Defence Industrial Outlook

A Global Outlook with a Special Focus on the European Defence Fund

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Summary

This report consists of two parts, a global defence industrial outlook and a specific topic concerning the impact of the EDF on the Swedish defence sector.

Within the global defence industry, the US holds a uniquely strong position in terms of arms sales, capability scope, and technological sophistication. However, this dominance is increasingly being challenged, not least by China. Meanwhile, the Russian defence industry has a broad scope and is fairly advanced, but faces challenges due to the war on Ukraine and subsequent Western sanctions. The European defence industry has a broad scope and is technologically advanced, but is characterised by fragmentation.

In the past decades, the EU has introduced several defence industrial integration initiatives, most recently the EDF. According to various stakeholder representatives within the Swedish defence sector, the fund provides both opportunities and challenges for Sweden. The EDF presents opportunities in terms of funding, networking, knowledge exchange and cooperation on innovation. Meanwhile, challenges for Swedish EDF participation include potential differing goals and priorities of the EDF and the interests of Swedish defence actors as well as mismatches related to the Swedish budgeting and planning process. Successful future participation requires such challenges to be addressed.

Keywords: Defence industry, US, China, Russia, EU, EDF, Sweden

Sammanfattning

Denna rapport består av två delar, en global försvarsindustriell utblick och ett särskilt tema kring EDFs påverkan på den svenska försvarssektorn.

Inom den globala försvarsindustrin innehar USA en unik styrkeposition i termer av vapenförsäljning, förmågebredd, samt teknologisk sofistikation. USA:s dominans inom dessa områden utmanas dock alltmer, inte minst av Kina. Samtidigt har den ryska försvarsindustrin en avsevärd förmågebredd samt är tämligen avancerad, men står inför utmaningar till följd av kriget mot Ukraina och efterföljande västerländska sanktioner. Den europeiska försvarsindustrin har en stor förmågebredd och är tekniskt avancerad, men präglas av fragmentering.

De senaste decennierna har EU introducerat ett flertal försvarsindustriella integrationsinitiativ, mest nyligen EDF. Enligt representanter för intressenter inom den svenska försvarssektorn, medför fonden både möjligheter och utmaningar för Sverige. EDF innebär nya möjligheter till finansiering, nätverkande, kunskapsutbyte och samarbete kring innovation. Samtidigt innefattar utmaningar för svensk EDF-medverkan ett flertal potentiella skillnader mellan mål och prioriteringar inom EDF och intressen hos svenska försvarsaktörer liksom matchningsproblem relaterade till svensk budget- och planeringsprocess. Framgångsrik framtida medverkan kräver att sådana utmaningar adresseras.

Nyckelord: Försvarsindustri, USA, Kina, Ryssland, EU, EDF, Sverige

Preface

The Swedish Defence Research Agency (FOI) has a long-established tradition of conducting research regarding defence industrial capabilities, concerning both the Swedish domestic defence industry as well as international analyses and comparisons. The report Defence Industrial Outlook draws inspiration from the Defence Economic Outlook report series, which provides an assessment of the global military power balance between major world powers such as the US, China, Russia and large Western European countries in terms of military expenditure, equipment quantities and equipment quality. Defence Industrial Outlook complements this report series by focusing on global defence industrial capabilities, while also offering an in-depth look at a specific topic within this global context.

This report provides an outlook on the global defence industry by presenting a broad picture of the industrial capabilities of major arms producers, in terms of size, scope and sophistication. The report also features the specific topic focusing on the impact of the European Defence Fund (EDF), in terms of opportunities and challenges, on the Swedish defence sector, particularly the defence industry.

The report is written on behalf of the Swedish Ministry of Defence, within the Defence Economics and Materiel Supply project. The project and the authors would like to express our sincerest gratitude and appreciation to Calle Håkansson (Malmö University and the Swedish Institute of International Affairs), who reviewed the factual content of this report and Richard Langlais, who reviewed the language.

Per Olsson (FOI)

Project Manager, Defence Economics and Materiel Supply

Stockholm, 25 October 2022

Abbreviations

AI	Artificial intelligence
ASD	AeroSpace and Defence Industries Association of Europe
AUKUS	Australia, United Kingdom and United States
C4ISR	Command, control, communications, computers, intelligence, surveillance and reconnaissance
CARD	Coordinated Annual Review on Defence
CBRN	Chemical biological radiological nuclear
CDP	Capability Development Plan
CSDP	Common Security and Defence Policy
DG DEFIS	Director-General for Defence Industry and Space
EC	European Commission
EDA	European Defence Agency
EDAP	European Defence Action Plan
EDF	European Defence Fund
EDIDP	European Defence Industrial Development Programme
EDTIB	European Defence Technological and Industrial Base
EU	European Union
FCASC	Future Combat Aircraft Cooperation
FMV	Swedish Defence Materiel Administration
FOI	Swedish Defence Research Agency
IPR	Intellectual property rights
ISP	Swedish National Inspectorate of Strategic Products
ITAR	International Traffic in Arms Regulations
MoD	Ministry of Defence
NATO	North Atlantic Treaty Organization
PADR	Preparatory Action on Defence Research
PESCO	Permanent Structured Cooperation
R&D	Research & development
SIPRI	Stockholm International Peace and Research Institute
SME	Small and medium-sized enterprise
SOFF	Swedish Security & Defence Association
TRL	Technology readiness level
UAS	Unmanned aircraft systems

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1 Introduction

Amidst a rapidly transforming international security environment, the global defence industry has been characterised by both continuity and change over the past decades.

The US defence industry continues to dominate the global arms market, a consequence of the US being the world's largest military spender as well as largest arms exporter, by significant margins. Meanwhile, Russia has managed to maintain a strong market position, partly due to the country's military modernisation, but also due to its relatively strong export performance. However, Western sanctions following Russia's invasion of Ukraine and the lacklustre performance of Russian military equipment may affect its defence industry negatively in the near future. The large Western European countries the UK, France, Germany and Italy have also maintained relatively strong market positions. Several European countries were planning to increase their military spending even before Russia's war on Ukraine. Now these plans have grown significantly in scope, which may benefit their defence industries. At the same time, rapid growth poses challenges for European defence companies, limited in size due to decades of stagnant domestic military spending and the fragmented nature of the European defence industry.

While the traditional defence industrial powerhouses of the US, Russia and Western European countries still dominate the global arms export market, emerging powers are increasingly making their mark. During the past two decades, China has emerged as the world's second-largest defence industrial nation, largely fuelled by the country's own military modernisation efforts and increased military expenditure, but also a growing share of global arms exports. Other emerging defence industrial countries, such as South Korea and Turkey, have also claimed modest, but steadily growing, shares of the global arms market.

The growing rivalry between the major global powers has changed military capability requirements worldwide, in turn changing defence industrial priorities. The US has shifted its focus from counterterrorism to meeting near-peer rivals such as China and Russia. Several Western European countries have followed suit, partly because of US pressure, but mainly due to Russian aggression in Eastern Europe.[1] At the same time, European countries, spearheaded by France, have increasingly stressed the importance of increased strategic autonomy within the European Union (EU). In recent years, there have been several initiatives to strengthen EU security policy, defence and defence industrial capabilities through increased inte-

[1] See, e.g., Olsson, Per; Dahl, Alma & Junerfält, Tobias (2020) *Defence Economic Outlook 2020 – An Assessment of the Global Power Balance 2010-2030*.

gration. The most recent and notable policy initiative concerning European defence industrial capabilities and integration is the European Defence Fund (EDF). The EDF has the stated goal to improve performance of future capabilities, maximise innovation, increase the effectiveness of military spending and reduce the fragmentation of defence products within the European defence industry.[2] The EDF has the potential to change the EU defence market radically,[3] and its introduction presents both challenges and opportunities for smaller and mid-sized EU member states, such as Sweden.

Research objective

This report outlines global defence industrial capabilities, while also offering an in-depth look at a specific topic within this global context. The ambition is that this report will become a recurring series, with the outlook as a permanent feature while the special topic may vary between issues.

This study has two research objectives. The first relates to the global outlook and aims to provide an assessment and comparison of defence industrial capabilities of major defence industrial countries in terms of size, scope and sophistication.

The second objective relates to the special topic of this report and aims to describe the European defence industrial integration, focusing on the EDF, as well as to outline and analyse the impact of the fund, in terms of challenges and opportunities, on the Swedish defence sector, particularly the defence industry.[4] The objective is not to provide any net assessment of the EDF, but to outline key challenges and opportunities presented by the fund. These challenges and opportunities are discerned through interviews with representatives of key stakeholders; agencies, organisations and companies, within the Swedish defence sector.

For an international audience, Sweden may serve as an interesting case study. It is a mid-sized European defence industrial country, which means that it balances its need for security of supply with its need for international cooperation. Sweden also needs to balance its national security and defence industrial interests between a stronger transatlantic link and deepened EU integration. The findings of this study may therefore be relevant for other small or mid-sized European countries with similar policy priorities.

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[2] Official Journal of the European Union (2021) *Regulation (EU) 2021/697 of the European Parliament and of the Council of 29 April 2021 establishing the European Defence Fund and repealing Regulation (EU) 2018/1092*. (Accessed 2022-03-03)

[3] See, e.g., Ianakev, Gueorgui (2019) *The European Defence Fund – A Game Changer for European Defence Industrial Collaboration*.

[4] For a paper with a similar research question, see Lundborg Regnér, Anna & Håkansson, Calle (2021) *Sweden, the European Defence Fund and Permanent Structured Cooperation: Challenges Ahead for Third Party Participation*.

Research questions

In order to fulfil the above-stated objectives of this study, the authors pose the following research questions:

- How do the global defence industrial capabilities of major defence industrial countries compare in terms of size, scope and sophistication?
- What impact, in terms of challenges and opportunities, does EDF present for the Swedish defence sector in general, and the Swedish defence industry in particular?

Disposition

Chapter 2 outlines the methodology of this study, including its research method, data, definitions and delimitations.

Chapter 3 covers the global defence industrial outlook of this report, which provides outlines and compares the defence industrial capabilities of major defence industrial countries in terms of size, scope and sophistication.

Chapters 4 and 5 feature the specific topic of this report. Chapter 4 outlines the recent initiatives for increased defence industrial integration within the EU, focusing on the EDF. Chapter 5 presents the views that the representatives of key stakeholders, agencies and companies within the Swedish defence sector have on EDF and its impact on the Swedish defence industry. The chapter concludes with a summary and discussion.

In Chapter 6, the authors offer some concluding remarks.

2 Methodology

This chapter covers the methods and data used in the ensuing chapters. It also covers definitions of key concepts and the delimitations of this study.

2.1 Method and Data

This section outlines the literature, method, data and framework used to describe and assess the capabilities of the global defence industry. It also presents the literature and data used to describe, more specifically, the European defence industry and recent initiatives for defence industrial integration. It then elaborates the framework, qualitative methods and data used to assess the challenges and opportunities posed by the EDF on the Swedish defence industry.

The Global Defence Industry

The global outlook presented in Chapter 3 relies on secondary sources, such as previous literature and quantitative data on the defence industry. The focus is on the defence industrial capabilities of the world's five largest defence industrial countries while providing a brief overview of the next fifteen largest.

The description of the included countries relies extensively on the book, *The Economics of the Global Defence Industry*,[5] and is complemented by information on individual companies, statements by governments and material from open sources. Data on arms sales of the included countries have been collected from the *SIPRI Arms Industrial Database*,[6] data on military spending from the *SIPRI Military Spending Database*,[7] and data on arms export and imports from the *SIPRI Arms Transfer Database*.[8]

The chapter concludes with a comparison of the defence industrial capabilities of the twenty largest defence industrial countries. The authors apply a framework similar to those of, e.g., Cheung, Bitzinger and Raska to compare defence industrial capabilities.[9] While these studies generally focus on assessing capabilities for innovation, the framework of this study is expanded to cover the dimensions of size, scope and sophistication, with the latter dimension capturing innovativeness, or technological advancement.

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[5] Hartley, Keith & Belin, Jean, eds. (2020) *The Economics of the Global Defence Industry*.
[6] *SIPRI (2021) SIPRI Arms Industry Database.*
[7] *SIPRI (2022) SIPRI Military Expenditure Database.*
[8] *SIPRI (2022) Trends in International Arms Transfers, 2021.*
[9] Bitzinger, Richard (2015) "New ways of thinking about the global arms industry – Dealing with 'limited autarky'", *Strategic Insights*; Raska, Michael & Bitzinger, Richard (2020) "Strategic Contours of China's Arms Transfers", *Strategic Studies Quarterly*; or Cheung Tai Ming (2016) "Innovation in China's Defense Technology Base: Foreign Technology and Military Capabilities", *Journal of Strategic Studies.*

The assessment of size is based on data on the arms sales of defence industrial companies within each country, collected from the *SIPRI Arms Industrial Database*,[10] which contains information on the arms sales of the world's 100 largest arms-producing companies. A detailed list of the arms sales of the twenty largest defence industrial countries is provided in Appendix A.

The assessment of defence industrial scope is based on the number of market segments, i.e. number of different types of larger equipment, covered by the defence industries within each country. Data on the different types of equipment are collected from the IISS publication, *The Military Balance 2022*.[11] A detailed comparison is provided in Appendix D, where combat aircraft, attack helicopters, main battle tanks, infantry fighting vehicles, self-propelled artillery, surface combatants and submarines are classified as either domestically developed and produced; developed, or produced, in cooperation with another country; imported; or a mix of the above. Information on equipment origin was collected from various open sources, such as reports and news outlets online.

The assessment of defence industrial sophistication is based on the findings of previous studies,[12] and complemented by this study's assessment of modernisation, market leadership and the pioneering of next-generation technologies developed by the defence industries within each country.

In the simplified sketch shown in Figure 1, a circle serves to illustrate a certain defence industrial country; the circle's size illustrates the size of that country's defence industry, in terms of arms sales. The x-axis reflects defence industrial scope; the further right a circle is positioned, the broader a certain country's defence industrial scope, in terms of number of market segments covered by that country's defence industry. The y-axis illustrates defence industrial sophistication; the higher the position of a circle, the more sophisticated the defence industry of that country is assessed to be.

[10] *SIPRI (2021) SIPRI Arms Industry Database.*
[11] IISS (2022) *The Military Balance 2022*.
[12] E.g., Raska & Bitzinger (2020), Cheung (2016), and Bitzinger (2015).

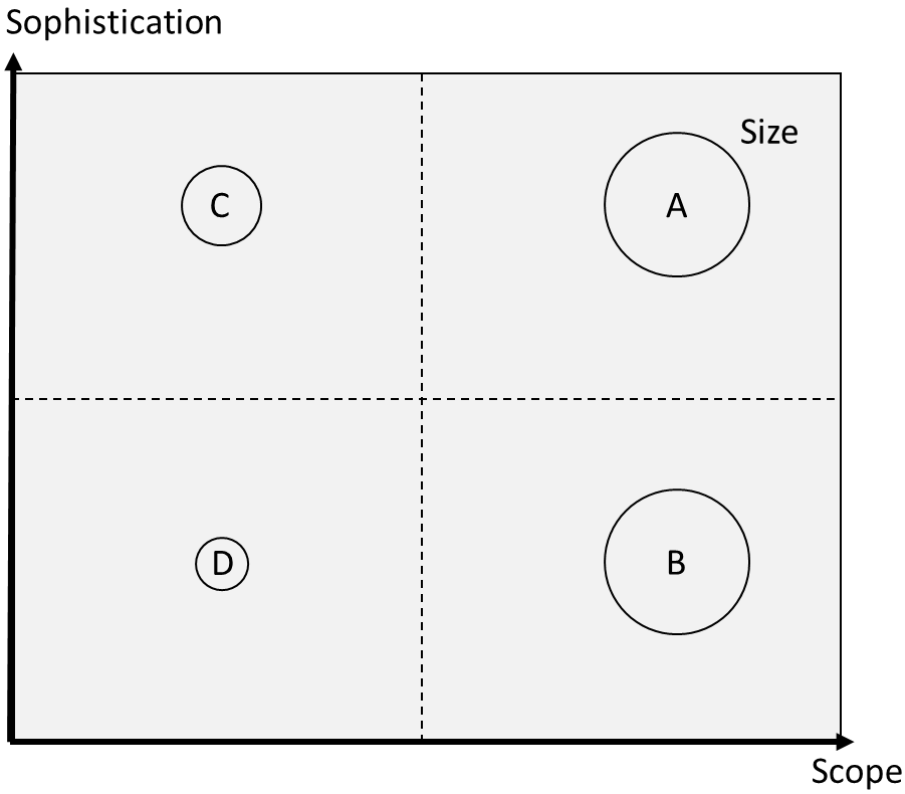

Figure 1: Simplified Sketch of Defence Industrial Size, Scope and Sophistication

In the example shown in Figure 1, the size of Country A's defence industry is large, with a broad scope and a high level of sophistication, what is sometimes referred to as being a critical technological innovator.[13] Country B has a defence industry of similar size and scope, but which is far less sophisticated compared to Country A. Country B is thus a large producer, but a follower in terms of innovation.[14] Country C has a defence industry of medium size, with a narrow scope, but which is highly sophisticated, what is sometimes referred to as being a niche innovator.[15] Country D has a small defence industry with a narrow scope and is relatively technologically unsophisticated, a defence industrial newcomer that mainly reproduces existing products.[16]

[13] What Bitzinger (2015) calls "critical technological innovators", roughly equivalent to what Cheung (2016) calls countries capable of "radical innovation".
[14] What Bitzinger (2015) calls "niche producers", roughly equivalent to what Cheung (2016) calls countries capable of "modular innovation".
[15] What Bitzinger (2015) classifies as "newly industrialised", roughly equivalent to what Cheung (2016) calls countries capable of "creative adaption" and in some cases "incremental innovation".
[16] Such countries are what Bitzinger (2015) calls "copiers and reproducers", roughly equivalent to what Cheung (2016) calls countries capable of "duplicative imitation" and in some cases "creative imitation".

It should be noted that defence industrial size, scope and sophistication, illustrated in the way presented above, constitute rough approximations and should not be seen as fixed or scalable values, according to any well-established criteria.

The European Defence Industrial Integration

The description of the European defence industry that is found in Chapter 4 relies on previous research literature.[17] The authors collected information regarding initiatives for European defence integration, mainly the EDF, from open sources, such as policy documents (primarily on the regulation of the EDF), European Commission (EC) press releases and research literature.[18]

The Impact of the EDF on the Swedish Defence Industry

The description of the Swedish defence industry offered as a background in Chapter 5 is mainly based on previous research literature.[19] Identification of the initial position of the Swedish government regarding the EDF is mainly based on policy documents,[20] and complemented by documentation of the early views of other key stakeholders.[21]

The identification of challenges and opportunities that the EDF may pose for the Swedish defence industry is based on qualitative data collected through semi-structured interviews with representatives of ten key stakeholders, henceforth referred to as actors, including three government agencies, one industry organisation and six companies within the Swedish defence sector. Three of these companies are large and three are small and medium-sized Enterprises (SMEs). This combination of agencies, larger and smaller companies, and an industry organisation was designed to capture the potential commonalities and differences in priorities and conditions among the actors.

The interviews were designed to capture the views of the actors' representatives, henceforth referred to as "representatives", or, when relevant for context, specified as representatives of "actors", "agencies", "companies", "large companies" or "SMEs". The actors represented in this report include, in alphabetical order, government agencies; the Swedish Armed Forces, the Swedish Defence Research Agency (FOI) and the Swedish Defence Materiel Administration (FMV), the industry organisation the Swedish Security & Defence Association (SOFF) and the

[17] E.g., Munich Security Conference (2017) and Olsson (2021).
[18] EU policy documents from, e.g., the EC, EDA and European Council; and research literature, such as Engberg (2021), Fiott (2018), Haroche (2020) and Håkansson (2021).
[19] Lundmark, Martin (2019) "The Swedish defence industry" in Hartley & Belin (eds), Olsson, Per (2019) *Pang för pengarna – en ESO-rapport om Sveriges militära materielförsörjning*. [Swedish].
[20] Swedish Ministry of Defence (2018) *Förordningen om Europeiska försvarsfonden*. [Swedish].
[21] E.g., SOFF (2018) and Ds 2019:8. *Värnkraft*, complemented by later views from SOU 2022:24 *Materielförsörjningsstrategi*. [Swedish].

defence industrial companies 4CStrategies, BAE Hägglund, BAE Bofors, Carmenta, Mildef and Saab.[22] The representatives interviewed all have key roles or responsibilities related to the EDF process or the fund itself within their respective organisations. The interviews were conducted in person or through digital platforms and lasted between one to one-and-a-half hours and were conducted from mid-September to early November, 2021. Each of the interviews was led by one of the present authors, with at least one additional author taking notes.

The interviews were conducted in Swedish and translated into English. The interviewed representatives were offered anonymity, with each interview randomly coded as "Interview No. X", for the purpose of internal traceability by the authors. In the reference list, below, the interviewed representatives are referred to as "representative of actor X, location and date", but these references are not externally traceable to specific interview numbers.[23] At this stage, the opportunities and challenges of the EDF that were explicitly stated by the representatives were merely summarised by the authors, without any evaluation regarding their validity or priority. In June and July 2022, the interviewees were given the opportunity to review their own interview answers in the summaries provided by the authors. This also allowed the authors the opportunity to gain an update in the event that the situation had changed drastically since the original interviews.

The framework used to structure the interview questions was inspired by Michael Porter's "Diamond Model". This model proposes four main determinants for attempting to explain why a country has national competitive advantages in an industry within the international market. The determinants of Porter's model are: 1) firm strategy, structure and rivalry; 2) factor conditions; 3) demand conditions; and 4) related and supporting industries. In this study, the strategy part of the first determinant includes questions regarding the actors' strategies and priorities regarding the EDF, the impact on research and development (R&D), the prospects of EDF participation and collaboration. The structure part focuses on the ownership and organisation of actors, while the rivalry part focuses on the impact of the EDF on the actors' competitive environment. The second determinant, factor conditions, focuses on the prospects for innovation and access to human capital. The third determinant, demand conditions, focuses on the perceived commonalities and differences in interests of the stakeholders. The fourth determinant, related and supporting industries, concerns the conditions for subcontractors to participate in the EDF.

Furthermore, Porter also proposed that the role of government policy should be included as a determinant, since it complements and supports national competitiveness. The EDF constitutes such a government policy, even though it is on the

[22] For the interview guide, see Appendix E.
[23] For the list of interviews, see References.

EU level. Yet another determinant of competitiveness, according to the Diamond Model, is chance.[24] The latter determinant does not feature in this report, as it does not include any ex-post analysis, where such a factor could be evaluated. In this study, the Diamond Model's four main determinants and the impact of government policy are used as a framework for structuring the interview questions and presenting their results. It is not, however, a tool for any structured analysis, on the basis of the answers provided by the interviews, of national competitiveness.

The analysis conducted in this report, concerning the opportunities and challenges posed by the EDF to the Swedish defence industry, proceeded by sorting related answers into broader categories identified by the authors. The potential impact of opportunities and challenges and their relative importance was sometimes explicitly stated by the interviewees themselves, but in other cases this had to be inferred through interpretation carried out by the authors.

2.2 Definitions and Delimitations

In this report, the "defence sector" includes the defence industry as well as the agencies, institutions and organisations with responsibilities related to national defence. The "defence industry" in turn comprises companies or military business segments within companies involved in the research, production, sale and maintenance of military materiel. Given the focus of this study, the agencies and institutions included are in some capacity linked to the R&D or procurement of military equipment.

The "global defence industry" is limited to the countries that are home to the world's 100 largest companies, with an extra focus on the five largest of these countries in terms of arms sales. There is a risk that these 100 largest companies are not representative of the global defence industry in its entirety, which may cause some results to be skewed when comparing global shares of arms sales. For instance, if larger companies are disproportionally present in larger countries, the global share of these large countries' arms sales will be overestimated by having omitted a large number of smaller companies. When comparing SIPRI's lists of the top 25 and top 100 defence industrial companies, this concern over skewedness seems to have some merit, but not to the extent that it drastically changes the overall picture of global arms sales.[25]

[24] See e.g. Porter, Michael (1990) *The Competitive Advantages of Nations*.

[25] When comparing the shares of largest defence industrial countries for SIPRI's top 25 list and top 100 list for 2019, the top 25 list allocates somewhat higher shares to the largest countries. Among the top 25 companies, the US has 61.3%, China 15.7%, UK 7.5%, France 4.2% and Russia 3.9%; see SIPRI (2020) *Arms Industry Database*. Among the top 100 companies, the US has 53.9%, China 12.3%, UK 6.9%, Russia 5.6% and France 4.8%; see SIPRI (2021) *Arms Industry Database*. While the overall shares of these larger countries are generally smaller in the 100 sample than in the one with 25, the relative size remains roughly the same. The only change in ranking is the shift between Russia and France.

The "European defence industry" is defined as and limited to the activities of arms industrial companies located within EU member states,[26] regardless of whether or not the ownership of a company is located inside the EU. "European defence industrial integration" is defined as those policies of the EC or EU member states that are aimed at deepening defence industrial coordination and cooperation between the members. European defence industrial integration does not include defence industrial collaborations between member states, nor cooperation between members and countries outside the EU.[27] These forms of cooperation, when included, are instead specifically referred to as, e.g., US-Italian, UK-Swedish, or Finnish-Norwegian, defence industrial cooperation. "Defence industrial cooperation" includes cooperation regarding R&D, production, and maintenance, as well as the pooling and sharing of capabilities.

The "Swedish defence industry" includes defence industrial companies and their activities, located inside Sweden, regardless of foreign or domestic ownership. Operations by Swedish-owned defence companies outside of Sweden are not included in the definition and therefore excluded from this report. The Swedish defence companies interviewed for this study account for a significant share of the Swedish defence market.[28] However, the interviewees can still only present their own views with regard to their own six entities among over a hundred security and defence industrial companies.[29] Therefore, in order to gain an industry-wide perspective, representatives from the industry organisation, SOFF, were also interviewed.

[26] The EU member states include Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

[27] Norway, though, does have the possibility of participating in the EDF as an associated country, see DG DEFIS (2022) *The European Defence Fund (EDF)*. (Accessed 2022-07-13).

[28] For instance, in 2018, Saab accounted for 70 per cent, BAE Hägglunds and BAE Bofors a further 10 per cent of total Swedish arms production, domestic sales and exports; see Olsson, Per (2019) *Pang för pengarna*. [Swedish], p. 43.

[29] Given that SOFF states that the organisation has over 100 members; see SOFF (2022) *About our member companies*. (Accessed 2022-03-03).

3 The Global Defence Industry

This chapter provides a broad outlook of the global defence industrial capabilities represented by the world's twenty largest defence industrial countries in terms of arms sales, focusing on the top five.[30] The top five overviews outline arms sales, military expenditure and arms exports, a summary description of the largest companies, and an assessment of overall defence industrial sophistication. The overview for the next fifteen defence industrial countries is summarised much more briefly. The chapter concludes with a comparative assessment of the defence industrial capabilities in terms of size, scope and sophistication among the included countries, using the classification framework described in Section 2.1.

3.1 Major Defence Industrial Countries

The US is the world's largest defence industrial country by a significant margin, with arms sales amounting to USD 306 billion, in 2020 (see Figure 2).

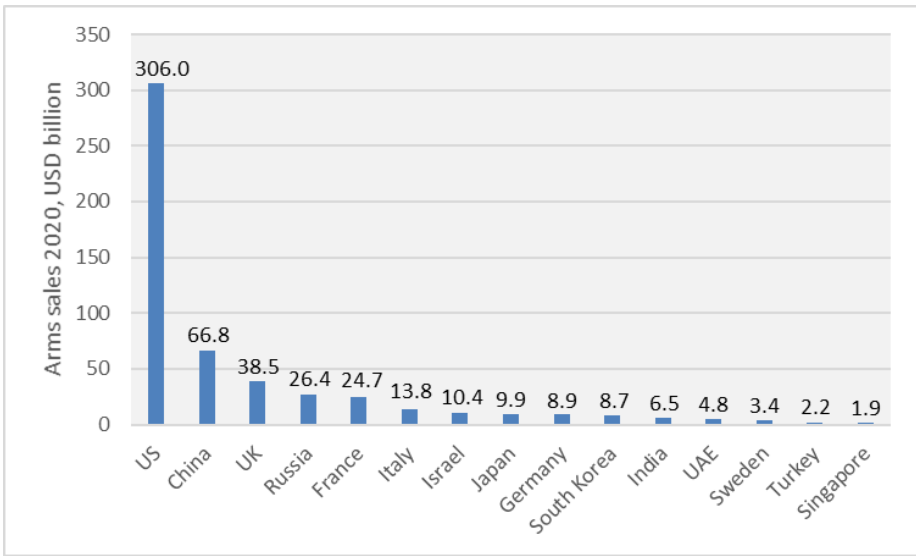

Figure 2: Arms Sales among the Largest Defence Industrial Countries, 2020

The same year, China was the second-largest defence industrial country, with sales of USD 67 billion, while the UK was third, with USD 39 billion, followed by Russia, with USD 26 billion, and France, with USD 25 billion. These top five were followed

[30] Largest in terms of arms sales among the 100 top arms-producing companies; see SIPRI (2021) *Arms Industry Database*.

by Italy, Israel, Japan, Germany, South Korea, India, the United Arab Emirates (UAE), Sweden, Turkey and Singapore.[31]

The United States of America

In 2020, the US was home to 45 of the world's 100 largest arms producers, accounting for 55 per cent of arms sales among those companies,[32] giving the US a clearly dominant market position relative to other countries. This can largely be explained by the fact that the US is by far the world's largest military spender, as well as the main customer for its domestic defence industry, spending USD 801 billion, or nearly 39 per cent of world total military expenditure, in 2021.[33] The US is also the world's largest arms exporter, accounting for 39 per cent of global arms exports from 2017 to 2021.[34]

As with all defence markets, the US domestic arms market is characterised by monopsony, with the US Armed Forces being the US defence companies' largest and most important customer. The US federal government also controls exports and international partnerships. However, consolidation within the US defence industry in recent decades also means that the government faces a limited number of suppliers, an oligopolistic or near monopolistic market.[35] In such a relationship between government and industry, terms are negotiated more often than determined through competition between multiple contractors.

The US domestic defence industry consists of private companies and is dominated by the so-called Big Five: Lockheed Martin, Boeing, Northrop Grumman, Raytheon Technologies and General Dynamics. These are not only the largest defence companies in the US, but also the five largest in the world.[36]

Lockheed Martin provides a broad range of defence capabilities, such as missiles and C4ISR[37] systems. Its single largest business segment, however, is military aircraft, mainly fighter aircraft, such as the F-35.[38] Known for its commercial aircraft, Boeing also provides several military aerospace products, such as fighters, tankers and trainer aircraft.[39] Northrop Grumman produces a broad array of military weap-

[31] Note that the Trans-European defence industry, containing the companies MBDA and Airbus, holds position number six, between France and Italy.
[32] SIPRI (2021) *SIPRI Arms Industry Database*. For a list of countries, see Appendix A.
[33] SIPRI (2022) *SIPRI Military Expenditure Database*. For a list of countries, see Appendix B.
[34] SIPRI (2022) *Trends in International Arms Transfers, 2021*. For a list of countries, see Appendix C.
[35] Amara, Jomana & Franck, Raymond (2020) "The United States and its defense industries" in Hartley, Keith & Belin, Jean (eds.) *The Economics of the Global Defence Industry*, pp. 15-16.
[36] SIPRI (2021) *SIPRI Arms Industry Database*.
[37] C4ISR is an abbreviation for Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance.
[38] Lockheed Martin (2021) *Lockheed Martin Corporation – 2020 Annual Report*, pp. 3-4. (Accessed 2022-02-28).
[39] Boeing (2021) *The Boeing Company – 2020 Annual Report*, pp. 1-2. (Accessed 2022-02-28).

ons and technologies. Its largest business segments are aeronautics and C4ISR systems.[40] Raytheon Technologies is an aerospace and defence conglomerate, producing aircraft engines, air defence systems and missiles. General Dynamics has a broad portfolio of defence products and services, among which the largest business segments are aerospace, information technology and marine systems.[41]

Apart from the Big Five, there are several other large US defence companies. L3Harris Technologies specialises in surveillance solutions, electronic warfare and microwave weaponry. Huntington Ingalls Industries is a large military shipbuilding company, producing surface combatants and attack submarines. Honeywell International is a conglomerate, which among other military products provides engines for aircraft and ground vehicles, although the company's main revenues come from non-defence business areas. Leidos is a large IT service provider, which merged with Lockheed Martin's IT sector in 2016. Booz Allen Hamilton also mainly focuses on IT services, including C4ISR, cybersecurity and advanced training solutions. General Electric is a large conglomerate involved in a variety of industries, including military aircraft engines and avionics.

The US has a nearly unique scope of defence industrial capabilities and a very high degree of self-sufficiency. Its defence industry develops and produces nearly every type of equipment of the country's armed forces, such as fighter aircraft, transport and tanker aircraft, helicopters, tanks, infantry fighting vehicles, other armoured vehicles, all types of surface combatants, strategic and tactical nuclear submarines as well as C4ISR systems, space systems and nuclear weapons.[42] Consequently, the US imports very few large weapon systems, aside from some types of light helicopters, transport aircraft and light armoured vehicles. The US also imports specific components, such as some types of naval sonars, radars, missiles and guns, mainly from other NATO countries.[43]

As stated above, the US is the world's largest arms exporter by a significant margin. The largest export destinations for the US defence industry from 2017 to 2021 were Saudi Arabia, accounting for 23 per cent, Australia with 9.4 per cent and South Korea with 6.8 per cent.[44] The most commonly exported types of equipment during this period were aircraft, missiles and armoured vehicles, followed by air defence systems, engines and sensors.[45]

The US defence industry is characterised by a very high degree of technological sophistication and is leading or pioneering within most defence market sectors globally, including 5th generation combat aircraft, naval shipbuilding, air defence

[40] Northrop Grumman (2020) *2019 Annual Report Northrop Grumman*, p. 32. (Accessed 2022-02-28).
[41] General Dynamics (2020) *2019 Annual Report General Dynamics*, p. 46. (Accessed 2022-02-28).
[42] For a comparison of defence industrial scope between major countries, see Appendix D.
[43] SIPRI (2021) *Arms Transfer Database*.
[44] SIPRI (2022) *Trends in International Arms Transfers, 2021*.
[45] SIPRI (2021) *Arms Transfer Database*.

and C4ISR systems, to name a few. Overall, this gives the US defence industry a unique position among what has been called "critical technological innovators", i.e. countries with a level of defence-related R&D that gives them a state-of-the-art technological edge.[46]

Despite its unique position, the US defence sector does face its fair share of challenges. These include increased technological demands, posed by the increased capabilities of near-peer competitors, mainly China, and consequent rising equipment costs. The US Department of Defense (DoD) also faces competing fiscal commitments, such as readiness, force size and service entitlements. Increased spending on service contracts, including administration and maintenance, will also strain the resources available for future force modernisation, including the development of next-generation aircraft, ground vehicles and naval vessels. Furthermore, outside of defence there are the rising costs of other public items, such as social costs and interest on federal debt. The so-called Third Offset Strategy is meant to alleviate some of this pressure. The strategy focuses on developing asymmetric capabilities through emerging and potentially disruptive technologies, such as hypersonic systems, quantum computing, artificial intelligence (AI), human-machine collaboration, and various unmanned and cyber systems. Increased inclusion of high-tech companies outside of the traditional defence sector may also create opportunities for increased innovativeness.[47] Whether or not such measures will mitigate the aforementioned challenges and enable the US to maintain its current lead over near-peer rivals remains to be seen.

The People's Republic of China

China has the world's second-largest defence industry, and is home to five of the world's top 100 defence industrial companies. Chinese defence companies account for 12 per cent of arms sales among these top 100 companies, just over a fifth of the US share in 2020.[48] China is also the world's second-largest military spender, with USD 293 billion, equivalent to 14 per cent of global military expenditure, or a third of the US share in 2021.[49] This high level of spending provides the Chinese defence industry with a sizeable domestic market, which is the main reason for China's position as the second-largest defence industrial country. While China was the world's fourth-largest arms exporter from 2017 to 2021, it only accounted for 4.6 per cent of global arms exports, less than an eighth of the US share.[50]

Chinese defence industrial companies mainly consist of state-owned enterprises (SOEs), under the control of the State-owned Assets Supervision and Administra-

[46] Raska & Bitzinger (2020). For the position of the US regarding defence industrial innovativeness, see also, e.g., Bitzinger (2015).
[47] Amara & Franck (2020), pp. 24-25.
[48] SIPRI (2021) *SIPRI Arms Industry Database*. For a list of countries, see Appendix A.
[49] SIPRI (2022) *SIPRI Military Expenditure Database*. For a list of countries, see Appendix B.
[50] SIPRI (2022) *Trends in International Arms Transfers, 2021*. For a list of countries, see Appendix C.

tion Commission (SASAC). These defence-related SOEs are usually large conglomerates with substantial civilian divisions, where military sales typically constitute only a minority share of total sales. In 2020, NORINCO was the largest among these companies in terms of arms sales. The company and its subsidiaries produce a wide range of civilian products and services along with military equipment, such as firearms, munitions, armoured vehicles, including tanks, and C4ISR systems. AVIC is China's main aerospace conglomerate and parent company to aircraft producers such as Chengdu, Shenyang, Xian and Harbin. These companies produce civilian aircraft together with a wide range of military aircraft, such as fighters, bombers, transports, helicopters and unmanned aerial systems (UASs). CETC is mainly involved in the business segment of information systems and electronic equipment, both civilian and military. Its military products include C4ISR and military electronics. CASIC develops and produces a wide range of aerospace capabilities, mainly spacecraft and launch vehicles, both civilian and military. It is China's main producer of missiles. Meanwhile, CSGC is a large conglomerate within the automotive industry, and produces firearms, munitions and vehicles.

There are other large Chinese defence companies, outside of the global top 100 list, which are worth mentioning. The shipbuilder CSSC, for instance, merged with China's other state-owned shipbuilding company, CSIC, to become the world's largest shipbuilder, with an estimated 20 per cent share of the global market in 2019.[51] The company and its subsidiaries provide the Chinese navy with surface combatants and submarines.

The Chinese defence industry currently provides China's armed forces, the People's Liberation Army, with nearly its entire scope of equipment needs. This is a marked change from just a decade ago, when China was the world's second-largest arms importer, with most of those imports coming from Russia. While China remains the world's fifth-largest arms importer, still with Russia as the main source of origin,[52] its level of self-sufficiency has increased drastically. All new tanks, armoured vehicles, surface combatants, strategic and tactical nuclear submarines, conventional submarines, most combat aircraft, including the fifth generation J-20, as well as C4ISR systems, space systems and nuclear weapons are currently domestically developed and produced.[53] However, some types of equipment, such as the S-400 anti-aircraft system, are imported and several domestic systems still contain foreign components, such as Ukrainian ship engines or Russian jet turbines.[54] The Chinese defence industry has historically relied heavily on technology and knowhow from abroad in order to modernise, sometimes through legal means

[51] IISS (2020) "Is China's shipbuilding merger on course?", *Military Balance Blog*. (Accessed 2022-01-17).
[52] See, for instance, SIPRI (2022) *Trends in International Arms Transfers, 2021*.
[53] For a comparison of defence industrial scope between major countries, see Appendix D.
[54] See, for instance, Kirchberger, Sarah & Mohr, Johannes (2020) "China's defence industry" in Hartley, Keith & Belin, Jean (eds.) *The Economics of the Global Defence Industry*, pp. 60-61.

such as technology transfer and joint research, sometimes through illicit means such as industrial espionage.[55] Legality notwithstanding, China's defence industry has become increasingly advanced, allowing the country to become more and more self-reliant. China has also strengthened its position as an arms exporter. However, its arms exports rely on a few, but relatively stable, customers, the most important of which is Pakistan. During the period 2017 to 2021, Pakistan and Bangladesh were top destinations for Chinese arms exports, accounting for 47 and 16 per cent, respectively, followed by Thailand, with 5.0 per cent.[56]

The Chinese defence industry has made significant strides during the past decades, but still lacks certain key capabilities and technologies. In terms of defence industrial sophistication, China can be characterised as a "fast follower" or "niche innovator".[57] It still displays limitations when it comes to developing cutting-edge integrated "system of systems" defence capabilities.[58] However, there are some areas where China demonstrates innovativeness. For instance, the Chinese missile programs, including its ballistic and cruise missiles, have been described as comparable to those of other top-tier countries.[59] Recently, China has been making efforts to consolidate its defence industry and promote civil-military integration, in order to utilise dual-use activities within the civilian industry to promote defence industrial R&D.[60] China has also invested heavily in defence-related R&D and is likely to continue to do so in the near future. This includes potentially disruptive technologies, such as hypersonic glide vehicles, quantum computers, AI, unmanned and space capabilities. It remains to be seen whether these efforts will elevate the Chinese defence industry to become an advanced or "critical technological" innovator.

The United Kingdom

The UK is home to eight of the world's 100 top arms industrial companies, accounting for 6.9 per cent of global arms sales in 2020.[61] The UK is the world's fifth-largest military spender, accounting for USD 68 billion, or 3.3 per cent of world total military expenditure, in 2021.[62] The UK is also the world's seventh-largest arms exporter, accounting for 2.9 per cent of global arms exports during the period 2017 to 2021.[63]

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[55] Raska & Bitzinger (2020), p. 94.
[56] SIPRI (2021) *Trends in International Arms Transfers, 2020*.
[57] Bitzinger, Richard (2016) "Reforming China's defense industry" in *Journal of Strategic Studies* 39:5-6, pp. 785-786.
[58] Kirchberger & Mohr (2020), pp. 60-61.
[59] DIA (2019) *China Military Power – Modernizing a Force to Fight and Win*, p. 106.
[60] Kirchberger & Mohr (2020), p. 63.
[61] SIPRI (2022) *SIPRI Arms Industry Database*. For a list of countries, see Appendix A.
[62] SIPRI (2021) *SIPRI Military Expenditure Database*. For a list of countries, see Appendix B.
[63] SIPRI (2022) *Trends in International Arms Transfers, 2021*. For a list of countries, see Appendix C.

BAE Systems is the largest defence contractor in the UK by a significant margin, and the sixth-largest defence company globally.[64] It produces a wide range of equipment, including military aircraft, armoured vehicles, and surface combatants, as well as strategic and tactical nuclear submarines. In 2020, the single largest business segment was air systems, accounting for 55 per cent of total sales.[65] Rolls-Royce is perhaps best known for producing luxury automobiles, but is also a manufacturer of military equipment. Aircraft engines and marine gas turbines are its primary defence-related products, among which transport and combat aircraft engines accounted for half of defence segment revenues in 2019.[66] Babcock International Group also provides a range of services and systems, including marine solutions and nuclear submarine sustainment.[67] The other UK defence industrial companies on the global top 100 list are the Serco Group, Melrose Industries, QinetiQ, and Devonport Royal Dockyard, a subsidiary of Babcock, and Meggitt.

British defence companies are privately owned, but the government has a strategic influence as a monopsony buyer.[68] Even though the UK, following Brexit, is no longer a member of the EU, there are several British defence companies with a high degree of integration with defence companies within the EU.[69]

The UK defence industry provides the country's armed forces with most of its current equipment, such as tanks, other armoured vehicles, artillery, surface combatants and submarines.[70] However, the UK does import some systems and produces some equipment of foreign origin, including US Apache attack helicopters and 5th generation F-35 combat aircraft. The country also relies on US missiles to carry its nuclear warheads. The UK took part in the joint development of the Eurofighter Typhoon combat aircraft with Germany, Italy and Spain. Like many other advanced defence industrial countries, the UK also imports several components of its equipment. The UK exports arms to a wide range of global customers, with the Middle East being a key market. Between 2017 and 2021, Oman accounted for 19 per cent of UK arms exports and Saudi Arabia for another 19 per cent. The US accounted for a further 19 per cent.[71]

The UK defence industry is technologically sophisticated and has a strong position as a global exporter. However, the UK faces many of the same challenges as other

[64] BAE Systems accounts for 64 per cent of arms sales among the eight UK defence companies included, see SIPRI (2021) *SIPRI Arms Industry Database*.
[65] BAE Systems (2021) *Annual Report 2020 – BAE Systems plc*, p. 2. (Accessed 2022-03-03).
[66] Rolls-Royce (2021) *Annual Report 2020 – Rolls-Royce Holdings plc*, p. 30. (Accessed 2022-03-03).
[67] Babcock International (2021) *Annual Report and Financial Statements 2021*, pp. 50-57. (Accessed 2022-03-03)
[68] Hartley, Keith (2020) "The United Kingdom" in Hartley, Keith & Belin, Jean (eds.) *The Economics of the Global Defence Industry*, pp. 132-137.
[69] Uttley, Matthew R.H. & Wilkinson, Benedict (2016) "A Spin of the wheel? Defence procurement and defence industries in the Brexit debates", *International Affairs, 92: 3*.
[70] For a comparison of defence industrial scope between major countries, see Appendix D.
[71] SIPRI (2022) *Trends in International Arms Transfers, 2021*.

defence industrial countries, such as the need to develop new technologies and the problems posed by the rising costs of military equipment.[72] Moreover, Brexit is not only likely to put a strain on the UK economy,[73] but also makes the UK a third party country with regard to the EDF. The UK has tried to mitigate the effects of Brexit by strengthening alternative international cooperations, both within and outside of Europe. As part of this strategy, the UK is increasingly looking towards cooperation with likeminded nations globally, with renewed geopolitical interest in the Indo-Pacific region. The UK's participation in AUKUS,[74] together with the US and Australia; cooperation with Japan; and engagement with ASEAN countries; are meant to diversify the UK's global partnerships, while maintaining the priority of the Euro-Atlantic.[75] The UK is also lead nation in the Future Combat Aircraft Cooperation (FCASC), together with Italy and Sweden, to develop next-generation fighter capabilities.[76] Most importantly for the UK, the country maintains a strong political and defence industrial relationship with the US.[77]

Russia

Russia had nine defence industrial companies and 4.8 per cent of arms sales among the global top 100 in 2020.[78] Russia is the world's fourth-largest military spender, with USD 66 billion, or 3.2 per cent of the global total, in 2021.[79] Moreover, Russia is the world's second-largest arms exporter, accounting for 19 per cent of global arms exports from 2017 to 2021.[80]

The Russian defence industry is organised into 65 large state-owned or state-controlled holding companies. By 2018, over 80 per cent of the defence sector was contained within this structure.[81] Among these companies, Almaz-Antey is the largest; its main products include air defence systems, C4ISR systems, munitions, artillery and UASs. United Aircraft Corporation is Russia's main aerospace holding company and parent company to aircraft producers such as Sukhoi, Mikoyan,

[72] Hartley (2020), pp. 141-142.
[73] Pre-Brexit estimates pointed to a 3.4-9.5 per cent stronger GDP performance over 15 years, if the UK were to remain within the EU rather than leave; see Chancellor of the Exchequer (2016) *HM Treasury analysis: the long-term economic impact of EU membership and the alternatives*.
[74] AUKUS is a trilateral security pact between Australia, the UK and the US.
[75] Aronsson, Albin (2021) *Global Britain: Navigating between Europe and the Indo-Pacific?*
[76] Government of Sweden (2019) *Sweden and United Kingdom sign agreement on development of future combat aircraft capabilities*. (Accessed 2022-02-25). Italian Ministry of Defence (2021) *Difesa: Progetto Tempest, firmato Memorandum of Understanding tra Italia, Regno Unito e Svezia. Il programma entra nel vivo - n.1*. [Italian]. (Accessed 2022-02-25).
[77] See, for instance, Aronsson (2021) for more on the political importance, and SIPRI (2022) *Trends in International Arms Transfers, 2021* for more on defence industrial importance.
[78] SIPRI (2021) *SIPRI Arms Industry Database*. For a list of countries, see Appendix A.
[79] SIPRI (2022) *SIPRI Military Expenditure Database*. For a list of countries, see Appendix B.
[80] SIPRI (2022) *Trends in International Arms Transfers, 2021*. For a list of countries, see Appendix C.
[81] Malmlöf, Tomas & Engvall, Johan (2019) "Russian armament deliveries" in Westerlund, Fredrik & Oxenstierna, Susanne (eds.). *Russian Military Capability in a Ten-Year Perspective – 2019*, p. 116.

Tupolev and Ilyushin. These subsidiaries produce fighters, transports, tanker aircraft and bombers. United Shipbuilding Corporation is a shipbuilding holding company and parent company to military wharves, which produce surface combatants, submarines and support ships. Tactical Missiles Corporation produces a range of munitions, mainly missiles. United Engines Corporation produces engines, marine gas turbines and fighter jet turbines. The other large Russian defence industrial companies on the global top 100 list include electronics companies KRET and Russian Electronics, Russian Helicopters and armoured vehicle producer UralVagonZavod.[82]

The Russian defence industry provides the country's armed forces with nearly the entire scope of equipment, including fighter aircraft, transport and tanker aircraft, helicopters, tanks, infantry fighting vehicles, other armoured vehicles, all types of surface combatants, strategic and tactical nuclear submarines, and conventional submarines, as well as C4ISR systems, space systems and nuclear weapons.[83] Consequently, Russia imports very few weapon systems or components. One of Russia's few traditional import sources of military components used to be Ukraine. However, since the annexation of Crimea in 2014, this avenue has naturally been cut off. Among other shortages, Russia was left without marine gas turbines for frigates, which consequently needed to be developed domestically.[84]

Russia exports a wide array of military equipment, with Asia as a key market. Between 2017 and 2021, India and China were Russia's top customers, receiving 28 and 21 per cent of Russian arms exports, respectively. During the same period, Egypt was Russia's third-largest export destination, accounting for 13 per cent of arms exports.[85]

Generally, the Russian defence industry still lags behind its US and Western European counterparts. However, Russia seems to have an edge within certain capabilities, such as hypersonic weapon systems.[86] The increased military spending from the early 2000s fuelled the modernisation of the armed forces and provided the defence industry with much-needed revenue. The future of the Russian defence industry seems less certain, however. Military spending had been slowing in the years leading up to the war against Ukraine and the plan was for the defence industry to diversify through an increased share of civilian production.[87] Russia also

[82] SIPRI (2021) *SIPRI Arms Industry Database*.
[83] For a comparison of defence industrial scope between major countries, see Appendix D.
[84] LaGrone, Sam (2015) "Russian Navy Faces Surface Modernization Delays Without Ukrainian Engines, Officials Pledge to Sue", *USNI News*. (Accessed 2022-02-25).
[85] SIPRI (2022) *Trends in International Arms Transfers, 2021*.
[86] Congressional Research Service (2020) *Hypersonic Weapons: Background and Issues for Congress*, pp. 11-12.
[87] Malmlöf, Tomas & Engvall, Johan (2019) "Russian armament deliveries" in Westerlund, Fredrik and Oxenstierna, Susanne (eds.). *Russian Military Capability in a Ten-Year Perspective – 2019*, p. 119.

faced the challenge of keeping up its military modernisation and the costs this entails, as European NATO members have been increasing their own modernisation efforts in recent years. Further issues, which curtail Russia's ability to modernise and challenge the West in terms of innovation, include long-term economic stagnation and 'brain drain' due to, e.g., the emigration of scientists and engineers.[88] Finally, Russia's war against Ukraine has seen the lacklustre performance of Russian military equipment as Russia has suffered heavy losses. These will need to be replaced, which will require heavy funding. On the one hand, the war may be used as an argument to increase military spending and acquisition, which may benefit the Russian defence industry. However, the war and Russian performance may deter export customers, which would deprive the defence industry of revenue.

Even before the war, the EU and the US had imposed sanctions directed at the Russian defence industry, following the annexation of Crimea in 2014, denying it access to funds as well as vital components and dual-use technology.[89] The Russian defence industry also has to contend with being denied or having limited access to important and much needed high-end machine tools from important European and US suppliers.[90] In the wake of Russia's war against Ukraine in 2022, additional and more severe sanctions were levied against arms producers and Russian industry at large, aiming to further block access to advanced tools and critical components.[91] This may have severe long-term effects on the Russian defence industry, especially if credible substitutes cannot be found.

France

France is home to six of the world's top 100 defence industrial companies, with 4.5 per cent of global arms sales in 2020.[92] It is the world's eighth-largest military spender, accounting for USD 57 billion, or 2.7 per cent of the global total, in 2021.[93] France was also the world's third-largest arms exporter between 2017 and 2021, accounting for 11 per cent of global arms exports during that period.[94]

Although the French defence industry has experienced a privatisation process during the past decades, the French government retains a strong influence. Besides it being the most important customer and provider of R&D investment, the French

[88] Gressel, Gustav C. (2017) "Section 1: Strategy and Challenges" in Bitzinger, Richard A. & Popescu, Nicu (eds.). *Defence industries in Russia and China: players and strategies*, pp. 35-36.
[89] Oxenstierna, Susanne & Olsson, Per (2015) *The economic sanctions against Russia – Impact and prospects of success*.
[90] Malmlöf, Tomas (2019) *The Russian machine tool industry – Prospects of a turnaround?*
[91] Gould, Joe (2022) "New US sanctions target Russia's multibillion-dollar defense sector", *Defense News*, 2 March 2022. (Accessed 2022-03-16).
[92] SIPRI (2021) *SIPRI Arms Industry Database*. For a list of countries, see Appendix A.
[93] SIPRI (2022) *SIPRI Military Expenditure Database*. For a list of countries, see Appendix B.
[94] SIPRI (2022) *Trends in International Arms Transfers, 2021*. For a list of countries, see Appendix C.

state still maintains varying degrees of ownership among the country's largest defence companies. The French defence industry consists of a core of large prime contractors and over 4,000 SMEs.[95]

In 2020, Thales was the largest French defence company in terms of arms sales. The company's largest business segment is Defence & Security, accounting for almost half of total company sales, with products and services including air, land, naval and C4ISR capabilities.[96] Safran is the second-largest French defence company, with products including aircraft and helicopter engines as well as rocket engines and guidance systems.[97] Naval Group develops and produces a range of surface combatants as well as nuclear and conventional submarines.[98] Dassault Aviation Group is a privately owned aircraft manufacturer, producing a wide range of military and civil aircraft, with military aircraft constituting the main source of company revenue.[99] Other major French providers of defence products include nuclear technological institute CEA and land-systems producer Nexter.[100]

Overall, the French defence industry provides the country's armed forces with a broad range of equipment, such as fighters, transport and tanker aircraft, helicopters, tanks, armoured vehicles, surface combatants, strategic and tactical nuclear submarines as well as C4ISR systems, space systems and nuclear weapons.[101] However, France does import some types of military equipment, such as lighter hand arms, light armoured or specialised vehicles, reconnaissance and some transport aircraft, mainly from other European countries, or the US. Of total French arms exports between 2017 and 2021, 29 per cent went to India, 16 per cent to Qatar and 11 per cent to Egypt.[102]

The French defence industry is sophisticated, but like other European countries, its national defence budget is not large enough to maintain the country's defence industrial base through domestic orders alone. Exports have become more important and in recent years about half of French defence industry turnover came from exports.[103] Pressure from new competitors and requests for technology transfers in connection to export deals may pose challenges to the French defence industry.

France has a long-held defence industrial policy of strategic autonomy, meant to safeguard national independence regarding military security of supply. In recent

[95] Belin, Jean; Malizard, Julien & Masson, Hélène (2020) "The French defence industry" in Hartley, Keith & Belin, Jean (eds.) *The Economics of the Global Defence Industry*, pp. 145-151.
[96] Thales (2022) *Thales reports its 2020 Full-Year results*, 4 March 2021, p.6. (Accessed 2022-02-25).
[97] Safran (2022) *Safran at a glance*. (Accessed 2022-02-28).
[98] Naval Group (2022) *Naval defence*. (Accessed 2022-02-28).
[99] Dassault (2022) *Higher Together*. (Accessed 2022-02-28).
[100] CEA (2022) *Defence and security*, Nexter Group (2022) *Our Products*. (Accessed 2022-02-28).
[101] For a comparison of defence industrial scope between major countries, see Appendix D.
[102] SIPRI (2022) *Trends in International Arms Transfers, 2021*.
[103] Belin, Jean, et al. (2020), pp. 155-156.

years, France has come to champion the concept of European strategic autonomy.[104] In line with this policy stance, France actively participates in a large number of European collaborations. It was highly active in the European Defence Industrial Development Programme (EDIDP) and the Preparatory Action on Defence Research (PADR), pilot programmes to the EDF, being successful in the largest number of calls among participating countries in both.[105] Along with several European partners, France has also taken part in the development of remotely piloted aircraft systems and, together with Germany, of next-generation armoured vehicles.[106] France also has a leading role in the development, together with Germany and Spain, of a future combat aircraft, SCAF.[107]

Other Countries That Are Home to the Top 100 Companies

After the French defence industry, the two trans-European defence companies, MDBA and Airbus, have the largest combined share of global arms sales. While the former mainly develops and produces missiles, the latter mainly develops and produces aircraft, including military combat aircraft, transports, tankers and helicopters. The remaining fifteen among the twenty largest defence industrial countries include Italy, Israel, Japan, Germany, South Korea, India, the UAE, Sweden, Turkey, Singapore, Poland, Ukraine, Spain, Canada and Norway. As with the top five, the number of companies among the top 100 for the remaining fifteen are based on SIPRI,[108] while the occurrence of domestically developed and produced as well as imported equipment is based on IISS.[109]

Italy is home to two of the world's top 100 defence companies, Leonardo and Fincantieri. The Italian defence industry provides domestically developed and produced surface combatants, attack helicopters, tanks and armoured vehicles, missiles, C4ISR systems and, in cooperation with German and British companies, the Eurofighter combat aircraft. It is also a partner in the UK-led FCASC cooperation. Italian submarines are currently developed by German ThyssenKrupp and licence-produced in Italy, which has also bought the US fifth-generation F-35 combat aircraft, for which Italy provides maintenance globally. Like those of many other medium-sized European countries, the Italian defence industry is advanced. However, Italy relies on imports of certain defence segments and components in addition to cooperation within Europe and with the US.

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[104] Franke, Ulrike & Varma, Tara (2018) *Independence Play: Europe's Pursuit of Strategic Autonomy*, pp. 3-4.
[105] Masson, Hélène (2020) *European Industrial Development Programme (EDIDP) - Results of the calls (15.06.2020)*. Fondation pour la Recherche Stratégique.
[106] Sprenger, Sebastian (2020) "German, French defense ministers push for Eurodrone progress", *Defence News*. (Accessed 2022-05-03), Rizzi, Alberto (2020) "Towards a European Tank: France and Germany sign agreements on MGCS project", *Finabel*. (Accessed 2022-05-03).
[107] The Defence Post (2021) "Boost for European Fighter Jet as Paris, Berlin, Madrid Seal Deal", *The Defence Post*. 17 May 2021. (Accessed 2022-05-03).
[108] SIPRI (2021) *SIPRI Arms Industry Database*. For a list of countries, see Appendix A.
[109] IISS (2022) *The Military Balance 2022*, see, also, Appendix D.

Israel is home to three of the world's top 100 defence companies: Elbit Systems, Israel Aerospace Industry and Rafael. The Israeli defence industry provides domestically developed and produced surface combatants, tanks and armoured vehicles, UASs, missiles and C4ISR systems. Israel is importing German-designed submarines and the US fifth-generation F-35 combat aircraft. Israel also relies on systems and components that are primarily from the US and Europe.

Japan is home to five of the world's top 100 defence companies: Mitsubishi Heavy Industries, Kawasaki Heavy Industries, Fujitsu, IHI Corporation and Mitsubishi Electric Corporation. The Japanese defence industry provides domestically developed and produced armoured vehicles, artillery, surface combatants, C4ISR systems and, with US assistance, domestic combat aircraft such as the F-2, based on the US F-16. However, most of the Japanese Air Self-Defence Force still operates US fighters. While Japanese surface combatants are domestically developed and produced, they usually carry US weaponry and sensors.

Germany is home to four of the world's top 100 defence companies: Rheinmetall, ThysenKrupp, Krauss-Maffei Wegmann and Hensoldt. The German defence industry provides domestically developed and produced surface combatants, submarines, tanks and armoured vehicles, missiles and C4ISR systems. It also developed the Eurofighter combat aircraft, together with Italy and the UK, as well as the Tiger attack helicopter, in cooperation with France. It is currently a partner in the SCAF programme and the next-generation armoured vehicle development. The German defence industry is advanced, and market-leading in some segments, but too small to cover all market segments. For certain defence systems and components, Germany relies on imports and on cooperation within Europe and with the US.

South Korea is home to six of the world's top 100 defence companies: Hanwha Aerospace, including its subsidiaries Hanwha Defence and Hanwha Systems; Korea Aerospace Industries; Hanwha Group; and LIG Nex1. The South Korean defence industry domestically develops and produces surface combatants, submarines, tanks, infantry fighting vehicles, artillery and light attack helicopters. It imports combat aircraft. It is fairly advanced and has gained several export contracts, but still relies heavily on imported components, mainly from the US.

India is home to three of the world's top 100 defence companies: Hindustan Aeronautics, Indian Ordnance Factories and Bharat Electronics. The Indian defence industry domestically develops and produces surface combatants, attack helicopters, one type of tank and a combat aircraft. Despite having improved its level of self-sufficiency and technology, imported equipment still account for several military systems within the Indian Armed Forces, such as most tanks and combat aircraft as well as all of its infantry fighting vehicles and submarines.

The UAE is home to one of the world's top 100 defence companies, EDGE. This defence conglomerate produces armoured vehicles, munitions, electronic warfare

and cyber equipment. Despite a growing domestic industry, the UAE still relies heavily on imports for most of its military equipment.

Sweden is home to one of the world's top 100 defence companies, Saab. Other large defence companies include BAE Hägglunds and BAE Bofors. The Swedish defence industry provides domestically developed and produced combat aircraft, surface combatants, submarines, armoured vehicles, missiles and C4ISR systems. Meanwhile, Sweden uses imported tanks, helicopters and some armoured personnel carriers. The Swedish defence industry is advanced, but small in size. Traditionally self-sufficient, Sweden has become increasingly reliant on imported components.[110]

Turkey is home to one of the world's top 100 defence companies, ASELSAN. Other large defence companies include armoured vehicle producer Otokar. Despite increased self-sufficiency and successes on the export market, Turkey is still reliant on imports for several military systems such as aircraft as well as components for its domestic defence industry.

Singapore is home to one of the world's top 100 defence companies, ST Engineering. The country produces some military systems, such as armoured vehicles, artillery and several surface combatants, but is still reliant on imports for several military systems and components.

Poland is home to one of the world's top 100 defence companies, PGZ, under which most of the Polish defence industry has been organised. Despite increased self-sufficiency and the increased ability to adapt foreign designs and produce them domestically, Poland still relies on imports for several military systems and components.

Ukraine is home to one of the world's top 100 defence companies, UkrOboronProm. While the Ukrainian Armed Forces still relies on large quantities of Soviet-legacy equipment, its domestic defence industry has made further development to modernising such equipment and has been able to develop domestic missiles, as well as remaining strong in the production of engines.

Spain is home to one of the world's top 100 defence companies, Navantia. Other large defence companies include Indra. The Spanish defence industry has developed and produced domestic surface combatants and submarines as well as a wide range of systems and components. Spain took part in developing the Eurofighter and Tigre, and is currently part of the SCAF programme. However, Spain still relies on imports for several of its military systems and components.

Canada is home to one of the world's top 100 defence companies, CAE. The Canadian defence industry produces several systems, such as armoured personnel carriers, and surface combatants, but its armed forces are heavily reliant on imports of foreign equipment and components.

[110] See e.g. Lundmark, Martin (2022) "The Evolution Towards the Partial Strategic Autonomy of Sweden's Essential Security Interests", *Defence and Peace Economics*.

Norway is home to one of the world's top 100 defence companies, Kongsberg. The Norwegian defence industry develops and produces military systems, such as advanced missiles, but the Norwegian Armed Forces is heavily reliant on imports for most of its military equipment.

3.2 Comparing Defence Industries

In order to present and compare the defence industrial capabilities of the large defence industrial countries, those capabilities have been assessed and ranked based on the dimensions of size, scope and sophistication, as shown in Figure 3, below. As stated in Section 2.1, the dimension of size is based on arms sales,[111] while scope is based on the number of market segments.[112] Sophistication is based on an assessment of the general technological sophistication of the military equipment developed and produced within a given country.[113]

These assessments are approximations, rather than exact positions; especially technological sophistication is difficult to assess with any higher degree of accuracy. The assessments are also generalisations about the entire defence industry. A certain country could be market-leading in certain segments and still have an overall low ranking, while another might lag in some specific areas but still rank highly.

As stated above, the US defence industry is by far the largest in size, with a nearly complete scope of defence-market segments and a uniquely high level of technological sophistication, often pioneering or leading.

China's defence industry is large in size and covers a very broad scope of defence-market segments. China has made significant strides to catch up technologically, but still lags behind most Western countries with regard to technological sophistication. It can be characterised as a fast follower, with some niche advantages.

In a global context, Russia has a larger medium-sized defence industry, with a nearly complete scope of defence-market segments. However, it also lags behind most Western countries in terms of technological sophistication, but it has some niche advantages.

European defence industries are generally sophisticated, but medium to small in size and scope. The French defence industry is medium-sized, with very broad scope, and a high level of technological sophistication. Similarly, the UK defence industry is larger medium-sized, with a broad scope and high sophistication. The defence industries of Germany and Italy are also medium-sized, with broad scopes, and are highly sophisticated while that of Spain is small in size, with a medium scope and medium technological sophistication, and some niche advantages. The

[111] SIPRI (2021) *SIPRI Arms Industry Database*. For a list of countries, see Appendix A.
[112] For a comparison of defence industrial scope between major countries, see Appendix D.
[113] Based on the outline in Chapter 3 and, e.g., Raska & Bitzinger (2020), Cheung (2016), and Bitzinger.

defence industry of Poland is also small in size, with a narrow but increasingly broad domestic scope and technological sophistication. Sweden's defence industry also has a broad scope of defence-industrial capabilities, and is highly sophisticated, but small in size. Norway's defence industry is highly sophisticated, but small in size, and covers a limited scope of defence-market segments.

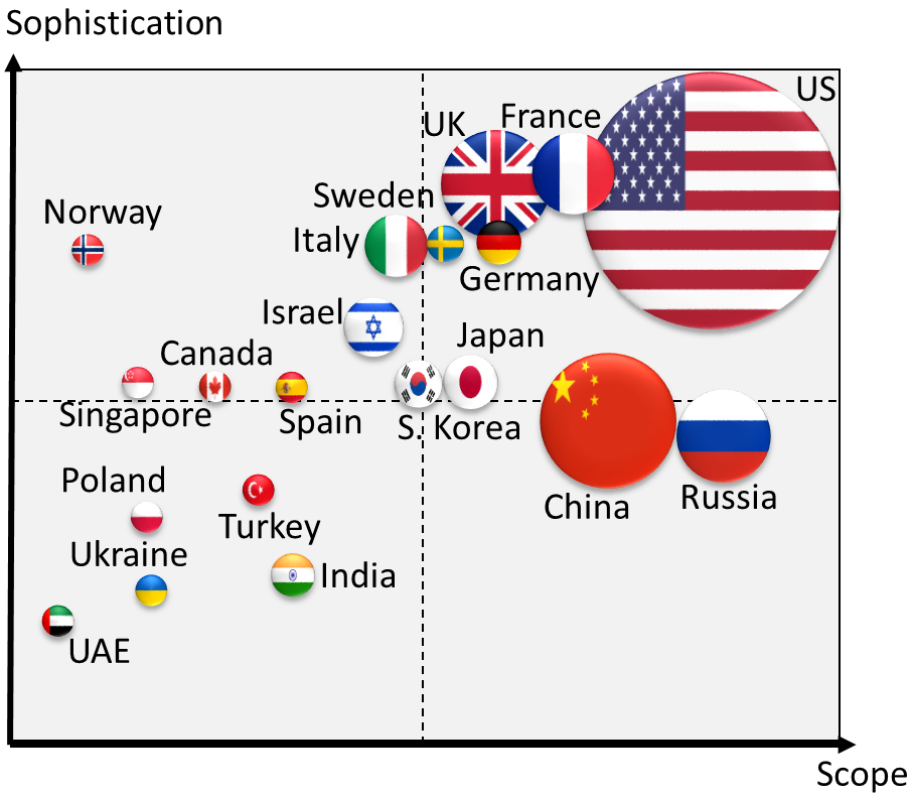

Figure 3: Size, Scope and Sophistication of Major Defence Industrial Countries

In Asia, the defence industries of Japan and South Korea are both of medium size, with medium scope and relatively high level of technological sophistication. Meanwhile, Singapore is a niche producer, of small size and narrow scope, but relatively high technological sophistication in the products they make. India's defence industry is medium in size and scope, with moderate levels of overall technological sophistication.

In the Middle East, Israel's defence industry is medium in size and scope, with a high level of technological sophistication. Meanwhile, Turkey's is also small in size, with an increasingly broad scope and growing technological sophistication; it is a fast follower, with some niche advantages. The UAE is small in size and of narrow scope; it is a fast follower and adapter in some market niches.

Canada's defence industry is small in size, with medium scope, but a high level of technological sophistication. The Ukrainian defence industry is small in size and, as a developer of new equipment, narrow in scope. In terms of technological sophistication, it can be characterised as an adapter and innovation-follower, with some niche advantages.

When comparing the defence-industrial capabilities presented above with other common metrics, such as military expenditure, some interesting observations can be made.[114] First, the US position is even more dominant in terms of arms sales than in terms of military expenditure, which could partly be explained by its position as the largest arms exporter on the international market. Furthermore, Russia's defence industry is also relatively large compared to its military spending; the country also maintains a relatively large share of global arms exports. European countries also hold large shares of the global market compared to their share of global military spending.

However, the assessment presented in Figure 3 illustrates only a specific point in time, more specifically the year 2020, and does not capture the most recent decades of development. During the last twenty years, China has claimed an increasing share, both of global military expenditure and arms sales, even though its defence industrial expansion is mainly driven by domestic demand rather than exports, which though increasing still lags behind the more established arms exporters. Other actors, such as South Korea and Turkey, have also emerged as strong defence industrial countries, with a growing share of global arms exports.

To reiterate, the above assessment offers a generalised overview and should not be seen as a detailed evaluation, a qualification that is especially true for the dimension of technological sophistication. However, the assessment does draw upon previous studies,[115] and corresponds fairly well with the degree of modernisation within the respective armed forces of several of the included countries.[116] Overall, the assessment provides an approximate picture of the global defence industry and the comparative position of the twenty largest defence industrial countries.

[114] SIPRI (2022) *SIPRI Military Expenditure Database*. For a list of countries, see Appendix B.

[115] Raska & Bitzinger (2020) rank countries into tiers within a pyramid, with the US being the only top Tier 1A country, while other large and advanced defence industrial countries such as Britain, France, Germany and Russia rank as Tier 1B. Small but technologically advanced defence industries such as those of Australia, Canada, Israel, Norway, Japan, and Sweden rank as Tier 2A; newly industrialised economies such as China, Argentina, Brazil, Indonesia, Iran, South Africa, South Korea, Taiwan, and Turkey rank as Tier 2B; while relative newcomers such as India rank as Tier 2C. Cheung (2016) does not provide a ranking of defence-industrial capabilities, but focuses instead on outlining the development of the Chinese defence industry, from levels of mere duplication, through adaptation and re-innovation. However, Cheung does state that the US is "the most effective role model for integrated innovation", indicating a still significant gap between US and Chinese defence-industrial innovation capabilities.

[116] For an assessment of force modernity, see e.g. Olsson, et al. (2020).

4 European Defence Industrial Integration

As outlined in the previous chapter, the European defence industry is highly advanced, with several countries that are able to develop and produce a wide scope of equipment. However, the home markets of individual European countries are relatively small. Consequently, there have been several policy initiatives from both the European Commission (EC) and the European Council to integrate the EU defence market and European defence industry. This chapter begins with a brief overview of the European defence industry and continues with an outline of key EU initiatives for deepened defence industrial integration. Finally, the chapter describes one of the most recent among these initiatives, the EDF.

4.1 The European Defence Industry

The European defence industry, here limited to the defence industrial activities located within EU member states, consists of 27 national defence industries. Several of these can trace their histories back to the late 19th century and the two world wars,[117] with some companies having histories dating back centuries.[118] Historically, the European defence industries have been geared towards producing equipment to fight each other's armed forces, a situation that remained true until after the Second World War. During the Cold War, the European defence industries were divided along geopolitical lines, but continued to be mostly national in nature. After the Cold War, new alliances formed, with several former Warsaw Pact countries joining NATO and the EU.

Meanwhile, the perceived European peace dividend led to falling military spending during the 2000s and 2010s. Decreased spending led to decreased demand for military equipment, which led to pressure for rationalisation. Three large trends emerged: privatisation, internationalisation and consolidation. Most European defence industries went through a process of privatisation, but to varying degrees. Sweden has a completely privatised defence industry, Germany's is almost entirely privatised, while several countries, including France, Italy, Norway and Finland, retain some degree of state ownership. Internationalisation allowed for increased degrees of foreign ownership of defence companies and an increased reliance on export and import of equipment, components and services, both from inside and

[117] For instance, British Marconi and Vickers, both now part of BAE Systems, can trace their histories back to the late 19th century, as can both German Thyssen and Krupp. Italian OTO Melara, now a subsidiary of Leonardo, was founded in 1905. French Dassault's predecessor, Société des Avions Marcel Bloch, was founded in 1929, while Swedish Saab was founded in 1937.

[118] For instance, Italian Beretta, can claim the title as the world's oldest arms manufacturer, with arquebus production dating back to 1526. Beretta (2022) *Fabrica d'Armi Pietro Beretta S.p.A. Today*. (Accessed 2022-07-19).

outside Europe. Most of the consolidation occurred nationally, gathering entire market segments under one dominant firm, such as German TKMS and KMW, French Naval Group and Nexter, or large national champions such as Italian Leonardo or Swedish Saab. In the 2000s, there were also some examples of European consolidation, mainly resulting in the two trans-European companies, Airbus and MBDA.

A widely cited study from the Munich Security Conference, in 2017, showed that the European defence market was highly fragmented, especially when compared to that of the US.[119] This should not be surprising, as the EU consists of 27 member states, with their respective domestic defence markets, while the US constitutes one single market.

However, when looking at market segments, the overall picture of European defence market fragmentation becomes somewhat more nuanced. Market concentration varies significantly depending on which market segment is being examined. For instance, the main battle tank market is fairly concentrated, with the Leopard 2 accounting for 70 per cent of all European third-generation tanks currently in service. The infantry fighting vehicle market is more fragmented and, while the market for self-propelled howitzers is currently quite concentrated, several emerging competitors may change that situation. The fighter market is moderately fragmented, with US combat aircraft making up over a third of the market, with European fighters comprising the rest. The most fragmented market segment among major weapon systems in Europe, and highly national in nature, is for surface combatants. Meanwhile, the submarine market is currently quite concentrated, with German classes making up almost 60 per cent of the market.[120]

Despite variation between market segments, the European defence industry and defence market as a whole remain fragmented along national lines. This fragmentation poses a challenge for member states, as it reduces the potential for economies of scale. A larger variation leads to smaller production series, which in turn means that fewer produced units need to carry the fixed costs incurred, such as investments in physical infrastructure, human capital or R&D, when developing and producing new weapon systems.

As seen in the previous chapter, most European defence industrial countries are technologically sophisticated, but of small to medium size in a global context. This persistent fragmentation, together with pressure from international competition and the increasing need for technological development and security of supply, caused by the worsening global security environment, has led to a series of recent initiatives to promote integration within the European defence industry.

[119] Munich Security Conference (2017) *More European, More Connected and More Capable*.
[120] Olsson, Per (2021) *The European Defence Market – Unevenly Fragmented*.

4.2 EU Defence Industrial Initiatives

Over the past decades, the EU has attempted to increase defence cooperation between its member states by establishing new EU defence initiatives and structures. The strategic drivers that have been identified behind this change are deterioration in EU's immediate security environment, changing global power relationships and a European desire to take greater responsibility for its own security.[121]

Several recent EU defence initiatives have been intergovernmental in nature. In 2004, the European Council established the European Defence Agency (EDA) to further develop intergovernmental cooperation.[122] The EDA's mission is to support the development of defence capabilities and military cooperation, as well as to strengthen the European Defence Technological and Industrial Base (EDTIB).[123]

Furthermore, in 2017, the European Council established the Permanent Structured Cooperation (PESCO). The initiative is intended to increase both defence cooperation between participating member states and the joint development of defence capabilities. The framework includes binding commitments and projects, which it stipulates should have either an operational or a capability perspective. The projects should be formulated in line with the stated EU capability priorities and overcome potential capability needs identified through the Coordinated Annual Review on Defence (CARD) and Capability Development Plan (CDP). Moreover, they should contribute to the strengthening of the EDTIB.[124] Participation is voluntary for the member states and so far the PESCO includes 25 member states. [125]

Moreover, the Council established the CARD in 2017 and, in 2018, the EDA revised the already recognised CDP. The CARD aimed to improve the member states' national defence planning processes by increasing transparency, harmonising plans, and identifying potential areas for cooperation.[126] The CDP is both a process and a document; it has resulted in a list of EU's defence capability short-term requirements and long-term capability and technology needs.[127]

Besides the intergovernmental actors, the EC plays an active role when it comes to developing initiatives to support and integrate the European defence industry.[128]

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[121] Engberg, Katrina (2021) *A European Defence Union by 2025? Work in progress*.
[122] Fiott, Daniel, ed (2020) *The CSDP in 2020 The EU's legacy and ambition in security and defence*, p. 62.
[123] EDA (2022) *Mission*. European Defence Agency. (Accessed 2022-01-31).
[124] Official Journal of the European Union (2017) *European Council Decision (CFSP) 2017/2315 of 11 December 2017 establishing permanent structured cooperation (PESCO) and determining the list of participating Member States*. (Accessed 2022-01-26).
[125] European Commission (2021) *The European Defence Fund*. (Accessed 2021-06-01).
[126] EDA (2021) *Coordinated Annual Review on Defence (CARD)*. (Accessed 2021-06-15).
[127] Fiott, Daniel (2018) *EU defence capability development: Plans priorities, projects*.
[128] Haroche, Pierre (2020) "Supranationalism strikes back: a neofunctionalist account of the European Defence Fund", pp. 853-872.

In 2009, the EC adopted two new directives,[129] which aim to promote a more integrated defence market and to support the consolidation of the European defence industry.[130] Furthermore, in the European Defence Action Plan (EDAP), from 2016, the EC emphasised the need for more defence cooperation to achieve a stronger Europe. The EC also identified that the European defence market suffers from fragmentation, duplication and a lack of cooperation. To support the defence industry, the EC proposed that a more concrete point of action be added to the EDAP, which was a European Defence Fund (EDF).[131] In March 2022, the EC approved the Strategic Compass for Security and Defence, henceforth the EU Strategic Compass, which is a strategic document containing, among other things, analyses of global and regional threats, and proposals regarding EU defence capabilities, as well as a description of aims pertaining to EU relations with cooperation partners such as NATO. The EU Strategic Compass also describes ongoing work aimed at facilitating the joint acquisition of defence materiel within the EU, including new financial solutions and changes to arms export control practices.[132]

However, there are different views among the EU member states regarding whether to achieve defence integration through supranational or intergovernmental initiatives.[133] A majority of the EU member states regard security and defence policy as intrinsic to national sovereignty. There are tensions between member states concerning to what extent decision-making within the defence area ought to be transferred to the EU level. This includes defence industrial topics. Some member states suggest that joint investment, production and acquisition would strengthen European defence capabilities, whereas others argue that EU-level policies undermine national defence industries.[134] In this context, the introduction of the EDF and related initiatives serve to strengthen the role of the EC, as a supranational actor, within the defence area.[135] The increased presence of supranational actors within the defence area has also redefined the traditional separation of intergovernmental and supranational initiatives. For example, the EDF is a supranational initiative

[129] For more on intra-community transfers, see Official Journal of the European Union (2009) *Directive 2009/43/EC of the European Parliament and of the Council*, for defence procurement, see Official Journal of the European Union (2009) *Directive 2009/81/EC of the European Parliament and of the Council*.

[130] Fiott, Daniel, ed (2020).

[131] European Commission (2016) *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions – European Defence Action Plan*. (Accessed 2021-12-21).

[132] European External Action Service (2022) *A Strategic Compass for Security and Defence*. (Accessed 2022-09-06).

[133] Bátora, Jozef (2009) "European defence agency: a flashpoint of institutional logics", *West European Politics.*

[134] Engström, Alina & Thorburn, Emelie (2022) *Kompassen, kriget och konsekvenserna för EU som säkerhetspolitisk aktör*. [Swedish]

[135] Håkansson, Calle (2021) "The European Commission's new role in EU security and defence cooperation: the case of the European Defence Fund", *European Security*, pp. 589-608.

partially connected to the intergovernmental PESCO, due to the potential bonus that a PESCO project might receive within the EDF.[136]

EU member states also have differing opinions regarding the relative importance of the transatlantic link compared to intra-European cooperation in the defence industrial area. This results in conflicting perspectives on matters such as third-party participation in the EDF, and how to develop the EDTIB without adverse impact on defence industrial cooperation with the US.[137]

4.3 The European Defence Fund (EDF)

The Pilot Programmes – PADR and EDIDP

The launching of the EDF originated in two pilot programmes: the Preparatory Action on Defence Research (PADR) and the European Defence Industrial Development Programme (EDIDP). These programmes laid the respective foundations for the permanent research and capability windows of the EDF.[138] The EC has overall responsibility for PADR, with some implementation tasks delegated to EDA. For this relatively small instrument, EUR 90 million was allocated for the years 2017–2019.[139] Throughout its duration, EDA published three rounds of calls for proposals; in total, 18 research projects were awarded funding.[140] Furthermore, the industrial programme, the EDIDP, had a considerably larger budget, of EUR 500 million, during 2019–2020. The EC published calls for the programme in both 2019 and 2020. The categories covered by the latest calls were undersea, air combat, AI, CBRN, cyber, counter-UAS, ground combat, maritime, precision strike, SME, space and simulation.[141]

The Establishment of the EDF

In 2018, the EC presented a proposal for a regulation establishing the EDF, including a proposed budget of EUR 13 billion, under EU's long-term budget frame of 2021–2027.[142] The European Parliament (EP) and the member states reached political agreement in December 2020 regarding the regulation of the EDF.[143] The EP and European Council adopted the regulation in May 2021, when establishment

[136] Haroche (2020).
[137] Engström, Alina & Thorburn, Emelie (2022).
[138] European Commission (2021) *The European Defence Fund*. (Accessed 2021-06-01).
[139] European Commission (2021) *Preparatory Action on Defence Research (PADR)*. (Accessed 2021-07-15).
[140] European Commission (2021) *The European Defence Fund*. (Accessed 2021-06-01).
[141] European Commission (2021) *European Defence Industrial Development Programme 2020*. (Accessed 2021-12-16).
[142] Budget denoted in 2018 current prices, see European Commission (2018) *Proposal for a Regulation of the European Parliament and of the Council Establishing the European Defence Fund*, Article 4.
[143] European Commission (2020) *Commission welcomes agreement on European Defence Fund*. Press Release. (Accessed 2021-06-11).

of the fund was also finalised. However, the approved budget of slightly under EUR 8.0 billion was far smaller than the original proposal.[144] Nevertheless, the EDF budget is significant compared to the aforementioned pilot programmes.

The two components, or windows, of the EDF each have their own allocated share of the total budget: the research window has been assigned EUR 2.7 billion and the capability development window has been allocated EUR 5.3 billion.[145] Moreover, the EC allocated four to eight per cent of the total budget to projects aimed towards increasing the development of disruptive technologies.[146] Responsibility for the implementation of the EDF is with the recently established EU department, the Director-General for Defence Industry and Space (DG DEFIS).[147]

As stated by the regulation of the EDF, the general goal of the fund is to promote competitiveness and innovation within the EDTIB, with the aim of contributing to European strategic autonomy by supporting cooperation between entities within the EU,[148] specifically small and medium-sized enterprises (SME) and midcap-enterprises.[149] Furthermore, the regulation defines the following specific objectives: to support collaborative research and the collaborative development of defence products and technologies. In addition, the latter objective aims to induce greater economies of scale, reduce duplication and fragmentation, and lead to standardisation of defence systems and increased EU interoperability.[150]

How the EDF Works

Generally, the EC describes the production cycle of defence products and technologies as having three phases: research, development and acquisition. Only projects related to research and development are currently qualified for EU funding.[151] However, the EU Strategic Compass describes new proposals aimed towards facilitating the financing of joint defence capability acquisition within the EU. These proposals include a value-added tax waiver and new financing solutions.[152]

The main financial instruments applied for the research and development phases are grants and co-financing. In the research phase, the projects apply for funding

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[144] Official Journal of the European Union (2021) *Regulation (EU) 2021/697*.
[145] Denoted in 2021 current prices, see Article 4.2 a and b in *Regulation (EU) 2021/697*.
[146] According to the definition stated in the regulation of the EDF, a disruptive technology is an improved or completely new technology that impels a fundamental change and drives a paradigm shift, in terms of concepts and the conduct of activities within the defence area. Article 4.4 in *Regulation (EU) 2021/697*.
[147] DG DEFIS. *The EU Defence Industry*. (Accessed 2021-07-01).
[148] Official Journal of the European Union (2021) *Regulation (EU) 2021/697*, Paragraph 5.
[149] A midcap-enterprise refers to a company not defined as an SME and has a maximum of 3000 employees, according to the definition stated in the regulations of the EDF.
[150] Official Journal of the European Union (2021) *Regulation (EU) 2021/697*, Article 3.
[151] European Commission (2021) *The European Defence Fund*. (Accessed 2021-06-01).
[152] European External Action Service (2022) *A Strategic Compass for Security and Defence*. (Accessed 2022-09-06).

primarily through grants covering up to the total cost of the research project. In the development phase, the fund supports the projects through co-financing, which implies that the EU budget complements the member states' own investments. The rate of co-financing varies within the phase, with up to 20 per cent of the costs for prototype development, and up to 80 per cent for actions such as certification and verification.[153] Projects usually reach prototype development after the research phase, and it is often within this phase that the member states agree on cost distribution and project rights.[154]

According to the resolution of the EDF, projects have to fulfil the stated requirements to be qualified for funding. For example, the projects must be of a collaborative nature and be carried out by a group of entities, a consortium. Furthermore, a consortium should consist of participants from at least three legal entities, and from at least three different member states, or associated countries.[155] Thus far, Norway is the only country with an associated country status within the EDF.[156] For projects regarding disruptive technologies, it is possible for a single entity to carry out a project.[157] In the development window, the member states also have to commit to purchasing the final product or technology by signing a letter of intent, in order to qualify for EU funds.[158]

Moreover, a consortium might be able to attain a higher funding rate by fulfilling certain criteria in their application, for instance, by including a cross-border SME or a midcap-enterprise. In addition, as previously mentioned, PESCO projects might also be eligible for a bonus.[159] Recent initiatives towards extending the EDF bonus system include ongoing work aimed at increasing the support for joint procurement of defence capabilities under development.[160]

Participation of Third Countries or Third-country Entities

In the negotiation process to establish the EDF, the access to the fund by third countries or third-country entities was an important subject for some of the member states.[161] The process resulted in the following formulation: "For the purposes of an action supported by the Fund, the recipients and subcontractors involved in

[153] Ibid.
[154] Official Journal of the European Union (2021) *Regulation (EU) 2021/697*, Paragraph 25.
[155] Official Journal of the European Union (2021) *Regulation (EU) 2021/697*, Article 13.
[156] DG DEFIS (2022) *The European Defence Fund (EDF)*. (Accessed 2022-07-13).
[157] Official Journal of the European Union (2021) *Regulation (EU) 2021/697*, Paragraph 13.
[158] Official Journal of the European Union (2021) *Regulation (EU) 2021/697*, Paragraph 30.
[159] EEAS (2021) *Permanent structured cooperation – PESCO Deepening defence cooperation among EU member states*. (Accessed 2021-09-28).
[160] European External Action Service (2022) *A Strategic Compass for Security and Defence.* (Accessed 2022-09-07).
[161] Mauro, Frédéric; Simon, Edouard & Xavier, Ana Isabel (2021) *Review of the Preparatory Action on Defence Research (PADR) and European Defence Industrial Development Programme (EDIDP): lessons for the implementation of the European Defence Fund (EDF)*. EP Directorate-General for External Policies-Policy Department. Brussels.

an action shall not be subject to control by a non-associated third country or by a non-associated third-country entity".[162] The resolution does state that it is possible to cooperate with a third country or a third-country entity when carrying out a project, including using assets, infrastructure, facilities and resources. However, the EC must view the cooperation as suitable and as taking the security of the EU and the goal of the EDF into regard. Furthermore, the fund does not cover costs associated with third-party participation.[163]

It is possible for a project to involve an entity with a subsidiary in the EU, but owned by a third-country entity located outside of the EU. This on the condition that the member state in which the subsidiary is established approves security guarantees.[164] Even if the regulation states as much, some countries emphasised that the possibility for third-party participation was of great importance. Therefore, the EC stressed the fact that third-party-owned subsidiaries were able to participate when launching the selected calls for EDIDP 2019. Included were four participating entities whose controlling entities were variously located in Canada, Japan and the US.[165] Another important condition stated in the resolution is that third countries and third-country entities are not allowed control over the ownership of the Intellectual Property Rights (IPR). The results of the projects must also stay within the EU, otherwise the EC has the right to demand a refund.[166] The compromise reached between the countries that wanted open access for third-party participation and those wishing for the EDF to contribute to EU's strategic autonomy did address some of the concerns of the former, but can be seen as closer in line with the position of the latter.

Work Programmes and Project Selection

The EC implements the EDF through annual work programmes, which specify the call categories, topics and specific budgets.[167] During the process of preparing these programmes, the EC is required to insure that the programmes are in line with the member states' views. This is done by vote in the Work Programme Committee, which consists of representatives from the 27 EU members, in which the vote must result in a qualified majority in favour of the programmes.[168]

It is up to the member states and country entities to form consortia. They also need to write a project proposal, which they submit to the workgroup responsible for

[162] Official Journal of the European Union (2021) *Regulation (EU) 2021/697*, Article 9.3.
[163] Official Journal of the European Union (2021) *Regulation (EU) 2021/697*, Paragraph 30.
[164] Official Journal of the European Union (2021) *Regulation (EU) 2021/697*, Article 9.4.
[165] European Commission (2020) *More than €205 million to boost EU Defence Industry*. (Accessed 2021-08-05).
[166] Official Journal of the European Union (2021) *Regulation (EU) 2021/697*, Article 20.4.
[167] European Commission (2021) *The European Defence Fund*. June 2021. (Accessed 2021-06-01).
[168] Mauro, et al. (2021) *Review of the Preparatory Action on Defence Research (PADR) and European Defence Industrial Development Programme (EDIDP): lessons for the implementation of the European Defence Fund (EDF)*.

evaluating the proposals. To assist them, a group of independent experts who represent a broad range of member states is assigned. The EC reviews the proposals, first by ranking and then scoring them according to specified criteria. This evaluation process results in a list displaying the attained scores of the proposals, i.e. an order of precedence. After the evaluation process, the EC again has to present the selected projects to the Work Programme Committee. The committee must once again vote in favour of the selected projects, otherwise the EC cannot move forward to an award decision. However, the Work Programme Committee has to consider the projects as a whole when voting, to prevent specific member states from having opinions about certain aspects of the selected projects.[169]

In June 2021, the EC published the 2021 annual work programme.[170] Listed below are the categories of the calls for the EDF published in 2021:

- Medical response & CBRN
- Information superiority
- Sensors
- Cyber
- Space
- Digital transformation
- Energy & environment
- Materials & components
- Air combat
- Air & missile defence
- Ground combat
- Force protection & mobility
- Naval combat
- Disruptive technologies
- Non-thematic calls for innovative & future-oriented defence solutions

For 2021, the total budget was 1.2 billion EUR, with 15 call categories, 23 calls, and a total of 61 projects.[171]

The 2021 EDF calls have resulted in the participation of 25 different Swedish actors in 21 different projects, of which nine are research projects and 12 development projects. In a field of 28 member states, the participation of Swedish actors ended up in 7th place, which is significant progress compared to previous experience with the EDIDP and PADR programmes.[172]

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[169] Ibid. p. 20.

[170] European Commission (2021) *Commission Implementing Decision on the financing of the European Defence Fund established by Regulation (EU) No 2021/697 of the European Parliament and the Council and the adoption of the work programme for 2021*.

[171] European Commission (2022). *Results of the EDF 2021 Calls for Proposals: EU invests €1.2 billion in 61 defence industrial cooperation projects*. (Accessed 2022-08-03).

[172] FMV (2022) *Information om den Europeiska försvarsfonden (EDF) och det Permanenta strukturerade samarbetet (PESCO).* [Swedish].

5 Impact of the EDF on the Swedish Defence Industry

This chapter begins with a background description of the Swedish defence industry and initial official Swedish views regarding the introduction of the EDF. The main section of this chapter presents the results from the ten semi-structured interviews conducted for this study; these contain the views on EDF as stated by the Swedish government agencies, defence companies and defence industrial organisation.

5.1 The Swedish Defence Industry

The Swedish defence industry is fairly consolidated, with development and production being concentrated to a few major companies. It is completely privatised and highly internationalised in terms of export dependency and cooperation.

As described in Chapter 3, the Swedish defence industry is capable of developing and producing a broad scope of defence equipment, including combat aircraft, infantry fighting vehicles, surface combatants and submarines, as well as guided and unguided munitions, sensors and components. Only a few major weapon systems in use by the Swedish Armed Forces, such as main battle tanks and helicopters, are imported. This high degree of system-level autonomy for such a small country can be attributed to Sweden's long history of non-alignment, where defence industrial autonomy was seen as an essential precondition of that policy. However, the above system-level description presents an inaccurate picture of the current degree of Swedish defence industrial self-sufficiency, as several sub-systems and components are imported or developed in cooperation with other countries.[173] For instance, the turbofan engine on Sweden's new combat aircraft, Saab JAS 39 Gripen E, has been developed by US General Electric, and the radar by Italian-UK Selex, a subsidiary of Italian Leonardo.

Following the end of the Cold War and the fall of the Soviet Union, the Swedish defence industry experienced the same international trends as most other defence industries; internationalisation, privatisation and consolidation. Internationalisation meant an increased reliance on exports due to diminishing domestic demand. In 2018, about 70 per cent of the security and defence industry's revenue came from exports.[174] At the same time, the Swedish defence industry was also opened to increased foreign ownership, with the most notable results being UK BAE's acquisition of Hägglunds and Bofors. Privatisation was an ongoing process, even during the Cold War, but was finalised with the sale of the last state-owned defence

[173] For a detailed description of the Swedish defence industry see, Lundmark, Martin (2019) "The Swedish defence industry" in Hartley, Keith & Belin, Jean (eds.), *The Economics of the Global Defence Industry.*
[174] SOFF (2018) *Nyttan med internationell samverkan*. [Swedish]

company, Celsius AB, to Saab, in 2000. Consolidation meant that several smaller companies were bought by or merged into larger entities, the largest by far being Saab. In 2018, Saab accounted for about 70 per cent of Swedish defence-related production, while BAE Hägglunds and BAE Bofors together accounted for an additional 10 per cent.[175]

Generally, defence companies often cooperate with local producers and subcontractors in connection with export contracts, and the Swedish defence industry is no exception. The Swedish defence industry's main partnerships include the defence industries of the US, the UK and other European countries. For instance, Saab cooperated with US Boeing to develop and produce the T-7 Red Hawk trainer aircraft. Saab developed and produced the NLAW anti-tank missile with the UK.[176] Saab also participated in the MBDA-led development of the Meteor air-to-air long-range missile and of the IRIS-T short-range air-to-air missile, led by German Diehl. In 2019, Sweden signed the aforementioned Memorandum of Understanding with the UK, and later Italy, regarding development of future combat aircraft capabilities.[177]

5.2 Official Swedish Views on the EDF

Initial official statements by Swedish actors, such as the government and the security and defence industrial organisation, SOFF, suggested that the EDF comes with opportunities, but that there are also certain aspects of the fund that pose challenges.

In 2018, the Swedish government declared its position regarding the EDF, welcoming the strengthening of EU cooperation within the area of defence materiel. However, the government also raised its concern that the formulation regarding third-country-entity participation was too strictly formulated, since it could restrict cooperation with strategic partners outside the EU. Hence, Sweden pushed for a more flexible framework, while pointing out that it was going to continue to strive for this formulation during the upcoming negotiations.[178]Accordingly, during the ensuing negotiations Sweden strongly advocated for an inclusive approach to third-party participation.[179]

SOFF also expressed concern about third-party participation and stressed its significance. The organisation advocated for an inclusive strategy, which would welcome

[175] Olsson (2019) *Pang för pengarna*, p. 43. [Swedish]
[176] Lundmark, Martin (2019), pp. 294-295.
[177] Government of Sweden (2019) *Sweden and United Kingdom sign agreement on development of future combat aircraft capabilities*. Accessed 2022-02-25, Italian Ministry of Defence (2021) *Difesa: Progetto Tempest, firmato Memorandum of Understanding tra Italia, Regno Unito e Svezia*. Accessed 2022-02-25. [Italian], see also Section 3.1.
[178] Swedish Ministry of Defence (2018) *Förordningen om Europeiska försvarsfonden*, pp. 7-8. [Swedish]
[179] Håkansson, Calle (2021) "Finding its way in EU security and defence cooperation: A view from Sweden", *European View*, pp. 80-87.

third-country entities to participate in EDF projects.[180] Moreover, the 2019 report of the Swedish Defence Commission, a forum for consultation between the government and the political parties in the Swedish parliament, also emphasised the question of securing third-country participation. The Commission stated that the implementation of the EDF could otherwise involve a risk that parts of the Swedish defence industry would be discriminated against or even excluded from the fund. Furthermore, the Defence Commission also pointed out that the implementation of the EDF might risk weakening Sweden's defence industrial cooperation with the US and the UK.[181]

In 2020, the Swedish government decided to task an inquiry with analysing the needs of and providing proposals for a new Swedish defence materiel supply strategy. In May 2022, the inquiry published its report, which also includes its assessment of the EDF. In broad terms, the inquiry report suggests that the Swedish state needs to strive to ensure that the EDF develops in a way that is relevant to Sweden's defence materiel supply, industry and research actors. Furthermore, the state should ascertain that the market effects of the EDF do not have an adverse impact on the preconditions for Swedish defence materiel supply. Consequently, when formulating Sweden's priorities concerning the EDF, the state needs to keep the interests of Swedish industry and its research actors in mind. This also necessitates coordination with other member states, as well as a proper understanding of how the EDF is related to other defence-related EU cooperation.[182]

5.3 Results from the Interviews

This section presents the results from the interviews conducted with ten key actors within the Swedish defence sector between September and October 2021. The ten interviews included representatives from three government agencies, one arms industrial organisation and six companies, of which three were larger and three were SMEs. The interview responses have been sorted using a framework based on Porter's Diamond Model. The responses were condensed in order to avoid duplication, but the views presented here are nevertheless those of the representatives; this section does not present the views or analysis of the authors. For further details about interview methodology, see Section 2.1. This section first presents the general views expressed by the actors in the interviews, followed by their views on strategy, structure and rivalry, factor conditions, demand conditions, related and supporting industries, and government policy. The section concludes by presenting the actors' previous experience with EU cooperation.

[180] SOFF (2018) *SOFF:s remissvar på EU-kommissionens förslag till Europaparlamentets och rådets förordning om inrättande av europeiska försvarsfonden COM (2018) 476 med hänvisning till diarienummer Fö2018/01010/MFU*. [Swedish]
[181] Ds 2019:8. *Värnkraft – Inriktningen av säkerhetspolitiken och utformningen av det militära försvaret 2021-2025*. [Swedish]
[182] SOU 2022:24. *Materielförsörjningsstrategi – För vår gemensamma säkerhet*. [Swedish]

5.3.1 General Views on the EDF

From the interviews, it was discerned that most of the representatives viewed the EDF as significant, with the potential to change the European defence market radically. Most representatives also found that the fund presents both challenges and opportunities for the Swedish defence industry, a notion in line with the second research question of this study.

Several representatives had a generally positive view of the EDF. Specific examples were that the fund could serve as a source of R&D, an instrument for knowledge creation, a way to strengthen European defence capability, and a possibility for SMEs to work with prime contractors. It could also enhance cooperation within the Swedish defence industry.[183] Other representatives answered in more neutral terms, viewing the EDF as significant and something they have to relate to whether they plan to participate or not.[184] Similarly, another representative stated that the EDF is large enough to determine the direction of European defence R&D.[185] A couple of representatives stated that the EDF will change the European defence industrial landscape.[186] A representative from a government agency stated that while EUR 8 billion was not a large sum when it comes to defence R&D, the EDF does have strategic implications and creates conditions in particular for EU states and associated states to participate.[187]

Several representatives also identified challenges with the implementation of EDF. The EDF was seen as having a complex framework and rules, thus presenting an administrative burden, especially for SMEs, and comprising large investments with uncertainties regarding payoffs. The EDF was also seen to entail defence industrial consolidation, which may neither align with Swedish interests, nor necessarily match Swedish defence industrial needs, the Armed Force's needs or its investment planning process.[188] One representative claimed that a common European system does not fit Sweden well, and that there is a higher degree of reluctance from industry and state actors among the Nordic countries. Nordic countries and especially governments need to adapt to a larger degree if this is to work.[189] One SME representative claimed that from their own perspective the market would have been better without the EDF, as they see it creating more challenges than opportunities.[190]

[183] Interview 10, Interview 8, Interview 2, Interview 4
[184] Interview 6, Interview 8.
[185] Interview 2.
[186] Interview 1, Interview 9.
[187] Interview 1.
[188] Interview 1, Interview 4, Interview 7, Interview 5.
[189] Interview 10.
[190] Interview 3.

Some challenges were considered to be more related to the Swedish response to the EDF, rather than the EDF itself. The response was seen as being largely reactive rather than proactive, which puts Sweden at a disadvantage compared to larger and more active nations. One company representative stated that the government and the government agencies initially viewed the EDF as mainly an industrial programme, but have begun to see it more as a source for building defence capabilities.[191]

5.3.2 Strategy

In the interviews, nearly all the representatives answered that they had specific ambitions with the EDF, but that these were not formalised into measurable goals; only a few actors had a formalised, explicitly stated or written strategy. However, some actors were in the process of developing EDF strategies. Furthermore, several government agencies, FMV and FOI, and the Armed Forces were in the process of developing a common set of goals, based on the overall goals of the government and parliament.[192]

Larger companies generally had more clearly defined ambitions than the smaller ones.[193] For instance, one representative of a larger company stated that these goals were expressed in terms of knowledge accumulation, the building of competencies and networks, and participation in relevant areas, rather than goals in terms of euro.[194] SMEs generally view themselves as subcontractors, but with different degrees of direct EDF involvement. For instance, one SME representative stated that they wanted to have the role of subcontractor, while not becoming member of a consortium.[195] Another SME representative stated that their company has a more "passive-active" approach, where they react when an issue important to them arises within the EDF calls.[196] A third SME representative stated that their company was not at all active, but focused instead on current customers rather than potential EDF projects.[197]

Priorities

While all actors claimed that the EDF was considered a priority within their organisation, the degree of prioritisation varied. One representative stated that while the EDF is currently only partially prioritised, its importance is increasing due to

[191] Interview 6.
[192] Interview 1.
[193] Interview 6, Interview 7, Interview 9.
[194] Interview 6.
[195] Interview 4.
[196] Interview 3.
[197] Interview 8.

the possibilities of R&D financing. It also helps them to obtain knowledge regarding the development priorities of other member states.[198] Meanwhile, another representative stated that the EDF was not a priority for them, given the currently beneficial market situation of their company.[199] Regarding the level of priority assigned to the EDF, there was no large difference that depended on whether or not the actor was a government agency or large enterprise, although some SMEs seemed to consider the EDF as being less of a priority.

Most actors had a designated person or persons working with tasks related to the EDF. However, this work generally took place within the regular organisation, with only some of the larger actors having designated coordination groups. Generally, the size of the company seems to matter on the question of how many people or how much resources can be allocated to the EDF.

Impact on R&D

Some representatives saw opportunities for increased R&D through cooperation and financing via the fund.[200] Others predicted a shift in the direction of R&D priorities, rather than an increase.[201] A representative of a larger company stated that they will continue with their own R&D investments and that not every EDF project is of equal importance to them.[202] Another representative of a large company similarly stated that they were interested in cooperation and networking, but will participate only on a case-by-case basis.[203] One SME representative stated that the development of their base product would continue independently of the EDF, but that certain implementations can be done within the EDF.[204] Another SME representative stated that their company had so far not been affected by the EDF, but if they were approached by a consortium and decided to participate, this might affect their R&D priorities.[205] An agency representative mentioned that the EDF is not supposed to affect their R&D priorities as a whole, but could do so within certain areas.[206]

Prospects of Participation

The stated views of the representatives regarding their own and Sweden's prospects for participating in the EDF seemed to vary according to their roles and preconditions within the industry. Most representatives perceived Sweden's

[198] Interview 7.
[199] Interview 8.
[200] Interview 6, Interview 7.
[201] Interview 10.
[202] Interview 6.
[203] Interview 9.
[204] Interview 4.
[205] Interview 8.
[206] Interview 2.

chances of participating as being generally good.[207] Again, some SME representatives saw their companies' chances of participating as limited, either due to their size or competing priorities.[208]

Moreover, those who saw possibilities for participation also recognised several limitations. One representative mentioned that participation requires a lot of resources, such as critical personnel and legal expertise, due to the extensive administration required.[209] The participating consortia need to cover as wide a competency range as possible in order to win calls. For instance, consortia partners need to cover the entire call questionnaire, or they will have points deducted.[210] Always having to allocate the brightest people requires a lot of resources.[211] One representative pointed to the challenge of the time pressure associated with the EDF process. The representative stated that in other international fora these types of cooperation agreements normally take 2–3 years to negotiate, whereas in the case of the EDF, between two and twelve countries must accomplish this within a shorter timeframe.[212]

One representative also stressed the importance of defining requirements, which is more difficult for EDF projects than for national projects.[213] Another challenge identified was that Sweden's current materiel supply strategy lacks a long-term perspective.[214] One representative also stated that Sweden lacks routines to provide financial guarantees and commitments.[215]

As stated by one representative, there may also be instances where Sweden does not want to participate. For example, these may be cases where we do not want to give away exclusive knowledge. The same representative also stated that for Sweden there is a potential trade-off between European and transatlantic cooperation. If Sweden participates in a project outside of the EU, the possibility of participating in a similar project within the EDF decreases.[216] Sweden also needs to match its development needs with its national capability requirements, which might be difficult to match with projects led by other nations if they, too, are mainly adapted to their own requirements.

[207] Interview 1, Interview 2, Interview 4, Interview 6, Interview 9.
[208] Interview 3, Interview 8.
[209] Interview 2.
[210] Interview 9.
[211] Interview 8.
[212] Interview 1.
[213] Interview 9.
[214] Interview 5.
[215] Interview 10.
[216] Interview 10.

Prospects of Collaboration

When it comes to finding collaborative partners for EDF calls, the representatives stated that they experienced varying degrees of difficulty, depending on how well established the actor's contacts already were.[217] Two representatives stated that most Swedish companies have well-established international contacts with the potential for EDF cooperation.[218] However, another representative stated that finding collaborations is one thing and finding a common set of goals within a consortium is more difficult, especially in large consortia, a situation that seems to be common within the EDF.[219]

Some representatives emphasised specific difficulties for SMEs in finding collaborations, such as in finding new consortia and establishing new contacts in specific areas. One representative stressed the importance for SMEs to become part of supply chains, and that they sometimes can have difficulties in gaining a foothold. The same representative stated that it requires a certain size to become visible in the right context.[220] This concern was mirrored by a representative of a large company, who stated that it could be difficult to find SME partners, beyond already established contacts, in other countries.[221]

In the interviews, some representatives pointed out that there are fora that can facilitate contacts. For instance, the EC and the AeroSpace and Defence Industries Association of Europe (ASD) have "matchmaking events" to facilitate network creation.[222] One representative stated that in terms of market access they are already operating in Europe, where most countries have their own defence industry through which they can gain access to new markets as a partner.[223]

There was relative consensus among the actors that the EDF will provide new opportunities for collaboration, which they would otherwise lack access to. One representative stressed that the EDF motivates companies to seek new types of collaborations in new constellations.[224] According to two representatives, there are already examples of new opportunities that have arisen.[225] Another representative stated that the EDF opens up for interesting partners and new networks.[226] One representative especially mentioned opportunities for cooperation with SMEs, including smaller innovation companies.[227] In addition, one actor mentioned that

[217] Interview 4, Interview 6.
[218] Interview 4, Interview 6.
[219] Interview 9.
[220] Interview 3.
[221] Interview 6.
[222] Interview 1, Interview 6.
[223] Interview 8.
[224] Interview 5.
[225] Interview 1, Interview 6.
[226] Interview 4.
[227] Interview 7.

spin-off effects can also arise from collaborations within the EDF.[228] However, yet another representative expressed doubt that the EDF would lead them to find new forms of collaboration.[229]

When asked whether or not the EDF risks leading to participation in collaborations that would otherwise not be considered optimal or prioritised, nearly all actors saw such a risk. One representative stated that it might not be optimal for Sweden to participate in the EDF if we have taken a leading position in similar projects through other forms of collaborations.[230] Another representative answered that there can also be cases where Sweden already has existing collaborations or prefers to collaborate with strategic partners outside the EU, e.g., the UK or the US.[231] One representative pointed to the risk that companies might choose to participate only to gain or secure market access, even if other forms of cooperation would have been more optimal.[232] Another representative stated that there have also been cases where the strengthening of international ties has been the main purpose of previous projects, rather than developing the optimal product.[233]

According to several of the interviewees, another risk in projects' not being optimal is that companies might wish to protect their IPRs and not share all information within the consortia. This risks making the product development within the collaborations suboptimal and the final product less marketable.[234] Furthermore, one representative stated that countries that Sweden has not previously cooperated with in a defence industrial context, and therefore lacks security agreements with, have been seeking participation within the EDF calls. The lack of existing security agreements makes it difficult for Sweden to participate in those specific calls, given the short time frame for negotiation of new agreements. Another aspect emphasised by one representative is that the arms export controls within the EU fall within the responsibilities of each member state and are not harmonised. Some countries may not want to include Sweden if Swedish participation restricts the possibility of exports to third-party countries.[235] However, most of the representatives saw limited practical risks in participating in collaborations that they regarded as suboptimal, as the actors themselves decide in what calls they should participate or not.[236]

[228] Interview 8.
[229] Interview 3.
[230] Interview 2.
[231] Interview 6.
[232] Interview 6.
[233] Interview 5.
[234] Interview 7, Interview 8, Interview 9.
[235] Interview 10.
[236] Interview 4, Interview 6.

Economies of Scale

As stated in the EDF resolution, one specific objective of the fund is to promote economies of scale (see Section 4.3). In the interviews, the representatives' answers differed regarding the possibilities for the EDF to provide economies of scale. Some stated that within early stages of development, synergies and economies of scale can arise.[237] One representative pointed out that it is difficult to develop products alone; usually there are two or three partners involved. Even in cases where projects become problematic, the EDF can be a catalyst for partners to continue outside of the EDF.[238]

In the interviews, it appeared that some representatives also saw some negative aspects in promoting this objective. For example, one representative pointed out that the EDF can generate economies of scale, but the question is for whom. There are 27 nations with different interests. Economies of scale for Europe may not be economies of scale for smaller players, who risk being forced out.[239] One representative questioned the economies of scale within the research window, as the research is not very scalable in nature. The issue of the benefits of collaboration on research has more to do with reaching results faster and with a higher degree of maturity.[240] One representative also noted that the European defence industry has been fragmented, but that consolidation poses a risk for producers of being outcompeted.[241] One representative stated that the idea behind the EDF was to create common defence capabilities, even if it originally was more industry-focused. Consolidation of the industry is not stated outright, but is there in the background.[242]

Interoperability

Another specific objective of the EDF, according to the resolution, is to increase interoperability (see Section 4.3). In the interviews, some of the representatives noted that the EDF could present possibilities for interoperability within communications and control.[243] One of these respondents stated that they could benefit when technologies are integrated into their systems.[244]

One representative addressed the possible challenge presented by the fact that several European countries have the goal of being ITAR-free,[245] which is not a goal for Sweden, while at the same time being interoperable with NATO. These goals

[237] Interview 1, Interview 7.
[238] Interview 9.
[239] Interview 5.
[240] Interview 2.
[241] Interview 7.
[242] Interview 6.
[243] Interview 5, Interview 7.
[244] Interview 7.
[245] International Traffic in Arms Regulations (ITAR) is a US regulatory regime to restrict and control the export of defence and military related technologies.

may come into conflict with one another.[246] Another representative similarly noted the risk that conflicting interests would arise between European defence cooperation and the transatlantic link.[247]

5.3.3 Structure

When asked about the challenges regarding their structure (e.g. ownership, organisation, size), some of the representatives saw the risk that this might limit the likelihood of their or the Swedish defence sector's success with EDF applications. For instance, an agency representative stated that the EDF time constraints put pressure on the agency's internal control. Governance and control models function well, but demand a lot of resources.[248] Another agency representative also noted that communication and control on the strategic level function well, but the communication that up until 15 years ago existed on lower levels still needs to be re-established. Both the tools and personnel are fewer today.[249] Furthermore, a representative of a large company stated that, from a structural perspective, there are no issues for them, but they believe that company culture, for example its learning process, might experience a larger impact. There is a lack of understanding of how the EDF will affect market access ahead.[250]

Another challenge that some of the company representatives pointed out concerned IPRs. For example, two company representatives stated that there are challenges with third-party ownership, but that there are nuances to the level of challenge. Guarantees that IPRs will not leave the EU have to be submitted. One representative highlighted another perspective regarding IPRs when they stated that the problem is larger than ownership and that third-party ownership could become a problem if the EU wants to exclude the company for this reason, although this has not so far become an issue. [251] However, one of the representatives mentioned that they have observed policy discussions within the EDF about aligning policy documents more towards European-owned companies.[252] Another aspect of the IPRs highlighted by one representative was that they entail more administrative work, and the owners need to be convinced of the utility of participation.[253] Another representative stated that the risk of protectionist policies within the EDF had more to do with resource allocation than with ownership.[254]

[246] Interview 5.
[247] Interview 10.
[248] Interview 1.
[249] Interview 5.
[250] Interview 6.
[251] Interview 9.
[252] Interview 7.
[253] Interview 7.
[254] Interview 9.

The three SME representatives also observed challenges connected to their company structures. To exemplify, one SME representative stated that their company was simply too small, and that the EDF requires an ambitious effort, both in terms of participating and delivering. One representative stated that there are perks for SMEs inside the EDF, but there are also several challenges associated with them. For instance, the application construction is provided with bonuses for including cross-border SMEs; this was seen as highly problematic, since the lack of margin requirements means that large companies can claim the benefits.[255] One representative pointed out that because the classification is based on the entire company group, small companies that constitute subdivisions of a larger company may not be classified as SMEs and cannot therefore enjoy any advantage from the SME bonus build-in within the framework of the fund. They do have an advantage, however, by having a lot of personnel in a large European country, which makes it easier for them to participate in that country's applications.[256]

5.3.4 Rivalry

In the interviews, most of the representatives stressed the impact of the EDF on market access within the EU, both as a possibility and a challenge. One representative stressed that it is urgent for Sweden to act now, since it is now that the playing field is being set. If not an active part now, Sweden risks being left outside.[257] One representative stated that companies need to gain access to EU's internal market, and that those who participate in the EDF are closer to that market.[258]

Some representatives pointed to challenges with the implementation and, for instance, one actor stated that the EDF removes some of the competitive aspects. EDF calls are generally made in competition, but some calls in the capability window function through direct awards, which limits competition once a call has been completed (see Section 4.3 for a description of how the EDF works). Furthermore, one representative stated that once the procurement of a certain project is decided, this can "kill" that market segment within Europe. The chosen project can become "the European standard", making it extremely difficult to challenge.[259] An SME representative similarly emphasised that a large advantage received by winning a call is the signal this sends to other countries. It is a signal that they can go through direct awards without public acquisition, which risks locking the segment in terms of other actors. Therefore, they have to be part of those consortia, which however

[255] Interview 3.
[256] Interview 4.
[257] Interview 1.
[258] Interview 2.
[259] Interview 10.

is difficult for SMEs.[260] One representative claims that some companies join several different consortia to increase their chances.[261]

The large European countries were perceived as having had a disproportionately large influence on the work programs. Countries such as France, Germany and Italy meet in all kinds of contexts, including NATO, and have greater possibilities for dialogue.[262] These countries have several large companies that are strong competitors to Swedish companies.[263] Two representatives stated that countries on the continent know what they want out of the EDF, and are more used to this kind of cooperation.[264] Different member states have different views on geopolitics, which affects capability priorities. The priorities do not always align with Swedish priorities.[265] For instance, the strategy of one government agency was adapted to the conditions of Swedish companies, which makes it difficult to adjust to, e.g., French-led projects.[266] One representative stated that the Nordic alternative was the only option for greater influence.[267]

During the interviews, representatives not only mentioned challenges for their competitive environment with regard to EDF, but also pointed out possibilities. For example, one representative stated that their competitive situation will benefit from the EDF, as they will become more visible. It becomes a way to network and to remain updated.[268] Related to this, another representative mentioned that influence, knowledge exchange and market access make the EDF an important factor.[269]

One SME representative had a more reserved outlook on the fund, stating that other factors than the EDF are more important for their competitive situation. However, the EDF could potentially become an influencing factor in the future, if competitors were to gain greater market access.[270]

When asked about the overall match between their own projects and business areas versus the 2021 EDF calls, several representatives found this to be good. However, many also stated that it could have been better. Some of the calls that Sweden wished for were not included and some unwanted calls were.[271]

[260] Interview 3.
[261] Interview 7.
[262] Interview 6.
[263] Interview 5.
[264] Interview 2, Interview 9.
[265] Interview 10.
[266] Interview 5.
[267] Interview 10.
[268] Interview 9.
[269] Interview 9.
[270] Interview 8.
[271] Interview 5.

One representative stated that these calls match them better than those of the EDIDP (one of the pilot programmes of the EDF, see Chapter 4.3).[272] Another representative believed that, regarding research, there are no major matching problems, and that there is access to good contacts in Europe.[273] One representative stated that the EDF calls are important in identifying new areas of interest.[274]

A representative stated that one of the main challenges for Sweden is the lack of a strategy; however, there is ongoing work on agency level to come to terms with this.[275] Another representative similarly stated that the current Swedish materiel supply strategy lacks a long-term perspective.[276] Two representatives would have wanted Sweden, or the Ministry of Defence (MoD), to identify projects of interest for the Swedish defence industry.[277] Discussions need to be held between government and companies long before the calls in order to provide project proposals, and capability requirements need to be better specified.[278]

5.3.5 Factor Conditions

When asked whether the EDF would contribute to innovation, most representatives stated that the EDF can or could contribute to in a positive way through cooperation with new partners, the creation of projects they would otherwise not have participated in,[279] and through added financing.[280] Some representatives regarded the fact that the rules on the number of participants for calls regarding disruptive technologies were less strict as a positive feature of the EDF,[281] which aligns with Swedish interests.[282] Some representatives stated that the prospects for innovation are reasonably positive, but that it is too early to give any definitive answer.[283] This positive view was not unanimous, however. One representative stated that the EDF does not make sense from an innovation perspective and that it goes against the idea of "innovation clusters" by promoting cross-border cooperation over cooperation among Swedish companies. The representative also stated that the direct calls to SMEs are also small in scope.[284]

When asked how the EDF could affect the access to human capital, the representatives stated that the fund could present an opportunity in two ways. First, that it

[272] Interview 1.
[273] Interview 5.
[274] Interview 9.
[275] Interview 1.
[276] Interview 5.
[277] Interview 4, Interview 9.
[278] Interview 5.
[279] Interview 2, Interview 6, Interview 7.
[280] Interview 5, Interview 6.
[281] Interview 1.
[282] Interview 5.
[283] Interview 4, Interview 8, Interview 10.
[284] Interview 3.

could lead to increased resources and new projects.[285] One representative stated that part of the purpose of participating is to gain technological expertise as well as knowledge regarding international cooperation.[286] Another representative saw the fund as a potential way of attracting PhDs, given that academia could be included as partner.[287] The second way that EDF presents an opportunity for access to human capital is from a competition standpoint; the EDF could lead to increased demand for and pressure on current personnel.[288] Two agency representatives noted that the competition for skilled employees is connected to the overall growth of the Swedish defence sector, for which the EDF is one of several prioritised areas and where it may be more difficult to find qualified personnel than allocating funding.[289] One SME representative saw a risk in the EDF's forcing them to occupy their best engineers with tasks outside of the company's core business areas.[290] One representative saw challenges from an increased workload in the short run, but increased opportunity to develop capabilities and attract specialists in the long run.[291]

5.3.6 Demand Conditions

In order to create beneficial demand conditions for EDF participation, the priorities of customers and suppliers need to align. The representatives had some differing views regarding whether the priorities of government, as key customer, matched those of the industry, as supplier. No major disagreements were identified, but differences in emphasis. Some representatives noted that the priorities of the government agencies and the EDF seem to match.[292] One representative stated that the priorities match well enough for the process to work.[293] Other representatives pointed out that agencies tend to emphasise development of capabilities and research while companies prioritise their customers.[294] One company representative noted that government agencies were working on a common set of goals, which the industry could provide input to and that the likelihood of added financing would increase with such common agency goals.[295]

One company representative stated that the overarching priority of the defence sector and government agencies was that the industry should take part.[296] Another

[285] Interview 2, Interview 6, Interview 7.
[286] Interview 6.
[287] Interview 2.
[288] Interview 1, Interview 5, Interview 7, Interview 8.
[289] Interview 1, Interview 5.
[290] Interview 8.
[291] Interview 7.
[292] Interview 2, Interview 4, Interview 7.
[293] Interview 5.
[294] Interview 2, Interview 5, Interview 7.
[295] Interview 6.
[296] Interview 9.

representative stated that there was a good match of priorities at the technical level, but that priorities in the earlier stages were missing.[297] One representative stated that there was no ecosystem for dialogue between companies and government agencies, and that information exchange is difficult without established projects or agreements. The representative meant that the EDF created the risk of protectionism at an EU level, which increased the need for government involvement. The representative also believed that Sweden was stuck with the Swedish public procurement policy's focus on buying "off the shelf", while countries such as France and Germany were seen as having a more continuous dialogue between their defence industries and armed forces.[298]

Some representatives did not see a direct match between the priorities of customers and suppliers regarding the EDF. One representative believed that the priorities of the Swedish Armed Forces did not necessarily match their own; they also had the impression that the capability requirements of the Armed Forces did not include the defence industrial base in the analysis.[299] Another company representative stated that the industry is not mentioned when the EDF is described by the defence sector government agencies, and that it is unclear how the EDF should be used as a tool nationally. One representative noted that the priorities of their customers were not yet determined.[300]

When asked whether or not the priorities of their customers corresponded with the EDF calls, several representatives found it difficult to answer the question. Among those who did answer, most reiterated that other, larger countries had had a larger impact than Sweden.[301] One actor stated that small countries may disagree, but be hesitant to come with objections, due to the importance of relationships with larger countries. Smaller countries could have an impact by coordinating among themselves.[302] Another representative also stated that larger countries have more impact when it comes to selecting proposals and that the EDF largely fits their priorities. The representative stated that Sweden has to pool efforts with other countries, such as the Nordics and Baltics, to push its proposals. Pushing for unique solutions may not go well for Sweden.[303]

One representative stated that despite the fact that larger countries had larger impact on the EDF, they still believed that the priorities of the Swedish government agencies and the EDF calls match fairly well. Another representative stated that many, but not all, of the priorities of the Armed Forces and FMV were included in

[297] Interview 4.
[298] Interview 4, Interview 9.
[299] Interview 3.
[300] Interview 9.
[301] Interview 4, Interview 5.
[302] Interview 6.
[303] Interview 7.

the calls. There were about 30 calls presenting the possibility of Swedish participation.[304] The Armed Forces, FMV and FOI have constructed a list of suitable Swedish priorities within the EDF, which went through the MoD to the EC. Suggestions by the industry have to go through the screening of the Armed Forces.[305] One company representative stated that it was unclear to them how satisfied the Armed Forces were with the EDF calls for 2021. The representative also perceived a lack of long-term planning; it tends to end up in a catch-22, where the industry asks what the government agencies want and the government agencies in turn ask what the industry can provide. As part of the ongoing process of formulating a new materiel supply strategy, one task is to establish a form for dialogue between industry and government agencies.[306]

When asked about the customer's preconditions for contributing to the actors' ability to succeed in an EDF application, the answers varied slightly depending on who was seen as the customer: the government or a company. One representative stated that the basics are covered, but that Sweden as a customer currently lacks the muscles and tradition to be more assertive. The Swedish government could help stakeholders by facilitating consortia participation.[307] Another representative stated that Sweden has a strong industrial base, which has strategic cooperation with other countries.[308] One company representative stated that they had received good support from their customers, once consortia participation and focus had been decided.[309] Another company representative also saw the conditions of the customers as relatively good. The representative also communicates with the countries they work with to provide them with requirements.[310]

One company representative stated that the preconditions for the Swedish government to push for its areas of competence are good. The same representative suggested that the Armed Forces should take the lead. There is, however, a lack of a strategic framework to do this in.[311] Another company representative stated that the focus on building defence capabilities was good, but that the immediate needs of the Armed Forces do not necessarily reflect needs in a 10–20 year timeframe. An industrial perspective needs to be included.[312] Yet another company representative stated that the administrative processes are quite burdensome. The Swedish Armed Forces, FMV, and the Ministry of Enterprise and Innovation all work in their own pipelines, which makes coordination more difficult. However, the

[304] Interview 2.
[305] Interview 2.
[306] Interview 9.
[307] Interview 2.
[308] Interview 1.
[309] Interview 4.
[310] Interview 7.
[311] Interview 9.
[312] Interview 3.

FMV EDF Office fills a very important function.[313] One representative held the view that it was currently difficult to find the right competence in general, and that technical requirements are difficult. The representative believed that FMV had difficulties in this area, but that it applies to the entire defence industrial sector.[314]

5.3.7 Related and Supporting Industries

Not all representatives were able to answer the question of their subcontractors' prospects of participating in the EDF, mainly due to a lack of information at this early stage. One representative of a large company stated that it would be beneficial to include SMEs due to the EDF incentives, even though the representative was unsure of their prospects in doing so.[315]

Another representative of a large company stated that they have not explored the possibilities for their subcontractors yet, but that such possibilities do exist. They reiterated that administration and overhead can be fairly taxing on small companies. Their company has not worked with their subcontractors regarding the current calls, but has been approached by subcontractors concerning future calls.[316] Yet another representative of a large company believed that the possibilities were relatively good and that their subcontractors have likely also been identified by other larger companies. However, their subcontractors might have a more difficult time exercising influence early on. There can also be financing issues, especially for smaller companies. It can be difficult to afford committing resources to a project, especially since the payoff lies in a distant and uncertain future. Vinnova, the Swedish Agency for Innovation Systems, offers some support for SME participation, with funds available to facilitate participation in consortia.[317]

One representative stressed the difference between being a subcontractor to the projects instead of being a participant in the consortium. A subcontractor does not have to take part in the application process, where there is a lot of administration. As a subcontractor you can focus on actual project work and technology development, and you do not have to coordinate with other consortium members. Larger companies often have personnel allocated for handling administrative tasks, as well as lobbying, which smaller companies do not.[318] Two SME representatives stated that they did not have any subcontractors for which EDF participation would be relevant.[319]

[313] Interview 6.
[314] Interview 8.
[315] Interview 9.
[316] Interview 7.
[317] Interview 6.
[318] Interview 4.
[319] Interview 4, Interview 8.

5.3.8 Government

When asked whether the views of the interviewed actors converged or diverged from those of the government, the answers among the representatives varied. Three of the representatives commented on the government attitude toward the EDF in its early stages. One of these representatives perceived the government to have a reluctant attitude towards the initiative and that it instead had its focus on transatlantic relations and the UK. However, the same representative also mentioned that Sweden and the UK started out with a common view toward the EDF, although Sweden was on its own after Brexit.[320] Another representative stated that the late response to the EDIDP also meant that the government defence agencies at first did not actively take part on a broad scale in the EDIDP preparations. When they eventually did, they became somewhat overwhelmed by the workload. The same actor also addressed the fact that it took Sweden some time before it adopted a positive attitude towards the EDIDP. This to some extent spilled over into the EDF, especially regarding the capability window. However, Sweden was comparatively more active in the EDF process. Furthermore, the representative stated that it was the larger countries who wanted the EDF and the EDIDP to be accompanied by large budgets, and Sweden instead anticipated that the development would be intergovernmental and led by the EDA.[321] The third representative pointed out that Sweden initially thought of the EDF as an industry-supporting programme, and it was not prioritised by government agencies. However, this has changed over time and the agencies have now assigned a high priority to the EDF.[322]

One representative pointed out that it is difficult for smaller countries, such as Sweden, with limited state ownership or government support of defence industrial companies, to influence the direction of the work programmes. At the same time, they have to adapt to the consequences of the work programmes' outcomes.[323]

The three agency representatives stated that they and the Swedish government share a common view regarding the EDF.[324] One agency representative stated that the Swedish administrative model meant that the different government ministries and agencies can have their own perspectives.[325] Another agency representative pointed out that strengthening the Swedish defence industry was not an explicit part of the tasks assigned to them by the government, since their main task is to strengthen Swedish knowledge creation.[326]

[320] Interview 10.
[321] Interview 1.
[322] Interview 6.
[323] Interview 3.
[324] Interview 1, Interview 2, Interview 5.
[325] Interview 1.
[326] Interview 2.

Nearly all company representatives consider themselves and the government to have converging interests regarding the EDF in general. One company representative described the EDF as both a governmental and an EU project. Based on this premise, their interests should converge, but there is a risk of diverging interests if the state and industry do not coordinate. However, the company representative stressed that the need for cooperation is self-evident.[327] Another company representative mentioned that the input they have received regarding the EDF is that it is important for the Swedish defence industry to participate. The representative perceived that the government's perspective is that the most important thing is that Sweden participates, rather than the exact shape and form of that participation.[328] One representative stated that there is a need for added financing from the Swedish government to cover the costs not covered by the EC, in order to secure future recruitment.[329]

One SME representative stated that their and the government's interests may be divergent. The company also stated that they prefer close cooperation with their customer and less complex forms of cooperation than the EDF. The SME saw the logic behind the EDF, but from a taxpayer and SME perspective, the process demands a great amount of resources. The EDF implies an arduous process and close collaboration with competitors. The collaborations may lack in transparency, since the actors involved will want to partake of the result while not sharing their key intellectual property.[330] Another company representative stated that it is virtually impossible for SMEs to join as prime contractor without government support, which is lacking in Sweden.[331]

A representative of a larger company stated that their impression is that the government and the industry do not share the same interests, though the overall goal is to develop products that the government requests. The representative pointed out that the lack of a sufficient platform for cooperation will risk having a negative impact. The representative also believed that the materiel supply strategy is an important tool for dialogue and for lobbying towards Brussels.[332] Moreover, another representative of a large company stated that if the Swedish Armed Forces considers that a project is not important enough for them, they would also not co-finance their share. In that case, the company had to figure out whether they wanted to participate, even though they have to finance their participation on their own. The

[327] Interview 9.
[328] Interview 7.
[329] Interview 9.
[330] Interview 8.
[331] Interview 3.
[332] Interview 9.

representative also brought up a risk connected to the EDF's being a political process: if the company and the Swedish MoD disagree concerning priorities, the company's interests will not be promoted in the programme committee.[333]

An agency representative suggested that most other countries do not view the defence industry as part of industrial politics. The representative suggested that the survival of large Swedish defence companies could constitute a Swedish priority, which would mean that the EDF is more of an industrial rather than a defence matter.[334]

One representative noted that the other Nordic countries have explicit EDF strategies, and that Sweden has been slower in this regard.[335] Another representative stated that Finland had developed a plan for the capabilities they wanted to have in 2030–32 and that the Finnish government was tasked with lobbying these capabilities towards the EDF. The representative noted that they had not seen similar initiatives in Sweden.[336] The same representative also noted that the Danes have a new defence industrial strategy and that they are efficient in coordinating government agencies. The Danish strategy is clearly aimed at benefitting Danish industry. The strategy is intragovernmental and directed by the prime minister, i.e. more top-down. "This may be the way to succeed on the EU level."[337]

When asked how the actors' efforts regarding the EDF could be supported on the political level, over half of the interviewed representatives provided answers. One of the company representatives emphasised that the Swedish Government Offices (Swe. Regeringskansliet) has already made considerable efforts for third-party-owned companies to be able to participate in the EDF. The company representative also addressed the fact that the Government Offices has implemented processes and routines to enable the third-party-owned companies to confirm their independence.[338]

One representative suggested that Sweden as a nation has to become more forward-looking and proactive regarding the EDF. The representative also thought that Sweden's chances are good if the Armed Forces can lobby its wishes to the EDF via the Swedish Ministry of Defence.[339]

Three company representatives emphasised the importance of dialogue. One of the representatives suggested that there are three factors affecting Swedish EDF participation. Firstly, Sweden does not perceive itself as a unified entity. Secondly,

[333] Interview 6.
[334] Interview 5.
[335] Interview 7.
[336] Interview 9.
[337] Interview 9.
[338] Interview 7.
[339] Interview 9.

Sweden has no national defence industry strategy. Thirdly, the way Sweden approaches the question of capability requirements lacks a clear dialogue between the state and the industry. The company representative argued that these three aspects make it difficult to have a proactive dialogue and to lobby towards Brussels, unlike countries such as France, where all involved actors gather and reach a common agreement on capability requirements in order to succeed in the EDF calls.[340] Another representative similarly argued that the Swedish attitude is that collaborations will materialise spontaneously, whereas countries such as France help their stakeholders to identify collaborations.[341] A third representative also stated that it is important to have a dialogue about their product areas and in what way those correspond to Swedish capability.[342]

Two representatives brought up some suggestions for improvement in the EDF process. One representative considered that the EDF demands a different process, where the Government Offices is included. The representative also stated that the EDF has served to shed light on Sweden's lack of a process for developing competencies and capability over time. From this perspective, the representative believed that the EDF is positive, since it puts pressure on the government.[343] A company representative emphasised the need to clarify Swedish priorities. The representative further described what they mean by priorities: they would have wanted the Swedish government to be explicit about which EDF calls could be provided financing. Furthermore, the company representative stated that they already have a beneficial market situation, where they experience high demand for their products as well as full payment. This means that the Swedish government has to co-finance EDF projects if the company is to have any incentives to take part in the EDF calls. Moreover, the representative stressed that the priorities needed to be clearly specified. It is easy to suggest that Sweden should take part in the EDF to maximise taxpayer value, but the calls actually need to produce results. The company representative would have preferred that the priorities were specified early in the process, before the calls were published. The company further stressed that the industry cannot be responsible for pushing certain calls, but that this has to come from the highest level.[344]

Another company representative similarly raised the question of financing, regarding how much of the costs outside of the EDF funding the state was willing to cover, as starting up the projects is very expensive.[345] One company representative described what could be done to make the situation better for SMEs. While tar-

[340] Interview 3.
[341] Interview 2.
[342] Interview 9.
[343] Interview 10.
[344] Interview 4.
[345] Interview 9.

geted calls are beneficial, they could be larger in scope, and the state should already provide support during the application phase. The representative further stressed the need for the Ministry of Enterprise and Innovation, and not only the Ministry of Defence, to be involved as well.[346] An agency representative also saw the possibility that ministries other than defence could help finance Swedish participation in EDF projects. Not least, considering the values of innovation, strengthening the industry and increasing competitiveness are included in the legal foundations of the EDF.[347]

One company representative stated that the government could support them regarding export control. If a Swedish company owns the IPR, Swedish export controls will apply. The representative thought this was a significant challenge without an obvious solution, and was uncertain about the view of the ISP[348] on the subject. The representative stressed that export controls might pose a problem, due to the fact that other countries might not choose to work with Swedish companies if this comes with the risk of not being able to export the product. Germany has the same problem. Also identified as a challenge was the fact that the Armed Forces has to match posts with the EDF calls and that there is no "free post" for interesting future projects in the investment plan. The company representative raised the question of having an open budget pool for long-term, important projects not included in the investment plan.[349]

One representative stated that the defence companies are clear about the fact that they cannot be responsible for both financing and maintaining defence capabilities. The state needs to take responsibility for long-term investments in R&D.[350]

Political Priorities

When asked what political priorities regarding the EDF the representatives considered necessary, over half provided an answer. One agency representative identified clear goals and priorities as important factors.[351] Another agency representative pointed out that some European countries apply a broader perspective to the EDF, one where other government ministries such as Finance, Enterprise and Innovation, Foreign Affairs, and others also have heavier EDF responsibilities.[352]

Two company representatives reflected upon the new materiel supply strategy. One expressed the wish that the new materiel supply strategy would effectively

[346] Interview 3.
[347] Interview 1.
[348] National Inspectorate of Strategic Products (Swe: Inspektionen för strategiska produkter) is a Swedish government agency.
[349] Interview 6.
[350] Interview 10.
[351] Interview 2.
[352] Interview 1.

incorporate the EDF.[353] The other company representative stressed the need for the new materiel supply strategy to distance itself from the existing strategy.[354]

One SME representative stated that the whole chain, including the MoD, the Swedish Armed Forces and the FMV have to join efforts in determining a number of calls that they consider to be important for Sweden, at least for the smaller companies. The representative further emphasises the importance of prioritising and financing the areas as well as being proactive in the process.[355]

A company representative stated that they consider Sweden as their home market and that it therefore is interesting for them to link FMV's strategic requirements with their own strategy. However, FMV was considered to have been vague about their needs and expectations. It was noted that other Nordic countries have more clearly formulated strategies.[356]

An agency representative stressed the importance of having an "all of government" perspective on the EDF, specifically regarding concerns about any future defence industrial strategy. If there were long-term decisions for materiel acquisition made with certain companies in certain countries, Sweden would then be able to invest beyond what is covered by the investment plan.[357]

5.3.9 Previous Experience of EU Cooperation

There were some differences in the representatives' previous experience of EU cooperation. Two representatives stated that generally the EU projects have worked well and only a few of them can be regarded as having been less successful.[358] One representative believed that this depended on the level of competency and commitment within the team, and whether the focus of the project is correct.[359] Another representative added, however, that it might be difficult to implement the results in a systematic way.[360] A third representative mentioned that there were also positive spin-off effects, in terms of further business opportunities among participants.[361]

Factors that impacted cooperative projects in a negative way were also identified. For instance, two representatives emphasised that it had been difficult to convert the results from the projects into actual business cases.[362] Another representative

[353] Interview 6.
[354] Interview 9.
[355] Interview 4.
[356] Interview 7.
[357] Interview 5.
[358] Interview 2, Interview 6.
[359] Interview 6.
[360] Interview 2.
[361] Interview 8.
[362] Interview 4, Interview 8.

similarly stated that participation demanded hard work and that it did not result in a proper product. The representative believed that when a project reaches a higher TRL,[363] it should consist of a smaller number of participants.[364] A third representative added that it might have been difficult to implement the results in a systematic way.[365] Another factor mentioned was the culture aspect. One representative believed that Swedes might not share the same view of hierarchies as other countries and tended to be more consensus-driven. Swedes might focus on reaching broad agreement within the industry, while in other countries government agencies might just issue directives. The representative emphasised that it could have been good to discuss the cultural aspects and not only the technological ones.[366]

From the interviews, it appeared that some of the representatives believed that since the EDF has experienced changes within its terms, as well as other structural differences compared to previous EU projects, it might produce more concrete results, an outcome that some previous projects were seen to have lacked. For instance, one representative believed the EDF to be different, since there is more funding and political control involved.[367] One representative stressed another difference, which was that the fund might generate results because it not only involved discussions and coordination but also consortia, including "key companies".[368] Another representative mentioned that their previous experience told them that it has been hard to convert the results from the projects into actual business cases. However, they believed that within the EDF they might not have this issue, due to the possibility of direct awards.[369]

One representative stated that they have been working with these types of questions for a long time. The representative believed that the implementation of the EDA has not provided results corresponding to its purpose, since the pace of work in the EDA is set by the member states and the national politics regarding materiel issues imply a slower process. When it comes to the EDF, the Commission sets the pace, and policy documents are rapidly being harmonised. The representative was worried, however, that the rapid pace will have adverse effects in terms of the quality of the project results. The representative further stated that the larger EU countries have a greater possibility to influence decision-making. For Sweden, the matching between the existing plans of the Swedish Armed Forces and, e.g., the EDIDP calls has been difficult to find. It is a bottom-up process, where proposals received from companies are compared with the existing plans to find a match.

[363] Technology Readiness Level (TRL) is a method for estimating the maturity of technologies.
[364] Interview 9.
[365] Interview 2.
[366] Interview 6.
[367] Interview 9.
[368] Interview 7.
[369] Interview 4.

The representative stated that it has been difficult for Sweden to finance participation within the EDIDP. Ongoing work on the inter-agency efforts on the stated EDF goals aim to address these challenges.[370]

5.4 Summary and Discussion

This chapter summarises the key opportunities and challenges that the introduction of the EDF presents for the Swedish defence industry, as identified by the authors based on the interview results in the previous chapter. It concludes with a discussion by the authors.

5.4.1 Key Opportunities

This section outlines the main opportunities identified in the interviews.

A Source of Funding, Knowledge, Networking and Innovation

The EDF was identified as a new source of R&D and knowledge creation. Even though the stipulated EUR 8 billion is a moderate sum compared to the combined defence research budgets of EU member countries, the added financing may still be enough to affect priorities and incentivise participation. The EDF can also have a positive impact on access to the European defence market. It can contribute to innovation through cooperation with new partners, enabling projects that the actors would otherwise not participate in. The EDF can also provide possibilities to gain knowledge and technological expertise to develop defence capabilities and the potential to attract specialists through increased international cooperation.

The EDF is also a means for networking. It may, for instance, create possibilities for SMEs to work with prime contractors that they otherwise would not interact with. The EDF can also serve as a catalyst for continued cooperation outside the fund, which means that it can lead to positive spin-off effects, even when a project was not in itself optimal. The fund also provides an opportunity to remain up to date on current developments and information about business areas of interest and potential customers. It also serves as a way to become more visible within the European defence industry.

The Match between EDF Calls and Swedish Needs

The overall impression from the interviews was that the match between the EDF calls and Swedish defence actors' own projects and business areas was good, but could have been better. It was better overall, however, than during the EDIDP.

There seems to be less competition, i.e. fewer applications, within the development window than in the research window, which can be explained by the latter's being broader, while the former is more specific. The rules for calls regarding disruptive

[370] Interview 1.

technologies are less strict about the required number of participants; the calls also increase the funding possibilities in this area, which was regarded as positive. The fund's emphasis on disruptive technologies was also seen as matching well with Swedish priorities.

Previous Experience with EU Defence Programmes

Some companies consider that previous EU projects have worked well, with a few exceptions. The EDF was thought to have the prerequisites to be more successful than previous EU defence programmes, due to a higher commitment, as exemplified by more funding and political control.

5.4.2 Key Challenges

This section outlines the main challenges identified through the interviews.

Costs of Participation

Various issues were raised during the interviews concerning the costs of participation in the EDF. First, the EDF has a complex framework with complex rules, and participation requires many resources, especially for administrative work. Participation in EDF projects can increase the workload for the actors involved and, in some cases, this means that valuable expertise has to be allocated away from core business areas. There is considerable time pressure when it comes to negotiating agreements between several cooperation partners, which usually demands more time, and creates difficulties in keeping pace with the EC.

Furthermore, it is not obvious that the results of projects will correspond to the effort expended. Actors with less resources need to be part of a network, especially given that projects are not necessarily profitable by themselves. The potential risk could be especially high for SMEs if results were lacking, since the payoffs from projects may be uncertain, or lie in a distant future. Previous experience of EU defence projects suggests that results can be difficult to convert into actual business cases, or implement in a systematic way. The direct awards within the EDF development window and sunk costs might alleviate this issue, but there are no guarantees. Lastly, subcontractors to consortia do not have to be involved in administrative work in the same way as consortia members, which could be a possibility or alleviating factor for some companies.

Added Administration with Third-Party Ownership

Third-party ownership was not seen as a challenge in itself, but did add some administrative hurdles when participating in EDF calls, particularly regarding intellectual property rights. Companies with owners outside of the EU need to submit guarantees that IPRs will not leave the EU, i.e., they need to guarantee independ-

ence from their owners. Third-party ownership could potentially become a problem if the EU makes it more difficult for such companies to participate in EDF calls.

SME-specific Difficulties

Certain aspects of the EDF that pose a challenge specific to SMEs were addressed. The administrative burden of EDF applications has a prohibitive effect on some SMEs. It can also be difficult for SMEs to gain a foothold in consortia without the support of larger actors. Even though the EDF incentivises SME participation, there are issues with how these incentives are structured. For example, the applicability of bonuses for including SMEs in consortia depends on the company structure, e.g., whether the company in question is owned by a non-SME. The EDF's construction, providing bonuses for including cross-border SMEs, could also be problematic; the lack of margin requirements means that large companies can claim all the benefits. Some of the SME representatives interviewed were less enthusiastic about the EDF, since they saw that it might introduce greater risks than advantages for their business area.

Risks in Defence Industrial Consolidation

Reduced fragmentation and achieving economies of scale within the EDITB are stated goals for the EDF. This does not automatically imply consolidation. However, if project procurement increasingly becomes decided within EDF calls, entire market segments within Europe could be "monopolised" through the expectations of output that such a project creates. This dynamic may be desirable from a European perspective as it reduces duplication. For smaller defence industrial countries, however, this could mean having to choose between participation and being put at a disadvantage, especially given that smaller member states have more difficulty influencing the direction of the EDF work programmes.

A Need for Government and Industry Interaction

The EDF involves both state and industry actors and the interaction between these was touched upon in several interviews. For instance, it was stated that the EDF puts pressure on the Swedish government to act more proactively. It was claimed that the initial reactive approach towards the EDF meant that Swedish actors had a lot of catching up to do.

It was also stated that government agencies have to clarify their needs and priorities at an early stage, preferably before the EDF calls are published. Sweden needs to match capability requirements with development needs, and there has to be a functioning dialogue between state and industry on this issue.

The industry believes that the Swedish government needs to improve the facilitation of EDF collaborations for its various stakeholders. It also has an important role to play in helping third-party-owned companies in Sweden with their EDF participation, e.g., by facilitating the process of confirming their independence from holding companies. Furthermore, the government could support companies concerning IPR and export control.

Structural Issues in Sweden Regarding the EDF

During the interviews, various structural issues that were perceived as having an impact on the Swedish EDF participation were raised. One of these was that the EDF process does not match the Swedish government budget process, which makes, e.g., keeping up with certain deadlines more difficult. It was also pointed out that Sweden does not have a defined strategy for the EDF, and that the Swedish materiel supply strategy at the time of writing lacked a long-term perspective. Overall, Sweden was seen to lack a clear strategy for developing defence industrial competencies and capability over time and the EDF has served to shed light on this issue.

Moreover, there are difficulties concerning information exchange between companies and government agencies without established projects or agreements. Government entities are used to working in their own processes, separating government and industry, which makes coordination more challenging.

There are also financial issues connected to the EDF. Sweden lacks routines to provide financial guarantees and commitments to Swedish defence companies interested in EDF participation. Furthermore, the Armed Forces needs to match specific posts in its investment plan with EDF calls. It was seen as preferable to have some kind of open expenditure application, which would allow for increased financial flexibility for potential participation in interesting calls. Differing export policies may also make Sweden a less attractive collaboration partner for some member states.

Disproportionate Impact from Larger European Countries

It was the general impression of most representatives that the larger European countries have had a disproportionately large impact on EDF work programme content. Smaller countries value their relationships with larger countries and might be hesitant to object to the interests of the latter. It was suggested that smaller countries could coordinate among themselves, in order to act as a counterweight to any disproportionate impact by larger countries.

Other Challenges

Another potential risk with the EDF is that there might be negative effects on innovation clusters, due to the promotion of cross-border cooperation over local cooperation among Swedish companies.

The EDF could potentially mean trade-offs between European and transatlantic cooperation, even to the extent that these would be mutually exclusive. Another possible challenge is that the EDF also has a specific goal to increase interoperability. Given that several European countries strive to be increasingly ITAR-free, this might pose a challenge for Sweden, which so far has no such ambition.

Cultural differences, and lack of understanding thereof, may also impact collaborations within the EDF, where the consensus-seeking tradition in Sweden may be perceived as slow by other countries. Furthermore, a potential lack in transparency within the EDF could lead competitors to safeguard their key intellectual property, thereby limiting collaboration.

5.4.3 Discussion

While it was never the aim of this study to provide an evaluation of any net impact on the Swedish defence industry, as the fund is still in its infancy, some tentative findings concerning how to benefit from the identified opportunities and mitigate the negative consequences from the identified challenges should be further discussed.

The general impression from the interviews with stakeholder representatives within the Swedish defence sector was that the EDF comes with considerable opportunities, but also certain challenges. The EDF could serve as a catalyst for networking, knowledge exchange and potential innovation, regardless of the limited size of the EU budget allocated for it. Furthermore, the match between the interests of Swedish defence actors and EDF calls was deemed satisfactory overall.

However, several challenges were also identified in the interviews. These included the costs of participation, the added administration involved in third-party ownership, SME-specific difficulties, and the risks associated with consolidation. Furthermore, it was stressed that there is a need for government and industry interaction. The need for the government to be more proactive was also emphasised. Also, the EDF presents structural issues for Sweden, such as on financing and routines, and the possibility of a disproportionate impact from larger European actors, as well as a conflict in interests between European and transatlantic cooperation. At the same time, some of these difficulties can also be seen as natural consequences of implementing certain stated goals of the EDF, such as encouraging economies of scale and increased interoperability.

Parallel to the work of this report, an inquiry tasked by the Swedish government, as mentioned above, has been working on formulating a suggestion for a new national materiel supply strategy for Sweden. As part of its work, the inquiry outlines a range of challenges and opportunities connected with the EDF. The inquiry stresses that the government should consider the defence research and industrial actors when it establishes Swedish priorities with regard to the fund. The inquiry also stresses that the EDF should be seen in the larger context of Swedish materiel supply, but that Swedish materiel supply also needs to be viewed in a European context.[371]

Similar to the interviews in this study, the inquiry identifies the need for early action and for cooperation with other member states. It also identifies that the issue of access to national financing is important. Meanwhile, access to information and coordination are also seen as vital. In order to facilitate this, the EDF Office, together with the industry organisation, SOFF, and the organisation for small and medium-sized enterprises within defence, SME-D, are identified as essential.[372]

This report shares several of the findings of the inquiry, while expanding on some observations in more detail. If properly implemented, the suggested materiel supply strategy should help to alleviate some of the concerns regarding the current lack of a long-term materiel supply strategy and proactive government guidelines regarding the EDF.

[371] SOU 2022:24. *Materielförsörjningsstrategi – För vår gemensamma säkerhet*. [Swedish], pp. 179-192.
[372] Ibid., pp. 188-189.

6 Concluding Remarks

This report has two research objectives. First, to provide a global defence industrial outlook, focusing on the world's major defence industrial countries. Secondly, through the special topic of this report, to outline and analyse the challenges and opportunities that the EDF may present for the Swedish defence sector, focusing on the defence industry.

The Global Defence Industry

Within the global defence industry, the US holds a uniquely strong position. The US is the largest defence industrial country in terms of arms sales by a significant margin; it has a complete capability scope; and is often leading or pioneering in terms of technological sophistication. However, increasing challenges to this dominance have emerged, not least in the rise of a near-peer competitor, in the form of China, the world's second-largest defence industrial country. While still lagging behind the US in most respects, the Chinese defence industry has made indisputable gains in terms of size, self-sufficiency and scope of industrial capabilities, as well as technological sophistication, in the past decade. China should generally still be seen as a fast follower, but it has become an innovator in some niche areas.

The Russian defence industry is the fourth-largest in terms of arms sales, and the second-largest arms exporter, in the world. It has an almost complete defence industrial capability scope and while not as technologically sophisticated as its Western counterparts, it does have an edge in some niche capabilities. At the same time, Russia faces several long-term challenges, not least an uncertain economic outlook and a lack of key components due to Western sanctions in response to its ongoing war against Ukraine.

Europe includes several important defence industrial countries, the largest of which are the UK, France, Italy and Germany. The European defence industry generally has a high level of technological sophistication and a broad defence industrial scope. However, the size of European defence industrial countries is typically medium to small in terms of arms sales, at least when compared to the likes of the US or China. The European defence industry is characterised by fragmentation along national lines, which risks reducing the potential for economies of scale.

The current global situation, featuring increased great power rivalry between the US and China, Russia's war against Ukraine, Western support for Ukraine and renewed investment by European countries in their respective armed forces, puts significant stress on the global defence industry. This is especially true in the case of Europe, where the decades-long peace dividend has created a pent-up demand for military investment and equipment. It is worth asking whether or not the European defence industry can keep up with this rapidly increased demand, made even more pronounced by the need to replace equipment currently provided to Ukraine.

Meanwhile, sanction hit Russia will have to struggle with finding substitute components, just to keep its defence industry running.

The COVID-19 pandemic and its subsequent disruptions to global supply lines has also raised questions about the global security of supply, which poses challenges and tough choices for consumers and producers alike. The defence industry is no exception. Meanwhile, the currently rising inflation around the world, as well as the economic risks associated with monetary tightening, may impact global economic growth, which in turn may impact public spending, including spending on defence.

The Impact of the EDF for the Swedish Defence Sector

The stated goal of the EDF is to promote competitiveness and innovation within the EDTIB, supporting cooperation within the EU and contribute to European strategic autonomy, emphasising the involvement of SMEs and midcap enterprises. Through defence industrial collaboration, the fund aims to to promote system standardisation and interoperability on an EU level, in order to create greater opportunity for economies of scale, reduced duplication and fragmentation.

Through interviews with representatives of key stakeholders, this study identifies several opportunities and challenges that the introduction of the EDF presents for the Swedish defence industry. Even though an assessment of the net impact, positive or negative, is outside the scope of this study, some key tendencies can be identified.

The EDF creates incentives for defence industrial cooperation between EU member states, as well as for Swedish participation, regardless of whether this is seen as a desirable outcome or not. An increased consolidation of various defence market segments, an explicit aim of the EDF, could be seen as a natural consequence of successful EDF projects, insofar that it creates disincentives to participate in non-EDF projects within the same market segments. Whether such tendencies will have a positive or negative impact on the Swedish defence industry depends on the actor in question, based on various factors such as company size, current market position, and preconditions for successful participation in EDF calls. The net impact also depends on whether there are conflicts of interest between intra-European defence cooperation and the transatlantic link, between national and EU defence industrial needs, or between national and EU defence capability aims.

The above findings can potentially have relevance for countries other than Sweden, especially those with small to medium-sized defence industries. There are also further lessons to be learned regarding how to better utilise the opportunities provided by the EDF, as well as how to limit adverse impact. In order to benefit from the opportunities for added funding and knowledge creation offered by the fund, a possible lesson from the early Swedish experience is that countries need to be proactive in their approach to EDF calls. They need to know their defence and defence industrial capability requirements and be active in the work programmes.

It is also important to provide national funding for participation in the fund. Furthermore, successful applications may require an adaptation of administrative processes and support companies in order to maintain the high tempo of the fund. It may also be beneficial for state actors within countries with SMEs wanting to participate in the EDF to facilitate this participation, through funding or help in finding collaboration partners.

Some lessons may be particularly relevant for countries with smaller defence industries. If wishing to balance any potential disproportionate influence of larger countries, an attempt could be made by smaller defence industrial countries to coordinate requirements and priorities. Large countries in turn might either want to take a clear lead in work programmes and strive to further consolidate the market on their own terms, or try to build larger coalitions involving smaller countries.

It should be noted that during the work on this report, the Swedish security situation changed drastically, both considering Russia's war against Ukraine and Sweden's subsequent application to join NATO. These changes have and will almost certainly continue to shape Swedish priorities in the future. If implemented, the suggested new materiel supply strategy will also affect the Swedish defence sector, its agencies and the Swedish defence industry for years to come. However, it remains to be seen how these events will affect the topics discussed in this study.

Future Research

Lastly, it is worth asking how the results of this report can be further developed upon. For the global outlook, the development of the global defence industry will naturally have to be updated in any future study, in order to gain a relevant picture. The methods and framework used in this study could also be further improved upon. Alternative definitions of defence industrial size and scope could be tested. Furthermore, the method of evaluating the technological sophistication of a given country's defence industry could become more structured, in order to classify and compare defence industrial capabilities with added precision.

In order to properly evaluate the relevance of the opportunities and challenges for the Swedish defence industry with regard to the EDF that are identified in this report, future research should track policy developments and evaluate the outcomes of the fund as these materialise, sometime in the near future. The results of the 2021 EDF calls, were published in July 2022, and could provide valuable input data into future studies.

Preliminary results indicate that small- and middle-sized countries can do well in areas where they excel on a national level, despite the dominance of larger European countries. As for the Swedish results, preliminary takeaways include that guarantees for actors controlled by third-country entities functioned well, whereas

there was limited success in open calls targeted at disruptive research and SMEs.[373] In future studies, comparisons could be made with other countries or with the outcome of Swedish participation in previous programmes such as EDIDP and PADR. Such studies could help verify, challenge or complement the findings of this study as well as the findings of the inquiry for a new national materiel supply strategy for Sweden.

Complementary studies could also take a broader perspective by focusing on other European defence industrial countries, both those of similar size to Sweden, such as the other Nordic countries and the Netherlands, or smaller countries, such as Estonia, Latvia and Lithuania. Future studies could also focus on larger member countries, such as France, Germany, Italy or Spain, in order to gain the perspective of key stakeholders within their defence sectors.

In general, further studies of the EDF are needed as the international security environment changes. It is not unfeasible that further EDF funding could be made available in the near future. Will the EDF become a game-changer in Europe? Will the fund help strengthen the competitiveness of the European defence industry, or will it diminish in importance as national defence budgets increase? Will it lead to further consolidation and who will be the main beneficiaries of such a process? These questions, together several other related to global and European defence industrial development, should be viable topics for future research.

[373] FMV (2022) *Information om den Europeiska försvarsfonden (EDF) och det Permanenta strukturerade samarbetet (PESCO).* [Swedish].

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Interview with representative from Saab, 6 October 2021, Online.

Interview with representative from Swedish Security & Defence Association (SOFF), 30 September 2021, Stockholm.

Appendix A: Arms Industrial Countries

Table A. Size of Defence Industrial Countries by Top 100 Arms Companies, USD million, current prices, 2020.[374]

Rank	Country	Arms Sales	No. Entities among Top 100	Share of Top 100 (%), 2020	Share of Top 100 (%), 2011
1	US	306,020	45	55.2	56.9
2	China	66,750	5	12.0	-
3	UK	38,500	8	6.9	11.2
4	Russia	26,360	9	4.8	4.9
5	France	24,740	6	4.5	6.2
-	Trans-European	16,040	2	2.9	4.4
6	Italy	13,820	2	2.5	4.9
7	Israel	10,440	3	1.9	1.7
8	Japan	9,880	5	1.8	2.5
9	Germany	8,910	4	1.6	1.6
10	South Korea	8,700	6	1.6	0.9
11	India	6,500	3	1.2	1.3
12	UAE	4,750	1	0.9	-
13	Sweden	3,390	1	0.6	0.7
14	Turkey	2,200	1	0.4	-
15	Singapore	1,890	1	0.3	0.4
16	Poland	1,490	1	0.3	-
17	Ukraine	1,320	1	0.3	-
18	Spain	1,180	1	0.2	0.4
19	Canada	910	1	0.2	-
20	Norway	900	1	0.2	0.3

[374] SIPRI (2021) *Arms Industrial Database*.

Appendix B: Military Expenditure

Table B. Top 25 Countries by Military Expenditure, USD millions, current prices, 2021.[375]

Rank	Country	Military Expenditure	Share of GDP (%)	Share of World (%)
1	US	800,672	3.5	38.5
2	China	293,352	1.7	14.1
3	India	76,598	2.7	3.7
4	UK	68,366	2.2	3.3
5	Russia	65,908	4.1	3.2
6	France	56,646	2.0	2.7
7	Germany	56,017	1.3	2.7
8	Saudi Arabia	55,564	6.6	2.7
9	Japan	54,123	1.1	2.6
10	South Korea	50,227	2.8	2.4
11	Italy	32,006	1.5	1.5
12	Australia	31,754	2.0	1.5
13	Canada	26,449	1.3	1.3
14	Iran	24,589	2.3	1.2
15	Israel	21,704	5.2	1.2
16	Spain	19,544	1.4	0.9
17	Brazil	19,187	1.2	0.9
18	Turkey	15,478	2.1	0.7
19	Netherlands	13,752	1.4	0.7
20	Poland	13,711	2.1	0.7
21	Taiwan	12,958	1.7	0.6
22	Pakistan	11,305	3.8	0.5
23	Singapore	11,115	3.0	0.5
24	Colombia	10,180	3.4	0.5
25	Algeria	9,112	5.6	0.4
-	**Top 25**	**1,850,317**	**2.6***	**89.1**
-	**World**	**2,077,095**	**1.9***	**100.0**

* Average

[375] SIPRI (2022) *SIPRI Military Expenditure Database*.

Appendix C: Exporters and Importers

Table C.1. List of 25 Top Exporters, 2017-2021, SIPRI.[376]

Rank	Ex-porter	Share of Global Arms Exports (%)	Recipients (Share of Exporter's Total Exports, %)		
			No. 1	No. 2	No. 3
1	US	39	S. Ara. (23)	Austr. (9.4)	S. Korea (6.8)
2	Russia	19	India (28)	China (21)	Egypt (13)
3	France	11	India (29)	Qatar (16)	Egypt (11)
4	China	4.6	Pakistan (47)	Bangla. (16)	Thai. (5.0)
5	Ger.	4.5	S. Korea (25)	Egypt (14)	US (6.1)
6	Italy	3.1	Egypt (28)	Turkey (15)	Qatar (9.0)
7	UK	2.9	Oman (19)	S. Ara. (19)	US (19)
8	S. Korea	2.8	Philip. (16)	Indon. (14)	UK (14)
9	Spain	2.5	Austr. (51)	Turkey (13)	Belgium (8.6)
10	Israel	2.4	India (37)	Azerb. (13)	Vietnam (11)
11	Netherl.	1.9	Indon. (18)	US (16)	Mexico (10)
12	Turkey	0.9	Turkm. (16)	Oman (16)	Qatar (14)
13	Sweden	0.8	Pakist. (24)	US (24)	Brazil (15)
14	Ukraine	0.7	China (39)	Thai. (15)	Russia (13)
15	Switzerl.	0.7	Austr. (25)	Denm. (12)	France (8.7)
16	Australia	0.6	Canada (33)	Chile (29)	US (18)
17	Canada	0.5	S. Ara. (47)	UAE (22)	Austr. (6.8)
18	UAE	0.4	Egypt (31)	Jordan (24)	Algeria (15)
19	S. Africa	0.3	UAE (26)	US (21)	India (12)
20	Belarus	0.3	Serbia (34)	Vietn. (25)	Uganda (14)
21	Brazil	0.3	France (23)	Nigeria (13)	Chile (11)
22	Norway	0.3	Oman (27)	US (21)	Lithuania (14)
23	India	0.2	Myanm. (50)	Sri La. (25)	Armenia (11)
24	Czechia	0.2	US (28)	Ukr. (26)	Uganda (13)
25	Jordan	0.2	US (40)	Egypt (36)	Armenia (10)

[376] SIPRI (2022) *Trends in International Arms Transfers*, 2021, p. 2.

Table C.2. List of 25 Top Importers, 2017-2021, SIPRI.[377]

Rank	Importer	Share of Global Arms Imports (%)	Supplier (Share of Importer's Total Imports, %)		
			No. 1	No. 2	No. 3
1	India	11	Russia (46)	France (27)	US (12)
2	S. Arabia	11	US (82)	France (5.1)	UK (5.0)
3	Egypt	5.7	Russia (41)	France (21)	Italy (15)
4	Australia	5.4	US (69)	Spain (21)	Switz. (3.4)
5	China	4.8	Russia (81)	France (9.1)	Ukr. (5.9)
6	Qatar	4.6	US (46)	France (36)	Italy (6.1)
7	S. Korea	4.1	US (63)	Ger. (27)	Spain (7.8)
8	Pakistan	3.0	China (72)	Swed. (6.4)	Russia (5.6)
9	UAE	2.8	US (61)	France (6.2)	Russia (5.3)
10	Japan	2.6	US (98)	UK (1.7)	Swed. (0.7)
11	Algeria	2.6	Russia (81)	Ger. (6.4)	France (3.7)
12	UK	2.5	US (77)	S. Kor. (16)	Ger. (3.2)
13	US	2.4	UK (23)	Nether. (13)	France (12)
14	Israel	1.9	US (92)	Ger. (6.9)	Italy (1.0)
15	Indonesia	1.7	S. Kor. (23)	US (23)	Nether. (19)
16	Norway	1.6	US (83)	S. Kor. (10)	Italy (3.5)
17	Turkey	1.5	Italy (30)	US (22)	Spain (21)
18	Singapore	1.4	France (54)	US (22)	Ger. (7.9)
19	Netherl.	1.3	US (94)	Ger. (5.0)	Austra. (0.3)
20	Vietnam	1.3	Russia (56)	Israel (19)	S. Kor. (6.6)
21	Iraq	1.2	Russia (44)	US (35)	Italy (10)
22	Italy	1.2	US (72)	Ger. (17)	Israel (5.8)
23	Thailand	1.1	S. Kor. (28)	China (20)	Ukr. (9.9)
24	Bangla.	1.0	China (71)	Russia (9.2)	UK (5.2)
25	Morrocco	1.0	US (76)	China (14)	France (8.4)

[377] SIPRI (2022) *Trends in International Arms Transfers*, 2021, p. 6.

Appendix D: Defence Industrial Scope

Table D. Defence Industrial Development and Production Capabilities.[378]

Country	Combat Aircraft	Attack Hel.	MBT	IFV	SP Art.	Surface Comb.	Sub.
US	D	D	D	D	D	D	D
China	M	D*	D*	D*	D*	D	D*
UK	M	I*	D	D	D	D*	D
Russia	D	D	D	D	D	D	D
France	D	C	D	D	D	C	D
Italy	M	D	D	D	C	C	C
Israel	I	I	D	D	I	D*	I*
Japan	I*	I	D	D	D	D*	D
Germany	C	C	D	D	D	D*	D
S. Korea	I	M	D*	D*	D	D*	D*
India	I*	M	M	I*	M	D*	I
UAE	I	I	I	I	I	I*	-
Sweden	D*	-	I	D	D	D	D
Turkey	I	C	I	M	I*	M	I*
Singapore	I	I	I	D	D	M	I
Poland	I	I	M	I*	M	M	I
Ukraine	M	M	M	M	M	M	-
Spain	M	C	I	C	I	D*	M
Canada	I	D*	I	D	I*	D*	I
Norway	I	-	I	I	I	I*	I

D = Domestically developed and produced, D* = Mainly domestically developed and produced but with some imported equipment or large share of imported components, M = Mix of domestic and imported equipment, C = Developed and produced through cooperation, I = Imported equipment, I* = Mainly imported equipment with local production.

[378] For types, see IISS (2022) *The Military Balance 2021*, for origin various open online sources e.g. Janes.com, Defence News.com, Naval News.com, Reuters.com.

Appendix E: Interview Guide

— *Presentation of the study and the authors from FOI*
— *Material – Will take notes during the interview and the interview material will be a part of the analysis in the report.*
— *Reference to the interviews in the report – "Interview with representative from actor X, date Y, site Z".*

Initial question:

— What is your role within the….?
— What is your role within the EDF?

Firm Strategy, Structure and Rivalry:

Strategy:

1. What is your company's view regarding the implementation of the EDF?
2. Is there a strategy/goals/a structure you adhere to concerning the EDF?
   a) Do you consider the EDF a prioritised area for your company? Why?
   b) Is there a specific person/group in your company with tasks specifically related to the EDF?
   c) How do you view the company's prospects for participating in the EDF?
3. In what way does the implementation of the EDF affect your company's current R&D, e.g., in terms of quantity?
4. How does the EDF affect the company's priorities and focus regarding R&D?

Cooperation:

5. See below.

a) How easy or difficult is it for you to find cooperation partners?
b) Do you see any particular risks of the EDF's steering you towards collaborations you would otherwise deem irrelevant or suboptimal for your company?
c) Does the EDF provide any specific opportunities that would allow your company to participate in collaborations you would otherwise not have access to?
d) An expressed goal of the EDF is to promote economies of scale. What is your on the possibility of achieving economies of scale through EDF participation? Please elaborate.

e) An expressed goal of the EDF is to promote interoperability. What is your view on the possibility of achieving increased interoperability through EDF participation? Please elaborate.

Competition:

6. In what way do you estimate that the EDF will impact your competitive environment?
7. In June 2021, the first EDF calls were announced. To what degree do the EDF calls match your own projects? To what degree do the EDF calls match your company's strengths?

Structure:

8. Is there any aspect of your company's structure (ownership, organisation, and supply chains) that might limit the likelihood of a successful EDF application? Please elaborate.

Factor Conditions:

9. Do you estimate that the EDF will contribute to innovation within the defence industry/your market segment that would otherwise not take place? Please elaborate.
10. In what way do you estimate that the EDF might affect your access to human capital?

Demand Conditions:

(Customer = FM through FMV)

11. What is your estimation of the customer's priorities regarding the EDF?
12. Do you estimate that the general priorities of the customer are in accordance with the EDF calls? Please elaborate.
13. What is your estimation of the customer's preconditions (in terms of competency, knowledge, and structures) to be able to contribute to your company's ability to succeed in EDF applications?

Related and Supporting Industries:

14. How do you consider your subcontractors' prospects of participating in EDF?
    a) How about larger subcontractors?
    b) How about smaller subcontractors?

Government:

15. What is your view regarding possibilities/risks of your company and the state having converging/diverging interests regarding the EDF?
    a) How can your efforts regarding the EDF be supported on the political level? (E.g., through legislation)
    b) What priorities regarding the EDF do you consider necessary?

Bonus:

16. Do you have previous experience of cooperation within the EU?
    a) What went well? Why?
    b) What did not go well? Why?

This report consists of two parts, a global defence industrial outlook and a specific topic concerning the impact of the EDF on the Swedish defence sector. Within the global defence industry, the US holds a uniquely strong position in terms of arms sales, capability scope, and technological sophistication. However, this dominance is increasingly being challenged, not least by China. Meanwhile, the Russian defence industry has a broad scope and is fairly advanced, but faces challenges due to the war on Ukraine and subsequent Western sanctions. The European defence industry has a broad scope and is technologically advanced, but is characterised by fragmentation.

In the past decades, the EU has introduced several defence industrial integration initiatives, most recently the EDF. According to various stakeholder representatives within the Swedish defence sector, the fund provides both opportunities and challenges for Sweden. The EDF presents opportunities in terms of funding, networking, knowledge exchange and cooperation on innovation. Meanwhile, challenges for Swedish EDF participation include potential differing goals and priorities of the EDF and the interests of Swedish defence actors as well as mismatches related to the Swedish budgeting and planning process. Successful future participation requires such challenges to be addressed.

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