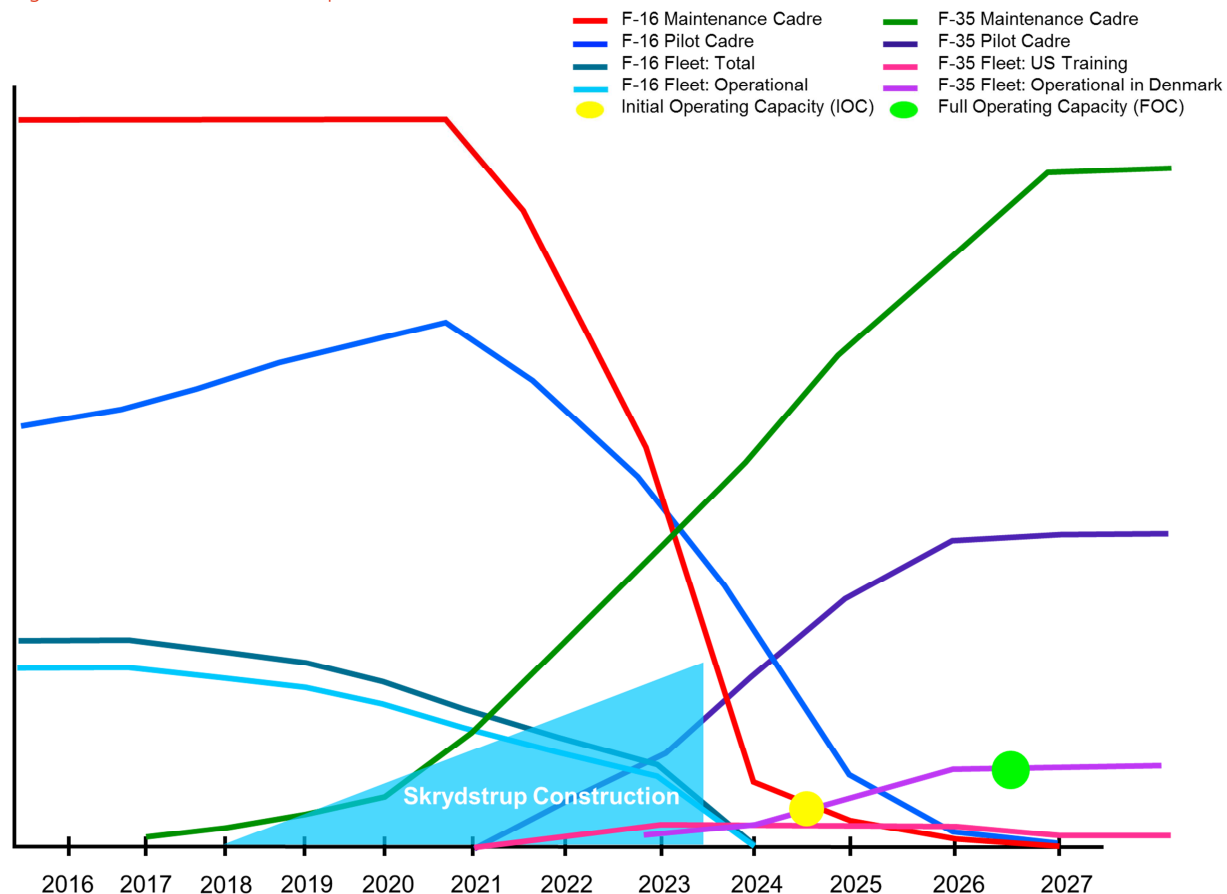
Danish security measures will have to meet standards set by the JPO and NATO, and – beyond protecting the base from a direct attack by an opposing military force – will necessarily include controlling physical access to sensitive areas of the air base, monitoring access to areas beyond the base (where aircraft will approach for take-off and landing), measures against drones (both for surveillance and the physical impediment of air operations),¹¹⁹ cybersecurity measures, and hardening against electronic warfare threats.¹²⁰ It is important to understand that there will be sensitive areas beyond the property of the base, and security will entail measures that the local community has not seen since the Cold War.

Aircraft, Personnel, and Facilities: An Interim Conclusion

Implementing a programme as large as the acquisition of a new combat aircraft fleet is a challenging and daunting prospect. Dividing the project into manageable parts eases the burden of accomplishing any one, but these should be adequately synchronized and brought to fruition simultaneously for the project to be successful. The prospect of recruiting, training, and retaining sufficient numbers of highly-trained personnel – pilots, flight engineers, electronics technicians, and others – poses a challenge for the Danish defence personnel system. Ensuring that there is sufficient space in the training programmes that will be utilized to instil the complex of competencies required for these personnel requires deft diplomatic relations with partner countries within the JSF programme, particularly the United States, and these partners may have their own considerations and constraints to manage. Ensuring that the construction of facilities occurs on schedule and to the required specifications entails coordinating many agencies and authorities in Denmark on the local, municipal, and national levels across multiple issue areas (e.g. environmental, construction, and labour) as well as negotiating with and overseeing the private sector companies that will undertake the actual work. This also relates to the JSF programme standards, including security requirements that go beyond those of normal civilian, and even military, facilities. All in all, the government has a challenging series of tasks ahead to administer this complex programme.

Figure 3.1b provides an overview of many of the lines of operation entailed in the implementation of the F-35, most of which should be completed before the first aircraft lands on Danish soil in late 2022. The graph highlights that the years between 2022 and 2025 will see the transition from the F-16 to the F-35, which is where the greatest security risk exists for Denmark. Planning carefully for this transition is therefore quite necessary, particularly since it leads to the transition from IOC to FOC, which Denmark is planning to make more quickly and with fewer resources than its partners in the UK and Norway. While we have not placed units on the vertical axis, it notionally captures the number of men, aircraft, and facilities that will be transitioned from the F-16 programme to the F-35 across the period considered.

Figure 3.1b: Lines of Effort to Implement The F-35



3.2

New RDAF Missions, Jointness, and Danish Defence Policy

New RDAF Missions

When Denmark decided in 1975 to acquire the F-16, it was a front-line state facing the Soviet Union and Warsaw Pact states of Poland and East Germany to the east and south. The RDAF was tasked with contributing to the defence of Danish territory in peacetime and in the event of a general European conflict through a focus on air-to-air engagement (counter air) and air-to-ground support of forces in the littorals of the Danish coastline (TASMO, or tactical air support for maritime operations) within the context of NATO.¹²¹ When Denmark’s national security strategy shifted after the Cold War to support expeditionary operations in the European periphery, the missions assigned to the RDAF shifted to intelligence, surveillance, and reconnaissance (ISR); strike, coordination, and reconnaissance (SCAR); and close air support (CAS) in uncontested environments.¹²²

Danish national security policy has recently begun emphasizing potential operations closer to home. Ambassador Taksøe-Jensen’s report,¹²³ the government’s Foreign and Security Policy Strategy,¹²⁴ and the Danish Defence Agreement 2018–2023 emphasize that ‘[t]owards the east NATO faces a challenging and more assertive Russia’.¹²⁵ The primary scenario that NATO nations are planning against in the region is the defence or liberation of the three Baltic states, which:

can easily be isolated from the rest of NATO by Russian land, maritime and air forces. Russia has a favorable strategic position from which to deter NATO intervention on land ... [Furthermore] Russia can make ... reinforcement difficult, effectively dominating large areas of the Baltic and Baltic airspace using missile forces based in the Leningrad and Kaliningrad oblasts. Mines and submarines – the traditional means of controlling access to the Baltic – would complement these anti-access [and] area denial (A2/AD) capabilities.¹²⁶

NATO's primary counter to this scenario will be a high-intensity air campaign to disable Russian A2/AD capabilities in the eastern Baltic to ensure NATO sea-lanes of communication to the Baltic states. Denmark could very well be a primary base of operations in such a campaign. Denmark is the closest JSF partner to the Baltic states, and only Skrydstrup places F-35s within unrefuelled range of them. It is therefore reasonable to expect the RDAF to be called upon to participate in such a campaign. As Vice Chief of Defence Lieutenant General MALT Nielsen has explained, 'It is paramount that we utilize the F-35's 5th generation capabilities for the greater good of NATO as a whole ... the F-35 will be the new spearhead to take on the most challenging tasks in the air and confront enemy air defences'.¹²⁷ The MoD evaluation of the potential candidates to replace the F-16 fleet emphasized the ability of the aircraft to perform air interdiction (AI), suppression of enemy air defence (SEAD), and destruction of enemy air defence (DEAD) missions – likely for this very reason.¹²⁸ For Baltic Sea security, Denmark will once again be a frontline state in terms of airpower.

But pilots require additional training for such missions. As journalist Steffen McGhie has noted, AI, SEAD, and DEAD 'are far from the typical missions of the Danish Air Force' today.¹²⁹ Danish air operations have taken place in relatively benign, uncontested environments in which the adversary lacked an effective capability to defend themselves.¹³⁰ Operating over the Baltic Sea against the advanced Russian A2/AD capabilities is a far more dangerous endeavour and will require extensive training. Denmark has participated in the USAF Red Flag training exercises to develop competencies in new mission areas over the past 30 years, but the limited flight hours remaining in the F-16 fleet likely precludes participation in such exercises until the full complement of F-35s arrive (i.e., after 2026). This suggests that Danish pilot training will have less of a basis than desired for those who will convert from the F-16 to the F-35 – and the RDAF may have to play catch-up relative to its partners.

Beyond training for new mission types, analysts have argued that the F-35 will enable new operational concepts that will have to be worked through and trained against.¹³¹ These will entail something more than using the F-35 as a 'Super F-16'¹³² that is 'able to perform the traditional role of a tactical strike fighter more effectively than ever before ... [given] its unprecedented situational-awareness capabilities ... "alone and unafraid" as part of a small formation in enemy territory'.¹³³ Future operational concepts being developed by Danish partners entail utilizing the F-35 as a 'shooter-sensor'¹³⁴ within a larger 'battle network'¹³⁵ to develop 'distributed lethality'.¹³⁶ The purported ability of the F-35 to operate, gather information with its sensors, and communicate stealthily with other platforms and operations centres can make it a potent force-multiplier, conveying targeting information (for example) to weapons and weapons-bearing platforms safely

outside of the range of the enemy's defences. Such a concept of operations would increase the effective range from which older, less stealthy platforms could operate. As Lieutenant General Nielsen has suggested, F-35 pilots could fill:

the role of forward Battle Managers. Through enhanced command and control, information sharing, and decision making, the F-35 can enhance and leverage the capabilities of 4th generation platforms in and above the battlefield ... This will be much the same as we saw with the introduction of airborne Early Warning and Control Systems (AWACS) and expect to see in the future with the Alliance Future Surveillance and Control capability.¹³⁷

The roles entailed in this ever-developing concept will also require extensive training – not only for pilots to acquire the skills, but also to assess and develop the capabilities for different platform types to communicate and collaborate effectively with one another, to refine the tactics, techniques, and procedures involved, and to operate effectively with allies and partners in actual operations.

Jointness

While the Danish acquisition of the F-35 has been criticized for having possibly come at the cost of materiel investments in the Royal Danish Navy (RDN) and Army,¹³⁸ the aircraft can facilitate joint operations at the combined level with NATO allies and partners, which may drive jointness at the national level. Whether jointness is achieved through combined operations with NATO or coalition partners or nationally, the three services can be tied together through the command, control, communications, and computing capabilities of the F-35 (and related platforms) in a US-led NATO 5th generation battle network. 'The F-35 is not only an air asset; it is also a collection platform which can interact with, and provide data to, both ground and maritime forces'.¹³⁹ The Norwegians,¹⁴⁰ Australians,¹⁴¹ and British¹⁴² are building joint capabilities around their F-35s, particularly in the maritime realm.

With the 2018–23 Defence Agreement, the Danish government will transfer the primary focus of Danish defence and security policy back to the Baltic Sea area. For the RDN this means a shift in focus from the lower-end maritime security missions, such as visit, board, search and seizure operations (VBSS), fishery protection, search-and-rescue (SAR), and anti-piracy missions. Instead, high-end air defence, maritime interdiction, anti-submarine warfare (ASW), mine counter-measures (MCM), sea-lane protection, and support to amphibious operations will become more important.¹⁴³ This requires investment in capabilities enhancing the combat power of the RDN's frigates to include robust anti-air, anti-submarine, and anti-surface warfare capabilities and explains the government's proposal to acquire 'both short-range and, eventually, long-range missiles (SM2 and SM6) to counter hostile aircraft and several types of missiles' and 'fitting the Royal Danish Navy's frigates with sonar and anti-torpedo systems and its maritime helicopters with dipping sonar and torpedoes to engage in anti-submarine warfare'.¹⁴⁴ The same requirement is also behind the consideration of acquiring a strike missile capability.¹⁴⁵

Yet these capabilities will not stand alone. Their integration into a network of sensor data will not only make them more effective, it will be re-

quired for them to be effective. These developments generally require an increased focus on jointness in both planning and execution, together with the integration of intelligence, surveillance, and reconnaissance (ISR) data to establish a robust information infrastructure across NATO forces in the Baltic Sea area. The F-35's sensors may greatly increase ISR in the region and could be more valuable if its information can be transmitted to, and utilized by, frigates and other vessels in the area of operations.¹⁴⁶ Thus, beyond basing F-35Bs on the Royal Navy's aircraft carriers, the UK and Norway each plan to utilize the *Aegis* combat systems aboard their frigates to integrate their maritime forces, including P-8 *Poseidon* maritime patrol aircraft, with the capabilities of their F-35s. These capabilities are similar to those of the United States and will therefore form the backbone of NATO's maritime approach to the North Atlantic and the Baltic Sea. Furthermore, the US Navy is developing the Naval Integrated Fire Control-Counter Air (NIFC-CA) system to link the sensors of its F-35C aircraft to a network that would then guide weapons launched by surface vessels, such as the *Tomahawk* or SM-6, to its targets.¹⁴⁷ Placing the sensors in front of (rather than inside) the munition greatly reduces costs without diminishing capability – but requires the ability to securely plug into the sensor network to work.

For the Royal Danish Army (RDA), the renewed focus on the Baltic Sea region requires investment in capabilities that enhance the combat capabilities of RDA units and eventually allow the RDA to establish a brigade-size unit. Such a unit will obviously require the equipment and training to integrate with NATO (and hence Danish) air capabilities, particularly to coordinate fires on the battlefield. Thus, its structure could include brigade air liaison officers, ground liaison, air-land integration cell, combat control capability, and joint terminal attack controller capabilities. As the F-35 might likely be used in this theatre, these officers should be familiar with the capabilities of the aircraft and its systems.

Furthermore, as with the increase in analysis that came from the data collected by unmanned aerial vehicles during the wars in Iraq and Afghanistan, NATO nations may be hard-pressed to process the potentially increased intelligence data collected by the F-35's sensor suite. The Army Intelligence Centre, which will form the core of a new Intelligence Battalion, or maybe a future joint ISR unit could provide a natural place for the Danish armed forces to analyse and exploit this information, as well as sharing it with its partners.¹⁴⁸

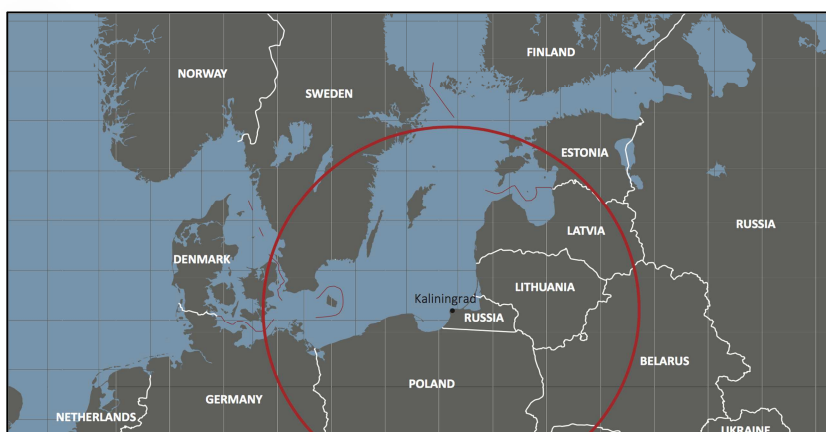
Danish Defence Policy

Danish defence policy is adapting to the shifts in '[t]he geopolitical tectonic plates on which Danish foreign policy has rested for many years' at a deliberate pace.¹⁴⁹ 'Denmark faces more serious threats than in any other period following the fall of the Berlin Wall. The freedom and security we value so highly cannot be taken for granted. To the east, NATO faces a confrontational and assertive Russia', stated the Danish government in the opening lines of its proposal for the 2018 defence agreement.¹⁵⁰

More specifically, the Danish Defence Intelligence Service (DDIS) argues that 'the Baltic Sea region [is] an area of friction between Russia and NATO',¹⁵¹ because it brings together in one region the Russian desire to be recognized as a great power, its aim to reverse the loss of influence and control over territories that were constituent republics of the Soviet Union, and the intermediate objective to undermine and deter the further integration of

these states into Western institutions, such as NATO and the EU. The DDIS judges that conflict with Russia will not directly confront NATO with military aggression, but may occur because Russia is willing to ‘take risks [that] increase the chance for miscalculations and strategic blunders’ in pursuit of policies to ‘deepen divisions in the EU countries, between the EU countries and in the transatlantic relations’, and that aim to ‘undermine, to the widest possible extent, NATO’s ability to ensure the collective defence of the Baltic countries’.¹⁵²

Figure 3.2:
DDIS Assessment of Range of Russian *Iskander* Missiles Deployed in Kaliningrad



As shown in Figure 3.2, Denmark’s geographical position places it ideally to serve as a base of operations in any crisis or high-intensity conflict with Russia over the Baltic states. Skrydstrup Air Base has two notable qualities that suggest that NATO planners may consider it a base of operations for the F-35 in a Baltic contingency. First, it is notably beyond the range of Russia’s *Iskander* missiles. Furthermore, as air bases are necessarily suited for the type of aircraft that normally operate from them, Denmark’s forthcoming status as the only JSF partner nation among the Baltic Sea littoral states could make Skrydstrup the closest suitable air base for F-35 operations.

The government’s argument for acquiring SM-2 and SM-6 air defence missiles for the RDN frigates appears to be based on similar conjecture.¹⁵³ Further consideration of the implications is merited. At minimum, plans and policies from the 1980s, when the United States pre-deployed equipment to different RDAF bases and regularly trained the deployment of its aircraft to augment northern European NATO forces adjacent to the Baltic Sea, may be reviewed and refreshed to enhance Denmark’s contribution to NATO deterrence in the region.

3.3

Preliminary Conclusions

The Danish acquisition of a new combat aircraft fleet comes at a significant time, when it seems as though a more aggressive Russian policy in the region is not merely a transitory phenomenon. Danish defence policy seems to have adapted to this reality, and the adjustment will continue throughout the period of the current defence agreement. In this context, acquiring the F-35 may make Denmark a reasonable staging area for any air campaign in the Baltic Sea region – just as its location made it a logical place for maritime and air reinforcement during the Cold War. Denmark’s allies will probably encourage the RDAF, RDN, and RDA to consider the implications of such scenarios for their structures and capabilities.

These policies may rest on the assumption that Denmark has invested sufficiently in its F-35 fleet to have a resilient force. Such a force would imply sufficient numbers of aircraft to fulfil the tasks assigned to the RDAF, sufficient numbers of trained and qualified pilots to fly the aircraft, sufficient numbers of flight engineers and technicians to maintain and sustain the aircraft and its operations at home and when deployed, and sufficiently robust facilities in which to base them. Yet the emphasis on ever-increasing levels of 'efficiency' going back to the 1980s has not resulted in resilient military forces, as suggested by recent experiences with mechanics, pilots, and aircraft. The arrival of the F-35 represents an opportunity to do it right from the beginning, to establish a firm foundation, and to set a trajectory for a resilient and effective air force. To that end, a number of suggestions and recommendations are presented in the next chapter.

4

Towards Implementation

The Danish government has committed to the largest defence acquisition in its history: DKK 20 billion (approximately EUR 2.7 billion) for 27 F-35 Joint Strike Fighter aircraft, associated equipment, and facilities. The effort of successive governments produced what the *Rigsrevisionen* called ‘thorough analyses and calculations’ to select the F-35 from amongst the competitors, to determine the number of aircraft, and to size the force structure, personnel, and training requirements. These decisions have been approved by the Danish Parliament.

But more remains to be done. The first task has been to conclude a financing agreement and a contract with the US government via the JPO.¹⁵⁴ The more difficult decisions will concern erecting a sufficiently robust and effective institutional edifice around the aircraft. The quality of decisions made – or deferred – will determine whether the F-35 purchase is seen as a sterling example of how major defence procurement should proceed¹⁵⁵ or as a failure caused by decisions that foster incomplete implementation.¹⁵⁶ Accepting increased risk in one area may be prudent and acceptable, but accepting increased risk across many areas multiplies risks significantly. Previous challenges that have been faced by the RDAF¹⁵⁷ are suggestive of the risks involved in implementing the acquisition. The cautious and deliberate assessment of these risks and the appropriate planning to mitigate them should be encouraged along with conscientious implementation to ensure that in the event that technical or financial risks do eventuate that these issues do not have significant political or policy consequences.

Thus, we offer suggestions in this chapter regarding the implementation of the F-35 programme in Denmark based on our assessment of Denmark’s previous experience with the F-16, the policies and plans of the British, Dutch, and Norwegians, as well as our own evaluation of risks, challenges, and opportunities. These suggestions range across many dimensions of the programme and coordinating actions between multiple stakeholders. The programmatic deal with building an effective institution around the F-35 fleet to ensure that it can meet the objectives stipulated by Parliament. Policy issues deal with understanding how this new military capability can enable Denmark to meet its national security and foreign policy objectives in the current and future geopolitical environment. And finally, some issues concerning the policies necessary to implement the programme, to adapt defence policy to accommodate and utilize this new capability effectively, and to perhaps even seize opportunities that arise to advance Danish interests.

Our suggestions are intended to inform our audience regarding the possibilities to mitigate the risks that we have identified. Just as these risks may eventuate individually or in combination, our suggestions can be adopted individually or together; and while they address analytically distinct issues, they may interact with one another. We have not fully investigated these interactions and their implications.

4.1

Programmatics

The fleet of 27 F-35 aircraft requires an effective organization with sufficient resources if it is to perform the functions expected by the government and approved by Parliament. The previous chapter discussed the different aspects of building such an organization: pilots, maintenance personnel, and facilities. To the extent that they have been made public, the current government plans suggest that each of these areas has been optimized to use a minimum amount of resources. Optimization implies risk should the assumptions upon which reduced investments are based prove incorrect. Multiple instances of conditions differing from the assumptions implies further risk, which could entail consequences for policy and politics. The following sections address the risks and challenges inherent in acquiring enough aircraft, recruiting and training enough personnel, and constructing sufficient infrastructure to achieve these objectives.

Aircraft

For the public and decision-makers alike, the number of aircraft necessary to fulfil the tasks required has been a central aspect of the discussion concerning the procurement decision.¹⁵⁸ This was a central theme in a report by the Danish state auditors, the *Rigsrevisionen*, as well as a subsequent government response prior to the approval of financing for the aircraft by the Finance Committee.¹⁵⁹ Press reports on the negotiations detailed sizeable reservations among several political decision-makers about whether 27 aircraft would be sufficient to accomplish the required tasks: national airspace defence, national tasks, international operations, air policing, training, and education.¹⁶⁰ In its report, *Rigsrevisionen* translated the requirements that the fighter fleet should meet into the flight hours it should produce each year.¹⁶¹

One factor that would not appear to have been considered in the dimensioning debate is the aircraft stationed for training purposes in the United States. Given how most of the stated training flight hours will be covered by these aircraft and that they will be unavailable for other missions, the actual but theoretically required average number of flight hours per aircraft based in Denmark might be even higher than assessed in earlier reports.¹⁶²

The procurement decision opens up the possibility that Denmark could make the decision to acquire fewer aircraft for financial reasons. Given the *Rigsrevisionen* report and the preceding and subsequent debate about assumptions in the dimensioning study, political decision-makers should also remain open to the possibility of having to acquire more aircraft in the future.

Additional aircraft would obviously require additional expenditures. Given that the costs of infrastructure and other expenses will have already been paid for, Denmark would bear mainly the additional costs of each aircraft (circa DKK 540 million/approximately EUR 72.4 million), the lifecycle costs of its operation (approximately DKK 2.11 billion/EUR 283 million over 30 years),¹⁶³ and the cost of personnel to operate and maintain it. As the dimensioning study debate has shown, lifecycle costs are also driven by factors such as pilot numbers, as these are tied to the number of aircraft and flight hours produced. Overall, the dimensioning debate, including the *Rigsrevisionen* recommendations, indicate that political decision-makers should continue to follow and monitor these aspects of the F-35 programme closely.

Personnel and Training

As discussed in an earlier CMS analysis, the Danish implementation of its F-16 fleet was hampered by the recruitment and retention of inadequate numbers of skilled employees, especially pilots and aircraft technicians.¹⁶⁴ In 2014, for instance, the RDAF had approximately 50 pilots assigned to man the 30 operational F-16s at Skrydstrup, which exceeded the NATO standard of 1.5 pilots per aircraft.¹⁶⁵ It had even more pilots available in staff positions and serving as instructor pilots to augment the fighter wing's complement, if necessary. This level of manning came under significant stress, however, during the 12-month deployment to Kuwait to support Operation Inherent Resolve in 2014–2015.¹⁶⁶ Indeed, the MoD dimensioning study for the new aircraft notes that the number of operational pilots assigned to fighter wing Skrydstrup fell between 2011 and 2014, 'indicating that the collective uptake of pilots has been insufficient to maintain the structure.'¹⁶⁷

Pilots are highly skilled employees and require significant initial and ongoing training to be given responsibility for very expensive aircraft that are used for military purposes in the name of the Danish state. These investments are expensive, and the perennial emphasis on optimizing the structure of the armed forces suggests that the risk of this sort of stress will not be eliminated. While the Finance Act of November 2017, *Aktstykke nr. 31*, indicated that previous analyses concluded that the required number of pilots was 70, subsequent analyses have concluded that 62 are sufficient.¹⁶⁸

Measuring the degree of risk inherent in such optimization is difficult for two reasons. First, the number of pilots required to adequately man a force is a function of the number of operational aircraft, the expected workload for the force, and the rules governing the employment of personnel, including mandatory rest periods and the balance that management finds acceptable and that can be negotiated with employees.¹⁶⁹ Second, regardless of the values placed on these variables, the actual pilot requirement has rarely been discussed openly, with actual numbers redacted in documents that the MoD has made public, including the *Analyse af Forsvarets Kampflykapacitet* and the *Rapport fra Udvalget for Dimensionering af Nyt Kampfly*. Alternatively, the methodology used to determine the workload has been obfuscated, as in the response to Parliament of 8 May 2018. What can be said, however, is that the smaller the pilot cadre, the greater the potential impact of small deviations from the assumptions used to optimize the force structure.

The present pilot cadre is the most experienced since the introduction of the F-16. But this also means that many of the most experienced pilots may be too old to convert to the F-35.¹⁷⁰ Ideally, most of the pilots converted to the F-35 should be able to put in at least six years of service time afterwards for the investment to pay dividends. If borne in mind, the age and experience of the current pilot cadre can be turned into an advantage. We suggest dividing the pilot cadre into three categories: very experienced, experienced, and less experienced. Very experienced pilots are those that will not remain in the fighter aircraft force after 2026. Following the Norwegian example, these older pilots should generally maintain the operational capability of the F-16 force until phased out and then be used in other positions rather than being converted to the F-35.¹⁷¹ Pilots in the experienced category should be among the vanguard that converts to the F-35 and serve as instructors to ensure that maximum experience is converted from the F-16 to the F-35.

Pilots who are relatively new to the force or recruited in the near future should train a minimum of 500 hours on the F-16 so that they can take advantage of the 'short' conversion course. This presumes that sufficient flight hours remain in the F-16 fleet to accommodate this training requirement.¹⁷² An option worth considering is to select some of the very experienced pilots to join the F-35 vanguard and form a permanent cadre of instructors based in the US for a longer period of time to provide a more stable training programme and to maximize the number of operational pilots at Skrydstrup from 2023 onwards.

There is a danger that the F-16 fleet cannot be managed to the degree necessary to ensure sufficient flight hours to meet its required tasks, let alone a surge in training, especially if they are committed to international missions beyond what is already planned. Furthermore, participation in exercises risks straining the F-16 fleet beyond its remaining capacity – as well as beyond the capacity of the planned F-35 fleet, at least until the late 2020s. Limited exercise participation risks reducing the competence of RDAF pilots and making them less valuable in coalition operations. Shortfalls in F-16 flight hours thus risk spilling over into multiple areas, including the phasing-in of the F-35.

Maintenance personnel are also a hard requirement for a capable and sustainable air force. The persistent shortage of qualified flight engineers and technicians has impacted operations repeatedly over the past decade. Given the numbers needed and the time required to train them, as mentioned above, Denmark risks falling behind schedule to have an adequate number until after the full complement of aircraft arrive in 2026. Hiring, training, and retaining qualified technical personnel is therefore a crucial element in achieving FOC as planned.

Facilities

All of the Danish F-35 aircraft will be based at Skrydstrup. While the process for determining the actual requirements for basing the F-35 there is ongoing, risks and challenges clearly exist in at least three areas: hangars, noise levels, and security. The Finance Act 31 of November 2017 indicates that the government will present a request for the authority to finance the modification of Skrydstrup once a complete plan has been prepared, which is expected in 2019.¹⁷³ Here, Denmark could learn from the Norwegian experience and initiate refurbishment or construction of 'robust' hangar facilities as soon as possible.

Secondly, the Netherlands, Norway, and the United States have made significant efforts to assess the different tones and levels of noise generated by the F-35 to minimize the impact on surrounding communities. The government is considering conducting live noise assessments with F-35s at Skrydstrup to determine the extent of the issues to be remedied. An option to do this would involve inviting an F-35 user nation to deploy aircraft to Skrydstrup for exercises, during which time noise testing could also be conducted.

Finally, the information-rich F-35 and the computerized facilities that will store and transmit its sensor, mission, and maintenance information between programme partners are particularly ripe targets for enemy espionage efforts. This also applies to Skrydstrup, and the facility's security will therefore be an important dimension of F-35 integration on the ground. Penetrating Danish security would yield highly-classified information about the capa-

bilities of all of Denmark's JSF partners. To reduce the risk that Danish defences may be penetrated, the physical, cyber, and electromagnetic security of Skrydstrup should receive the utmost attention from the MoD and DDIS.

Support and Maintenance

Denmark's F-16 fleet benefitted greatly from the commonality inherent in purchasing an aircraft that had been standardized across five European states and the US Air Force. This commonality permitted common upgrades, economies of scale in supplying spare parts, utilizing knowledge of wear and tear on the multinational fleet to optimize maintenance, enabled multinational deployments to exercises and expeditionary operations, and even allowed the sharing of weapons when the stocks of one partner were depleted.¹⁷⁴ This cooperation was also institutionalized so that all of the partners were updated, shared best practices, and made decisions together on a regular basis. Despite this level of cooperation, each nation retained its own squadron and depot-level maintenance structures, and some variation in systems – including engines – was introduced over the lifetime of the F-16. These national-level structures and modifications reduced the commonality of the aircraft at the margins, decreased the value of the common information for joint fleet management, and required more resources for maintenance and sustainment.

The JSF programme builds on this experience by establishing and incentivizing commonality across partners. Common airframes with common hardware and software configurations will limit, but not preclude, partners making distinct modifications to their aircraft – at the individual partner's expense for the entirety of the costs, from research and development, to testing and evaluation, and to the actual acquisition and integration with the aircraft's other systems. The common maintenance system, the Autonomic Logistics Information System (ALIS), will globalize the supply chain with international, fleet-wide logistical contracts based on the principles of Performance Based Logistics (PBL), and constantly update the status of the entire F-35 fleet across the partners. This is intended to optimize maintenance and sustainment operations, thereby saving money for all participants. Moreover, reaching agreement on regional depots for large-scale maintenance reduces the investment each partner must make in such structures. Denmark will not have any depot-level structures to maintain its F-35s, which will reduce what is necessary for squadron or wing-level maintenance structures and will require some adjustment in organization, practices, and expectations across all stakeholders.

4.2

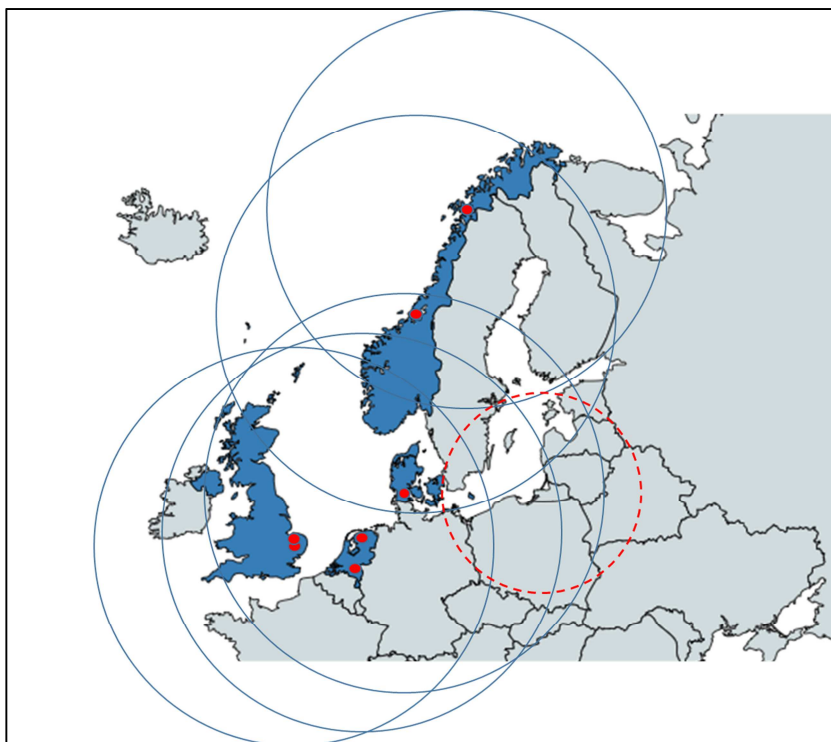
Longer-Term Planning Considerations

Small states making major investments in their defence capabilities can signal a change in defence policy. The Danish government has recognized the change in its security environment. Russian assertiveness from the Black Sea to the Baltic combined with the reach of modern weaponry has once again placed Denmark on the front line. These changes informed the acquisition of the F-35, which will enable – and perhaps necessitate – further changes in defence policy. The following suggestions indicate areas where such changes could take place.

The F-35, NATO, and the Baltic Sea

Skrydstrup will be a reasonable choice as the forward operating base for any NATO air campaign directed across the Baltic Sea. As seen in Figure 4.2, it is probably the best placed of the F-35 bases to deal with Baltic contingencies: within the unrefuelled range of the F-35 but just beyond the range of Russian *Iskander* missiles deployed in Kaliningrad.¹⁷⁵ In an allied context, the strategic significance of Skrydstrup's geographical location means that one option for Skrydstrup could be to make its facilities scalable and able to accommodate and integrate a significant number of additional aircraft and personnel from allies and partner nations, and the practice should be exercised regularly. If this is considered, Cold War-era plans for the pre-positioning of US and NATO equipment would have to be scrutinized and refreshed appropriately for the current context. Exercising such plans regularly with allies and partners could become a means to enhance the readiness of Danish armed forces. Skrydstrup's role in any such contingency will be obvious to Russian (and NATO) military planners, which should weigh heavily in the Danish conception of what is necessary.

Figure 4.2:
F-35 Bases in Northern
Europe ¹⁷⁶



Norway faces a similar dilemma in this regard with Ørland Main Air Station. Because strategic theory states that inadequate defences invite pre-emptive strikes, Norway is investing in ground-based air defence (GBAD) systems to protect its air bases from potential Russian strikes intended to destroy their F-35 fleet on the ground or, at minimum, disrupt operations.¹⁷⁷ Given the strategic significance of Skrydstrup's geography, the Danish government could consider following Norway's example and plan for the placement of a NATO GBAD system on Danish territory to provide optimal protection against Russian strikes. Such ground-based air defences could reinforce the sea-based deployment of RDN SM-2 and SM-6 missiles on frigates deployed in the vicinity of Danish territory.

RDAF Missions

As indicated in the criteria used to evaluate the military effectiveness of the candidate aircraft, the RDAF anticipates operating in a security environment in which air interdiction (AI), suppression of enemy air defence (SEAD), and destruction of enemy air defence (DEAD) missions will be required. This suggests that the RDAF is planning a long-term capability to be involved in a Baltic contingency requiring a high-intensity air campaign against Russian forces. In that context, Danish F-35s may be called upon to contribute to a force that will penetrate, suppress, and destroy Russian air defences in Kaliningrad intended to shield any aggression against NATO allies or partners in the eastern Baltic.

Missions of this type require training beyond that required for individual pilots to acquire their skills. They are generally exercised in formations and, preferably, in ways that realistically simulate adversary capabilities.¹⁷⁸ It is unlikely that they can be 'practiced' against Russian air defences to gain the 'synergy' between training and international operations presumed in the MoD's dimensioning study.¹⁷⁹ Thus, to the extent that RDAF missions do indeed evolve as indicated, two options could be explored to meet these training needs. The first is Red Flag, the USAF's premiere adversarial training exercise. The RDAF has participated in Red Flag regularly in the past in order to adapt the skillsets of its pilots to new mission requirements, such as close air support and DEAD.¹⁸⁰

The second option is to develop a regional exercise among NATO allies and partner states in the North Sea. Changes in how EU airspace will be regulated and allocated between civil and military uses will constrain the ability of air forces to exercise over Europe,¹⁸¹ while the increasing range of aircraft sensors requires even larger training ranges.¹⁸² This provides an opportunity to Denmark to take the lead to develop a regional exercise with its northern European F-35 partners, utilizing the airspace adjacent to Denmark to exercise over the North Sea. Such an exercise could differ from Red Flag in that it could potentially integrate the older and newer air capabilities of regional allies with one another, also together with maritime assets, so as to develop an effective regional joint force.

Joint Integration

In the unlikely event of a major conflict with Russia over one or more of the Baltic states, air forces will provide the initial response to penetrate and incapacitate Russian air defences in Kaliningrad to allow for NATO reinforcements to fly or sail to the Baltic states. They will necessarily be assisted by NATO and partner maritime forces in the Baltic Sea. These forces will not only work in parallel, for example, with RDN SM-2s and SM-6s providing air defence against incoming Russian missiles and aircraft, but will also work together as parts of a coherent battle network in which sensor information from F-35s and other platforms will be distributed to provide for a common operating picture and facilitate synergistic actions from allied forces. This will require air and maritime systems that communicate securely and stealthily with one another. Denmark's frigates should be integrated into this network if they are to be effective.

Distributed operations will enable Danish forces to be joint at the national and combined levels. Jointness may be driven down to the tactical level of each ship or platform. Allied militaries are developing concepts of operation that utilize the F-35's purported capabilities, and maritime forces will

necessarily be included given the strategic challenges facing the United States and its allies around the globe. The UK Royal Navy, the US Navy, and the US Marine Corps – all three services with both F-35s and maritime assets – will be the leading forces in developing concepts of operations, with the Royal Norwegian Navy paying avid attention.¹⁸³ The Royal Navy will possess its own F-35 force, 48 F-35Bs to be deployed on the new HMS Queen Elizabeth and HMS Prince of Wales aircraft carriers. The Norwegians are cooperating closely with the UK to integrate their F-35s and P-8 *Poseidon* maritime surveillance aircraft with their naval forces with an eye towards the Greenland–Iceland–UK ‘gap’ (the so-called GIUK gap).

Given this, together with the geography of F-35s in Northern Europe, the naval forces of the JSF partners should clearly also be keenly interested in developing exercises in the North Sea area. The RDN in particular should therefore consider training in air–sea integration in these waters and seek out opportunities to train and exercise with GIUK gap regional partners – such as the British, Norwegians, and Dutch – in integrated air–sea operations in the North Atlantic and apply the lessons to the Baltic. Either while doing so or in parallel, the RDN could analyse the required modifications to communication, command, and control systems for its three frigates to allow for a seamless data integration with 5th generation fighter aircraft. The RDN could also contribute to developing the regional exercise discussed above.

The joint integration of the F-35 with other capabilities in the Danish Defence could be handled by the Defence Command Joint Study Group in cooperation with the neighbouring F-35 countries as they address the joint aspects of their F-35 capability.

Command and Control

The operational concepts under consideration by allied militaries to utilize the F-35’s sensor, sensor fusion, and communications capabilities may require reconsideration of traditional notions of command and control (C2). These capabilities suggest that F-35 pilots may have greater situational awareness over a larger area of operations than the personnel who have traditionally collected, collated, and analysed tactical mission data in a Combined Air Operations Center (CAOC), an Airborne Warning and Control System (AWACS) aircraft, or in another command facility or unit. Exploiting this level of knowledge may require decentralizing control as well as execution in air operations, pushing authority as well as responsibility to the lowest level possible (i.e., the pilot). To investigate future C2 arrangements and ensure an agile, flexible, and effective employment of the F-35 aircraft, the European F-35 user nations should collectively explore the tactical, operational, strategic, political, and legal implications of distributing control to the tactical edge.¹⁸⁴

Strike Capacity

According to the Defence Agreement for 2018–23, ‘[a] potential future acquisition of long-range precision guided missiles (‘strike capacity’) will be investigated through a preliminary study that will assess a possible subsequent acquisition in the medium term (2023–2026)’.¹⁸⁵ While such a strike capacity could be ship-based with the RDN, it could also be part of the F-35 mission set. Although the stealth capability of the F-35 allows it to fly closer to heavily defended areas than previous fighter aircraft, including the F-16, there are

considerable limits to the stand-off range that can be achieved with precision-guided free-fall bombs or glide bombs that do not have a propulsion system. Thus, the investigation to inform a decision as to a long-range strike capability in the next defence agreement could include studying the possible acquisition of the long-range Norwegian Joint Strike Missile (JSM),¹⁸⁶ the shorter-range British SPEAR 3 currently under development,¹⁸⁷ and other alternatives.

4.3

Defence Policy

Defence policy results from the balance that leaders reach between the imperatives imposed upon them by the challenges and opportunities of the external security environment and those posed by domestic constraints and priorities. The DDIS 2016 Intelligence Risk Assessment suggests that some Danish defence policies (e.g., likely participation in NATO ballistic missile defence)¹⁸⁸ have caused Russia to become 'deeply anxious'.¹⁸⁹ Such Russian reactions suggest that it could see the capabilities of advanced fighter aircraft with sufficient range to strike Kaliningrad from Jutland as a serious military threat – and plan accordingly.

During the period of the new Defence Agreement 2018–23, the implementation of Danish defence policy could consider the equipment, personnel, infrastructure, training, exercise, and capability suggestions discussed above – ensuring that the RDAF possesses adequate numbers of aircraft and well-trained and highly skilled personnel; that the facilities at Skrydstrup are capable of hosting a surge of allied air forces that are well protected from air attacks; and that Danish forces exercise regularly with regional partners in scenarios that will prepare them for a high-intensity Baltic contingency. Danish defence policy during this period could transform its defence posture as surely as the denationalization of territorial defence and orientation towards expeditionary operations did after the 2004 defence agreement. This vision would recognize that Denmark is once again a frontline state in its own region and capitalize on the ability of high quality Danish forces to contribute effectively to deterring Russia from activities that could lead to a conflict.

5

Conclusion

This report has analysed the experiences and plans of Denmark's north European partners in the JSF programme – the UK, the Netherlands, and Norway – and provided an assessment of Denmark's previous experience with the F-16. Denmark chose to acquire 27 F-35A aircraft in 2016 – three to five years after its neighbours made similar decisions – and there are multiple lessons for Denmark to consider in the coming years. We have also analysed how the implementation of the F-35 aircraft in Denmark provides the RDAF and Danish defence with new capabilities, how it offers new opportunities to improve jointness and regional co-operation between North European F-35 countries, and the defence policy considerations it may require.

In the two years since the Danish acquisition decision, more than 300 F-35 aircraft have been delivered to eight countries, the JSF programme has completed the F-35 test phase, and it is expected to move into full-rate production in 2019.¹⁹⁰ With the decision to replace the F-16 with the F-35, Denmark is not just acquiring combat aircraft per se, but rather a new military capability. Such a military capability requires more than hardware; it requires people, organization, processes, and guidance before that hardware becomes an operational capability with political utility. This means that focus will now be shifting from the aircraft itself to the pilots who are going to fly the planes and the maintainers that are going to keep them flyable as well as the facilities at Skrydstrup that will ensure operations and protect the aircraft, all with the aim to successfully implement the F-35 into the Danish defence force structure.

The experiences of neighbouring countries in these areas have shown that proactive planning involving people, processes, and facilities is of paramount importance. Converting from the F-16 to the F-35 will require a substantial number of RDAF pilots and technicians spending time in the US to be trained for the F-35, meaning that they will be unavailable for operations. This will result in the reduced operational capability of the RDAF fighter force during the entire transition period (2021–26). During this transition, the RDAF will be extraordinarily vulnerable to a lack of personnel. To address these risks, actions should therefore be taken to retain and recruit the necessary number of pilots and technicians to allow for a smooth transition from the F-16 to the F-35. Every effort ought to be made to learn from the Dutch, Norwegian, and British experiences in the planning phase. Furthermore, adequate facilities at Skrydstrup should be completed in due time or the planned transfer of aircraft, pilots, and technicians from initial training in the USA will have to be postponed.

As of 2023, when the first Danish F-35 is scheduled to arrive at Skrydstrup, the RDAF will gradually start to build its operational capability as a so-called 'fifth-generation air force'. This means new possibilities and considerations both for the RDAF and Danish Defence. The F-35 acquisition had the overall purpose of maintaining the capability of Denmark's fighter force, and the 27 F-35 are therefore foreseen as accomplishing the same tasks as the 30 operational F-16 have been doing in recent years. As is known, the

procurement decision allows Denmark to decide on acquiring fewer aircraft for financial reasons. However, given the *Rigsrevisionen* report and the preceding and subsequent debate about the assumptions in the dimensioning study, our contention is that political decision-makers should keep their minds open to the possibility of having to acquire more aircraft in the future.

The F-35 Joint Strike Fighter presents a number of new capabilities that have considerable potential to improve jointness in the Danish armed forces. The Royal Danish Navy would get great return on investment in seeking cooperation with Royal Navy and the Royal Norwegian Navy to prepare for closer air-sea integration with a fifth-generation fighter aircraft. The location of North European F-35 bases around the North Sea area implies the potential to develop a regional exercise among the NATO allies and partner states there. This provides opportunity for Denmark to take the lead in developing such a regional exercise with its northern European F-35 partners, utilizing the airspace adjacent to Denmark to exercise over the North Sea.

In national and NATO operations alike, the vast F-35 sensor suite will provide the pilot with a higher degree of situational awareness than has been the case with the F-16. This means that changes to the command and control arrangements must be considered to exploit the intelligence, surveillance, and reconnaissance (ISR) capabilities of the F-35 effectively. Furthermore, the upcoming analysis of a future strike capability in accordance with the 2018 Defence Agreement would be well-suited to include a study of options for acquiring air-to-surface missiles for the F-35.

The Defence Agreement includes a re-orientation towards a more regional focus. Here, the Danish F-35 force will be strategically well-placed to counter crises in the Baltic Sea region. This means that NATO plans for a response to such a crisis will most likely have Air Base Skrydstrup as a focal point when it comes to air operations in the region. Plans for reinforcements from the Cold War period should therefore be revisited with respect to how Skrydstrup might function as a NATO F-35 forward operating base for a Baltic contingency. This will also require analysis of how best to protect the assets at Skrydstrup against physical or electronic attack.

All of the above recommendations require thoughtful consideration and leadership. The hard work required to replace the military capability of the Danish F-16 fleet has only just begun.

Notes

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