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Industrial Production in Support of European and Transatlantic Defence

by Michelangelo Freyrie

ABSTRACT

The Russian invasion of Ukraine has challenged most of the premises underpinning the European security order. Among these is the idea that high-intensity conventional wars are rare and mostly short affairs. After more than one year marked by the devastations ravaging Ukraine, this assumption is clearly no longer valid. At the same time, the European productive capacity cannot keep pace with the return of a large-scale war on the Old Continent. The ability to produce enough advanced weapon systems is highly limited by technical, political and administrative factors. The lack of economically sustainable industrial plans to respond to prolonged regional wars will hamper attempts to dissuade rivals such as Russia from carrying out aggressive policies in the European neighbourhood. This study presents an overview of the current state of the defence industry in the Euro-Atlantic area, with a particular focus on the European continent. It will analyse the challenges presented by the current shortage of military stocks as well as by capability gaps unrelated to the conflict. The study also provides an overview of the current defence market structure and presents some of the measures adopted by France, Germany and the European Union to facilitate production surges and improve the level of preparation of the respective armed forces.

keywords

European defence | *Defence industry* | *European Union* | *France* | *Germany* | *Italy*

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1. Strategic context: The assistance to Ukraine and the investment gap

1.1 The change in military aid to Ukraine and implications for the stocks

The coalition supporting Ukraine has mobilised states within and outside NATO, thus leading to unprecedented volumes of military aid. Delivered systems range from ammunition and armoured vehicles to missile launchers and tanks, including both old Soviet designs and advanced assets such as drones, artillery and missile systems.[1] As illustrated in Figure 1, over little more than 12 months Ukraine's supporters have transferred a large quantity of military goods, totalling more than 72 billion euro.[2]

In the immediate aftermath of 24 February 2022, donations mostly consisted of relatively simple types of equipment, such as the Stinger, an anti-aircraft man-portable missile systems (MANPADS) for infantry units. However, throughout the first year of war, the Ramstein coalition[3] has shifted to also supplying an increasingly large number of complex and technologically sophisticated systems.

[1] Forum on the Arms Trade website: *Arms Transfers to Ukraine*, https://www.forumarmstrade.org/ukrainearms.html.

[2] Regarding the Italy's contribution see Paola di Caro, "Tajani: «Italy will send the Samp-T missile system. We will support Ukraine: now peace is not possible»", in *Corriere della Sera*, 22 January 2023, https://www.esteri.it/en/?p=95259.

[3] A coalition of forty states meeting periodically at the titular US base in Germany to coordinate aid flows to Ukraine.

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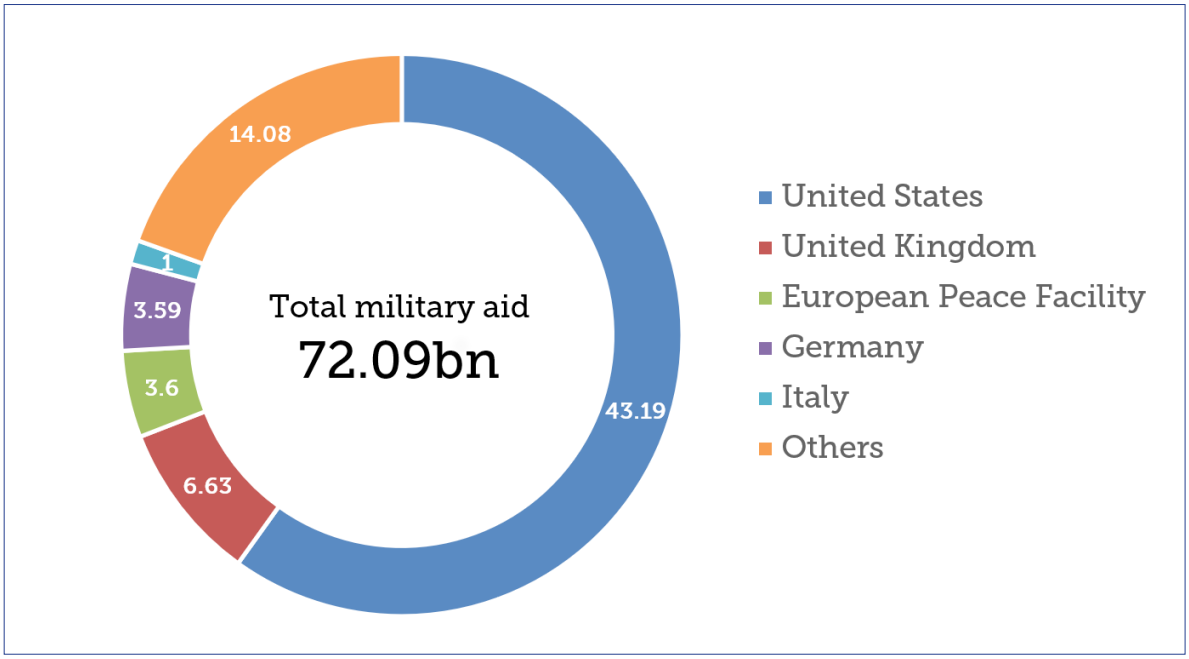
Starting from February 2023, military aid has even expanded to encompass the means necessary to organise mechanised counter-offensives, including German-made Leopard main battle tanks (MBTs).[4] The geographical origin of the transferred designs and ammunition has also changed: due to the depletion of Soviet stocks, countries supporting Ukraine have started resorting to newer Western-produced equipment.

Figure 1 | Military aid to Ukraine (billions of euro)



Source: Christoph Trebesch et al., "The Ukraine Support Tracker: Which Countries Help Ukraine and How?", in *Kiel Working Papers*, No. 2218 (February 2023), https://www.ifw-kiel.de/publications/kiel-working-papers/2022/17204.

Even still, European aid pales compared to the losses suffered by the Ukrainian army. According to independent analysts, during the first thirteen months of the war Ukraine has lost 486 tanks, 255 artillery pieces (towed as well as self-propelled units) and 89 anti-aircraft systems. Notably, this estimate is conservative and is probably lower than actual numbers.[5] Artillery shells represent a further example of how operational friction has marked this conflict. Ukrainian forces claim to consume an average of 90,000 155mm howitzers shells per month,[6] which

[4] Michelangelo Freyrie, "Cosa prevedono gli aiuti militari all'Ucraina decisi a Ramstein", in *AffarInternazionali*, 23 January 2023, https://www.affarinternazionali.it/?p=102162.

[5] Stijn Mitzer and Jakub Janovsky, "Attack on Europe: Documenting Ukrainian Equipment Losses During the 2022 Russian Invasion of Ukraine", in *Oryx*, last updated 18 June 2023, https://www.oryxspioenkop.com/2022/02/attack-on-europe-documenting-ukrainian.html.

[6] Gordon Lubdold, Nancy A. Youssef and Brett Forrest, "U.S. Reaches Deep into Its Global Ammunition Stockpiles to Help Ukraine", in *The Wall Street Journal*, 16 March 2023, https://www.wsj.com/articles/u-s-reaches-deep-into-its-global-ammunition-stockpiles-to-help-ukraine-8224d985.

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is significantly more than estimates applicable to analogous NATO- and US-led operations.[7] This has caused several issues for the countries supporting the Ukrainian cause. In fact, current production levels are remarkably lower than the rate of Ukrainian losses, meaning that, in most cases, a rapid substitution of assets transferred by European countries will be impossible. Furthermore, the sudden saturation of existing assembly lines risks provoking – or has already provoked – political spats between producers and consumers. Notably, in May 2022 some smaller European countries had to plead with Berlin to dissuade German producers from ignoring their tenders to substitute weapons and ammunitions provided to Ukraine, as most companies seemed to prioritise buyers with more conspicuous military budgets.[8] This unusual request depicts both the gravity of the current productive bottleneck as well as highlighting how competition among EU member states can be detrimental in the absence of coordination mechanisms. In the United States too, several analysts highlighted how the defence industrial base has partly lost its capacity to mobilise resources,[9] thus undermining the US ability to produce enough advanced systems – such as precision missiles – in case of large-scale wars.[10]

1.2 Qualitative instances of decreases in defence stocks

To properly evaluate the entity of military aid to Ukraine, it is necessary to analyse the state of Western military stocks, whose relevance has significantly risen during the last thirty years. On one hand, the overall reduction of enlisted personnel, accelerated by the abolition of mandatory conscription, has led to the withdrawal of several equipment types and assets from active duty. On the other hand, many of those systems previously placed in strategic reserves have been disassembled and reused, or "cannibalised". The aim of this practice is to obtain replacement parts for assets on active deployment, further heightening the relevance of stocks in force planning.[11] Moreover, considering how several assembly lines have been shuttered, it is clear that the transfer of reserve equipment to Ukraine represents a major sacrifice which directly affects the capability of NATO's armed forces to endure a high-intensity conflict.

[7] Shawn Snow, "These Marines in Syria Fired More Artillery than Any Battalion since Vietnam", in *Marine Corps Times*, 6 February 2018, https://www.marinecorpstimes.com/news/your-marine-corps/2018/02/06/these-marines-in-syria-fired-more-artillery-than-any-battalion-since-vietnam.

[8] Interview, 18 May 2022.

[9] Julie C. Kelly, Daniel E. Lago and James S. Thomason, "Strengthening Industrial Base Decision-Making for Precision-Guided Munitions", in *War on the Rocks*, 11 August 2020, https://warontherocks.com/?p=23202.

[10] Joe Gould, "US Defense Industry Unprepared for a China Fight, Says Report", in *Defense News*, 23 January 2023, https://www.defensenews.com/industry/2023/01/23/us-defense-industry-unprepared-for-a-china-fight-says-report.

[11] Léo Péria-Peigné, "Military Stockpiles: A Life-Insurance Policy in a High-Intensity Conflict?", in *Focus stratégique*, No. 113 (December 2022), p. 12, https://www.ifri.org/en/node/26801.

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The heterogeneity of military aid and the secrecy shrouding these transfers does not allow for a cross-cutting and comprehensive analysis of the deterioration of (national) military stocks in NATO members. Nevertheless, it is possible to report some of the most eloquent cases. As some data has not been updated as of April 2023, current percentages are probably higher than the one shown in Table 1.

Table 1 | Examples of weapon systems transferred to Ukraine

System	Country	Type	Original stocks	Transferred to Ukraine	% of total stock transferred
CAESAR	France	Self-propelled artillery	74[12]	30[13]	41
AHS Krab	Poland	Self-propelled artillery	80	>18[14]	>23
T-72A / T-72M1	Poland	Main battle tank	384[15]	260[16]	67
Challenger 2	UK	Main battle tank	157[17]	14	9
Leopard 2	Germany	Main battle tank	298	18[18]	6
Stinger	USA	MANPADS	5,600[19]	1,866	33

Artillery is currently in high demand among Ukrainian forces, and for this reason, France provided 30 self-propelled CAESAR howitzers. The French Army originally only had 77 CAESAR and has thus transferred 41 per cent of them to Ukraine. French president Emmanuel Macron has asked the supplier Nexter to further step up its

[12] Patricia Mirallès and Jean-Louis Thiériot, "La préparation à la haute intensité", in *Rapports d'information de l'Assemblée Nationale*, No. 5054 (17 February 2022), p. 76, https://www.assemblee-nationale.fr/dyn/old/15/rap-info/i5054.asp.

[13] French Ministry of Defence, *Soutien à l'Ukraine : les 4 points à retenir de l'audition de Sébastien Lecornu*, 16 March 2023, https://www.defense.gouv.fr/actualites/soutien-lukraine-4-points-retenir-laudition-sebastien-lecornu.

[14] Josh Smith and Joyce Lee, "Exclusive: Seoul Approved Poland's Export of Howitzers with S.Korean Parts to Ukraine", in *Reuters*, 8 March 2023, https://www.reuters.com/world/seoul-approved-polands-export-howitzers-with-skorean-parts-ukraine-official-says-2023-03-08.

[15] "Poland Provides Ukraine with More than 200 T-72 Main Battle Tanks", in *Army Recognition*, 29 April 2022, https://www.armyrecognition.com/x94y6.

[16] "Poland Has Already Transferred More than 260 T-72 Tanks to Ukraine", in *Militarnyi*, 17 January 2023, https://mil.in.ua/?p=186549.

[17] UK House of Commons Defence Committee, *Oral Evidence: Responsibilities of the Minister for the Armed Forces*, HC 717, 8 March 2023, https://committees.parliament.uk/oralevidence/12834/pdf.

[18] German Federal Government, *Military Support for Ukraine*, updated 29 June 2023, https://www.bundesregierung.de/breg-en/news/military-support-ukraine-2054992.

[19] Mark F. Cancian, "Is the United States Running out of Weapons to Send to Ukraine?", in *CSIS Commentaries*, 16 September 2022, https://www.csis.org/analysis/united-states-running-out-weapons-send-ukraine.

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productive activity, encouraging it to reach "war mode"[20] and to fully exploit all of its facilities, which were previously operating at 30 per cent of their maximum capacity.[21]

This situation is similar to the one of another howitzer, the Polish AHS Krabs. Warsaw's armed forces (*Wojska Lądowe*) currently deploy 80 AHS Krabs, and by ceding 18 units it has transferred 23 per cent of its available systems to Kyiv.[22]

Somewhat different circumstances apply to Stinger MANPADS, which have been extensively donated to Ukraine by the United States, Italy, and Germany. The US-made missile was already headed towards the end of active deployment, and in the US large-scale production had already come to a halt. This decision had relevant repercussions. First, even though manufacturing company Raytheon announced it would resume mass production of the Stinger, it is highly unlikely that this will occur before 2023–24 due to a lack of crucial components.[23] Second, it is likely that initial supplies will be destined to US forces.[24] According to industry sources, sufficient transfers to restock European donors will thus be unlikely before 2027.[25]

Poland, as other former Warsaw Pact countries, also sent T-72 MBTs, which by virtue of being common throughout Eastern Europe are highly accessible to Ukrainian personnel in terms of both training and logistical support. Warsaw supplied 260 units out of the 384 it deployed, namely 67 per cent of the total stock. While armoured vehicles offered by Eastern European countries make up most of mechanised military aid to Kyiv, from 2023 onwards many NATO allies have started to train and supply Ukrainian troops with Western-made tanks, such as the German Leopard 1 and 2[26] and the British Challenger 2.

In early 2023, after weeks of debate, Berlin finally decided to donate a first tranche of 18 Leopard 2 A6 tanks. Despite the transfer being limited in number, this must be considered in light of concurrent "circular exchange arrangements" (*Ringtausch*). These agreements commit Berlin to substitute Soviet designs donated by partner countries with an unspecified number of German-produced

[20] "Macron Urges Ceasar Howitzer Producer to Gear up Production to 'War Time' Mode", in *Reuters*, 16 June 2022, https://reut.rs/3QpIWlk.

[21] William Molinié, "Guerre en Ukraine : dans les coulisses de la fabrication des tubes de canons Caesar", in *Europe 1*, 8 July 2022, https://www.europe1.fr/politique/exclusif-guerre-en-ukraine-dans-les-coulisses-de-la-fabrication-des-tubes-de-canons-caesar-4122202.

[22] Oleg Danylov, "Poland Sells to Ukraine More than 50 New 155-Mm AHS Krab", in *Mezha Media*, 8 June 2022, https://mezha.media/en/?p=42993.

[23] "Raytheon Will Not Resume Mass Production of Stinger Missiles Until 2023", in *The Defense Post*, 26 April 2022, https://www.thedefensepost.com/2022/04/26/raytheon-production-stinger-missiles.

[24] Jen Judson and Joe Gould, "US Army Signs Deal to Backfill Stingers Sent to Ukraine", in *Defense News*, 27 May 2022, https://www.defensenews.com/land/2022/05/27/us-army-signs-deal-to-backfill-stingers-sent-to-ukraine.

[25] Interview, 14 July 2022.

[26] At present the countries that donated the Leopard 2 to Ukraine are Canada, Denmark, Germany, Netherlands, Norway, Poland, Portugal, Slovakia, Spain and Sweden.

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vehicles. This practice, which should have required the replacement of Polish and Slovak tanks, has however caused some frictions between allies. In fact, Germany apparently did not meet the set expectations, as it offered to supply Poland with a significantly smaller number of units compared to what had been promised.[27] This has contributed to Warsaw's decision to predominantly resort to extra-European partners, as confirmed by the acquisition of one thousand South-Korean T2 tanks. While 180 tanks have been directly provided by Seoul, it is still unknown when the other 820 units will be manufactured in Poland.[28]

Berlin's reticence is due to production bottlenecks and to the scarcity of Leopards in existing German stocks.[29] The German armed forces (*Bundeswehr*) currently hold 298 Leopard 2,[30] at different degrees of modernisation and employment readiness. Over the last few years, manufacturing company Krauss-Maffei Wegmann (KMW) has mostly updated old Leopard 2 models, which should reportedly reach the A7V version and a production rate of 6 units per month by 2027.[31] German media foresees that a new production line would need one or two years to be launched,[32] and that considering current estimations by specialised publications, KMW should be able to produce an average of 10 *panzers* per year.[33]

1.3 A pre-existent investment gap

Prior issues have contributed to the current shortage in arms and vehicles. At the European level, a dearth of investments in the defence sector was already a major concern preceding the breakout of the war and that persists following donations to Ukraine. Here, three complementary approaches to quantify these shortfalls are presented: qualitative data provided by the European Defence Agency (EDA) and the European Commission Directorate-General for Defence Industry and Space (DG DEFIS); a scenario analysis published by the think tank International Institute for Strategic Studies (IISS); and a qualitative estimate relative to military capabilities development projects without financial coverage provided by the Italian Ministry of Defence (MoD).

[27] Guy Chazan and Raphael Minder, "Germany and East European Allies Struggle to Seal Deals over Ukraine-Bound Weapons", in *Financial Times*, 28 July 2022, https://www.ft.com/content/f8b1b0b1-237e-4a91-b782-6ec49aac6308.

[28] Daniel Tilles, "First Korean Tanks and Howitzers Arrive in Poland", in *Notes from Poland*, 6 December 2022, https://notesfrompoland.com/?p=50294.

[29] Gerhard Hegmann, "Zwei Jahre für einen neuen Leopard – so groß ist der deutsche Rüstungs-Rückstand", in *Die Welt*, 17 May 2022, https://www.welt.de/wirtschaft/plus238759401.

[30] German Ministry of Defence, *Bericht zur materiellen Einsatzbereitschaft der Hauptwaffensysteme der Bundeswehr II/2021*, 15 December 2021, https://www.bmvg.de/resource/blob/5325364/11a1d50cce70b7b1a8307adc16991f4d/download-bericht-zur-materiellen-einsatzbereitschaft-2-2021-data.pdf.

[31] Dorothee Frank, "Leopard 2 A7V an Truppe übergeben", in *Behörden Spiegel*, 24 September 2021, http://web.archive.org/web/20210924122209/https://www.behoerden-spiegel.de/2021/09/24/leopard-2-a7v-an-truppe-uebergeben.

[32] Gerhard Hegmann, "Zwei Jahre für einen neuen Leopard", cit.

[33] Gerhard Heiming, "Recovery of the Leopard 2A6 Has Been Initiated", in *Europäische Sicherheit & Technik*, 23 February 2023, https://esut.de/en/2023/02/meldungen/40131.

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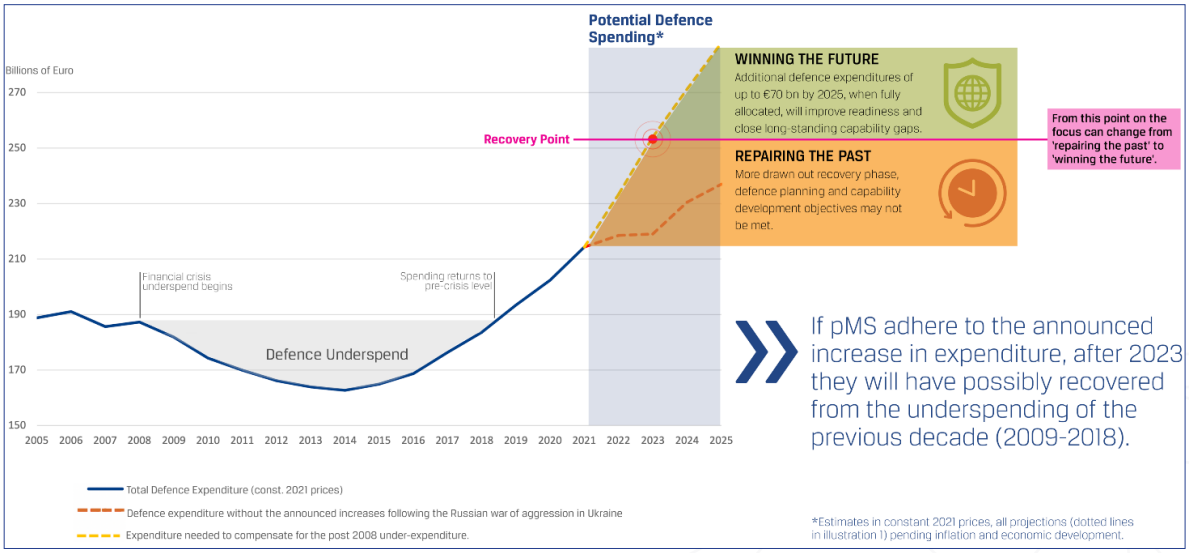
1.3.1 EU estimates

The Commission highlights eight areas in which member states should enhance their procurement efforts.[34] In the short term, the identified priorities are as follows:
1) The reconstruction of stocks transferred to Ukraine and the enhancement of long neglected strategic ammunition and weapons reserves;
2) The replacement of Soviet equipment in former Eastern bloc countries;
3) The strengthening of air and missile defence systems.

At the same time, gaps to be filled in the medium and long term refer to the following areas:
4) The lack of unmanned aerial vehicles (UAVs);
5) The shortage of armoured vehicles;
6) and 7) Defence capability in the new domains, namely space and cyber;
8) The scarcity of maritime assets.

Figure 2 | EDA member states military spending estimate



Source: European Defence Agency (EDA), *2022 Coordinated Annual Review on Defence Report*, November 2022, https://eda.europa.eu/docs/default-source/eda-publications/2022-card-report.pdf.

Already before the conflict, EDA has been providing to its participating member states (pMS)[35] periodic analyses of both European military capabilities and their relative gaps in the so-called Coordinated Annual Review on Defence (CARD), which was first launched in 2017. The CARD summary published in late 2022

[34] European Commission, *Defence Investment Gaps Factsheet*, 18 May 2022, https://ec.europa.eu/commission/presscorner/detail/en/FS_22_3145.

[35] Namely all EU member-states except for Denmark, which historically preferred not to take part. In 2022, Copenhagen decided through a referendum to adhere to the European Security and Defence Policy, thus it is negotiating to join the EDA.

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reports that between 2008 and 2018, EDA pMS have collectively spent less than 190 billion euro per year on defence.[36] This amount is identified as the bare minimum needed to maintain sufficient military preparation. The EDA also estimates that to fill the capability gaps opened during the 2009–19 decade of financial crises, the overall pMS defence spending must reach 250 billion euro at the end of 2023.

1.3.2 Estimates by the International Institute for Strategic Studies

Similar shortcomings are highlighted in an IISS study, published in 2019.[37] This research refers to the scenario of a potential Russian aggression, entailing the application of article 5 on collective defence from the North Atlantic Treaty. The authors identify several weaknesses that would hamper an efficient contribution to the continent's defence by NATO's European members. The study mostly provides quantitative estimates of the capability gaps, divided by operational domains, as reported in table 2.

Table 2 | Capability gaps estimates according to IISS (billions of euro)

	Min. estimate	Max. estimate
Aerospace forces	65	74.4
Maritime forces	62.7	73.14
Ground forces	136.7	180.6
Total	264.5	328.1

Note: These values date to 2019, so they have not been updated to inflation nor to the recent assistance provided to Ukraine.
Source: Douglas Barrie et al., "Defending Europe", cit., p. 38.

The most expensive gaps to be filled pertains to long-range ground-based air defence (GBAD) systems, such as the American Patriot and the French-Italian Samp-T, armoured units (e.g. Leopard 2A7), multirole fighters (e.g. Eurofighters, Rafale) and short-range air defence systems (e.g. Camm-Er, Stingers).[38]

1.3.3 Estimates of the Italian Ministry of Defence

Finally, every year the Italian Multiannual Planning Document (*Documento programmatico pluriennale della Difesa*, DPP)[39] reports the operational

[36] EDA, *2022 Coordinated Annual Review on Defence Report*, cit.

[37] Douglas Barrie et al., "Defending Europe: Scenario-Based Capability Requirements for NATO's European Members", in *IISS Research Reports*, April 2019, https://www.iiss.org/blogs/research-paper/2019/05/defending-europe.

[38] To deepen the topic, see: Ottavia Credi et al., "Short Range Air Defence: Operational and Technological Developments", in *Documenti IAI*, No. 22|07en (September 2022), https://www.iai.it/en/node/15971.

[39] Italian Ministry of Defence, *Documento programmatico pluriennale della Difesa per il triennio 2022-2024*, 2022, p. 86, https://www.difesa.it/Il_Ministro/Documents/DPP_2022_2024.pdf.

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requirements which were identified as necessary by the MoD but did not receive any financial coverage. While these projects have already been subject to technical evaluations and a projection of their costs relative to the next five years, they currently lack any ad hoc funds to implement them. The MoD singled out as priorities the procurement and modernisation of short-range air defence weapon systems (SHORAD), the necessity to expand and update unmanned reconnaissance systems including medium altitude, long endurance (MALE) UAVs, and a comprehensive modernisation of armoured forces. Details are illustrated in Table 3. These priorities, which lack proper financing, can be considered gaps to be filled. All in all, it is not by chance that there is a certain degree of convergence between the Italy document, the results provided by EU institutions – to which Italy contributed – and the IISS study, which is based on public sources.

Table 3 | Italian Defence's operational requirements without financing according to the 2022–24 DPP (millions of euro)

Area	Year x	Year x+1	Year x+2
Force preparation (e.g., Simulators, training infrastructure)	27	82	163
Force projection (e.g., Next generation fast helicopter)	8	9	27
Force protection (e.g., SHORAD)	65,7	663	1,075.6
Force sustainment (e.g., Procurement of Vulcano munitions)	253	398	550.5
C4ISR (e.g., Air Command Control System capability and space segments)	1	188.8	208.2
ISR (e.g., MALE drones modernisation)	24	239.3	469
Total requirements	378.7	1,661.4	2,493.1

2. The state of the defence industry

The scarcity affecting the stocks would not be so problematic if the defence industry were able to quickly climb to high production levels and substitute transferred systems. However, the current market structure does not seem to allow a quick shift of gears despite recent increases in defence budgets. This is due to several economic factors and business decisions that were made in the last decades and are now no longer appropriate in the strategic context ushered in by the war in Ukraine.

2.1 Market structure

In order to understand the defence market, it is necessary to consider both the business structures and industrial relations underpinning it. At a theoretical level, said market should be a monopsony, namely a situation in which several

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businesses compete among each other in order to sell their products to one client, namely the state, which should in turn be free to impose the price for the product it purchases.[40] Since this does not occur in reality, it is essential to analyse the main actors within the transatlantic defence market.

2.1.1 The main transatlantic defence businesses

First, the defence industrial base is made up of very diverse businesses. It is relevant to highlight the distinction between small and medium-sized enterprises (SMEs), specialised in supplying specific components, and so-called prime contractors. In fact, the former serve as system integrators, building direct relationships with both military buyers and enterprises identified as specialised suppliers. Some European prime contractors, such as Leonardo, are partially state-owned businesses; companies such as Airbus and MBDA are highly transnational in nature, while others less so. Also, while most of these actors are listed companies, some of them are completely private or family owned.

Throughout 2022, many European enterprises have benefited from rising demand in the defence sector. For instance, Leonardo reported a 21 per cent increase in orders;[41] Rheinmetall recorded a plus 13 per cent,[42] while Airbus experienced a rise ranging between six and 16 per cent depending on business segments.[43] Nevertheless, data relative to (actually) processed orders in 2022 are more mixed. Notably, Leonardo's orders backlog would require approximately 2.5 years to be completely processed. This might indicate physiological delays in processing new contracts, as well as limitations to the number of new projects that can be initiated in the short term.[44]

[40] Eric Lofgren, "Does the DOD Have Monopsony Power in Defense Markets?", in *Acquisition Talk*, 25 May 2019, https://wp.me/pasuo1-vb.

[41] Leonardo, *Leonardo: New Orders of € 17.3 bn (+21%)...*, 9 March 2023, https://www.leonardo.com/en/press-release-detail/-/detail/09.03.2023-leonardo-2022-results.

[42] Rheinmetall, *Financial Figures for 2022: Rheinmetall Is on Track for Success - All-Time Earnings High, Record Order Backlog*, 16 March 2023, https://www.rheinmetall.com/en/media/news-watch/news/2023/jan-mar/2023-03-16_rheinmetall-is-on-track-for-success-all-time-earnings-high,-record-order-backlog.

[43] Airbus, *Airbus Reports Full-Year (FY) 2022 Results*, 16 February 2023, https://www.airbus.com/en/newsroom/press-releases/2023-02-airbus-reports-full-year-fy-2022-results.

[44] It must be specified that these limitations are ordinary in an emergency context as the one currently experienced, but it is far from the "war economy" strictly intended. The latter is applied when a country is under attack, implying that the whole industrial sector is mobilised in support of the defence, as verified during the Second World War.

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Table 4 | Thirty European and American enterprises with the highest defence revenue (2021)

Company	Country	Military sales (billions of euro)
Lockheed Martin Corp.	United States	60.340
Raytheon Technologies	United States	41.850
Boeing	United States	33.420
Northrop Grumman Corp.	United States	29.880
General Dynamics Corp.	United States	26.390
BAE Systems	United Kingdom	26.020
Leonardo	Italy	13.870
L3Harris Technologies	United States	13.360
Airbus	France, Germany, Spain	10.850
Thales	France	9.770
Huntington Ingalls Industries	United States	8.570
Leidos	United States	8.030
Dassault Aviation Group	France	6.250
Peraton	United States	5.810
Booz Allen Hamilton	United States	5.600
Honeywell International	United States	5.150
Safran	France	5.050
Amentum	United States	5.020
Rolls-Royce	United Kingdom	4.970
MBDA	France, Germany, Italy, United Kingdom	4.960
Naval Group	France	4.740
Rheinmetall	Germany	4.450
CACI International	United States	4.330
General Electric	United States	4.140
Saab	Sweden	4.090
Science Applications International Corp.	United States	3,550
KBR	United States	3.530
Textron	United States	3.350
Babcock International Group	United Kingdom	3.100
KNDS	Joint Venture KMW – Nexter	3.030

Source: Diego Lopes da Silva et al., "The SIPRI Top 100 Arms-producing and Military Services Companies, 2021", in *SIPRI Fact Sheets*, December 2022, p. 9, https://doi.org/10.55163/VYJC8517.

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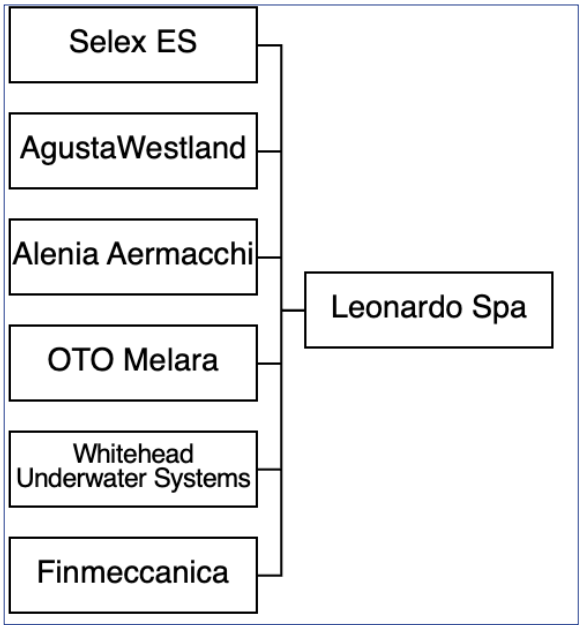
2.1.2 Europe: A partial consolidation

The European market features national divergences that hinder industrial consolidation. Nevertheless, the downsizing of the (purely) defence market since 1991 has led to numerous mergers, reconversions, as well as closure of businesses operating in the defence field.[45] In Italy, the transformation of Finmeccanica in Leonardo (the "One company" model) is emblematic, as it consisted in the consolidation of several enterprises and holdings into a single conglomerate. Compared to their American counterparts, European companies have managed to reach high levels of productivity. This allows them to compete in terms of price and technology with American businesses, whose primary client – the Pentagon – retains a significantly higher and centralised spending portfolio compared to the multitude of European defence ministries.[46]

Figure 3 | Consolidation of Leonardo



At the same time, current consolidation policies work under the assumption of functional value chains and of a 'just in time' industrial model,[47] and are thus aimed at reaching efficiency, rather than resilience. Broadly speaking, this target has been pursued by minimising superfluous productive capacities, for instance by shuttering underexploited industrial sites.[48] Like in the US, Europe

[45] Interview, 23 March 2023.

[46] Interview, 28 March 2023.

[47] The "just in time" logic imposes to minimise manufacturing to assets to be sold in the short term and to reduce the stocks to their bare minimum. This leads to rely on value chains' efficiency and on the flexibility of the markets of raw materials and intermediate products.

[48] McKinsey & Co., *The Future of European Defence: Tackling the Productivity Challenge*, 1 May 2013, p. 24, https://www.mckinsey.com/~/media/mckinsey/industries/public%20and%20social%20

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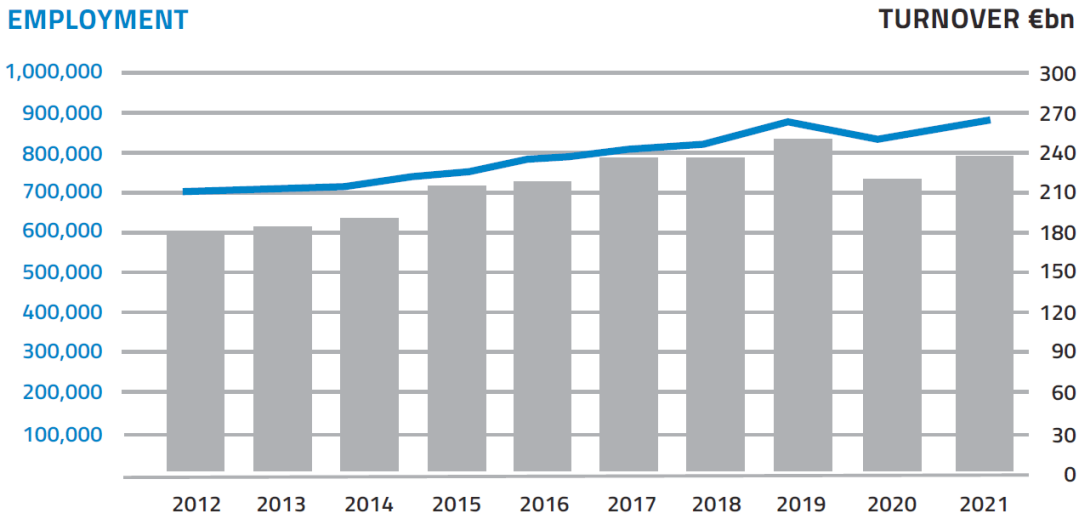
should reconsider these criteria in light of the challenges faced when striving towards production surges. In other terms, determining the optimal number of enterprises allowed in the market requires to find a compromise between market efficiency (albeit imperfect) and productive efficacy. The latter would result from the consolidation of enough companies with sufficient capital margins to scale up their output capacities.

Beyond that, the main obstacle to consolidating the supply of defence goods and to rationalise member states' industrial capabilities[49] is a highly fragmented demand, which also leads to lower volumes of orders. This hampers the amortisation of non-recurrent costs (such as the acquisition and modification of machineries to produce new weapon models) over a high number of sold units, consequently reducing the profit margin per unit.[50]

Figure 4 | Growth in European defence companies' revenue and labour force



Source: Aerospace, Security and Defence Industries Association of Europe (ASD), *2022 Facts & Figures*, November 2022, p. 5, https://asd-europe.paddlecms.net/news-publications/facts-figures.

Considering that value chains are fragmented, and that many prime contractors operate in a context of quasi-national monopoly, the rapid increase in orders might lead to businesses imposing higher costs to buyers, regardless of the quality of provided products. These higher costs may be reasonably justified by saturated assembly lines, but also by the possibility of benefiting from protectionist policies of the respective host countries. Indeed, the latter are eager to defend their

sector/our%20insights/enlisting%20productivity%20to%20reinforce%20european%20defense/the%20future%20of%20european%20defence.pdf.

[49] Ibid.

[50] Interview, 12 April 2023.

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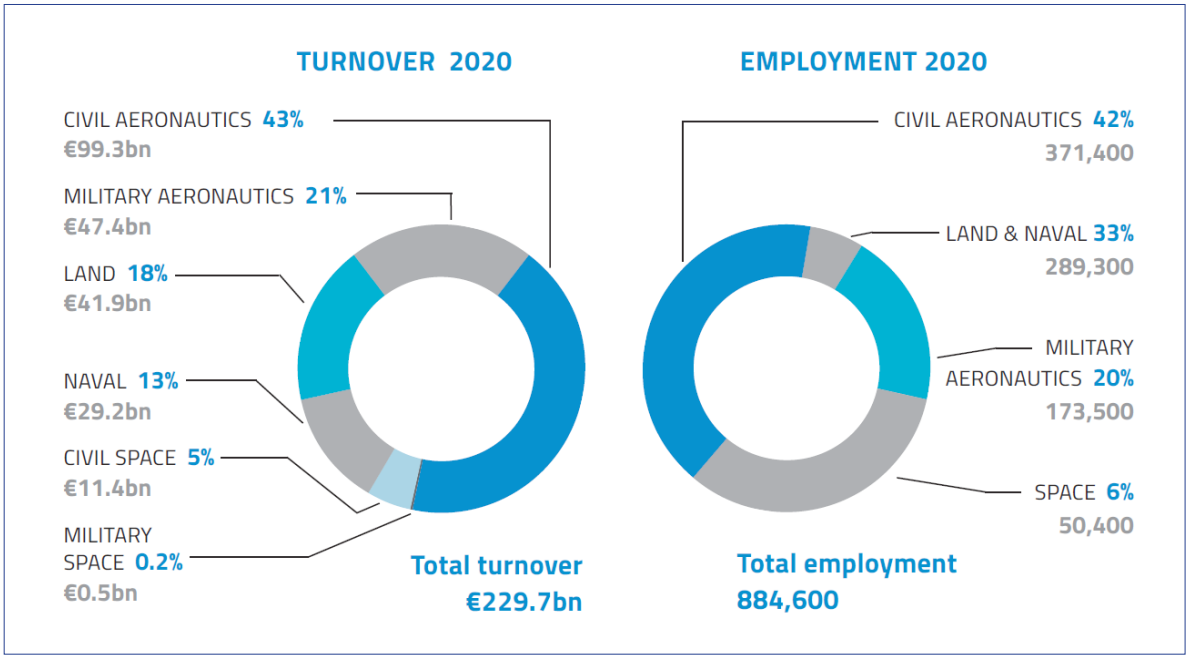
own national champions in a deeply competitive context, and examples of this phenomenon have already occurred on the European market throughout 2022.[51]

Figure 5 | European defence companies' revenue and labour force distribution by segment



Source: ASD, *2021 Facts & Figures*, December 2021, https://asd-europe.paddlecms.net/sites/default/files/2022-08/ASD_Facts&Figures_2021_.pdf.

2.2 Limits to the production process

2.2.1 Increasingly complex value chains

Over the last thirty years, advanced weapon systems have come with ever increasing complexity and costs. A telling example is the growth in the unit price of multirole fighters. The surge in aeronautic procurement costs is symptomatic of the increased complexity of these systems in terms of components, avionics, electronics, and software. This phenomenon can also be observed in the naval domain, affected by an exponential proliferation of electronic components per ship.[52] Rising complexity further challenges the ability to take advantage of economies of scale, allowing in simpler systems to limit unitary costs.[53]

[51] Interview, 4 April 2023.

[52] Mark V. Arena et al., *Why Has the Cost of Navy Ships Risen? A Macroscopic Examination of the Trends in U.S. Naval Ship Costs over the Past Several Decades*, Santa Monica, RAND Corporation, 2006, https://doi.org/10.7249/MG484.

[53] Mark V. Arena et al., *Why Has the Cost of Fixed-Wing Aircraft Risen? A Macroscopic Examination of the Trends in U.S. Military Aircraft Costs over the Past Several Decades*, Santa Monica, RAND Corporation, 2008, https://www.rand.org/pubs/monographs/MG696.html.

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At the same time, digitalisation has changed the kind of skills and workforce needed by businesses, while encouraging the outsourcing of some competences necessary for the maintenance of weapon systems.[54] This is a relevant detail, insofar as the higher number of suppliers and the transition to more complex value chains[55] makes it difficult to coordinate a sudden surge in production volumes. This is particularly true as single components (such as sensors and composite fuselages) depend on completely different production timelines and raw material markets.

Some companies are considering adopting integral digitalised supply chain management systems, which would allow to gain a real-time overview of the whole value chain. Their adoption is however hindered by issues related to cybersecurity and the risk of industrial espionage.[56] Moreover, relying on external suppliers, requires guaranteeing enough orders to justify the production of tailored components (from radars to special bolts), which are not particularly marketable in the civilian markets.[57]

2.2.2 Scarcity of human capital

The need for qualified personnel is also limiting the ability to increase productive volumes. The defence sector requires a highly qualified workforce, and not every production process can be automatised. This holds true even in advanced manufacturing sectors, such as aerospace and rotorcraft production,[58] and it also potentially complicates the transition of workers from the defence industry to the civilian sector.[59] To keep pace with new orders and considering extremely tight timelines and ambitious objectives, companies will have to significantly increase hirings (and provide training for additional human resources).[60]

The defence industry faces several shortcomings which makes it an unattractive employer on the overall labour market. Notably, this weakness is not limited

[54] Eric Ciampi and Archag Touloumian, "Defense Industry: Who Will Win the Digital Services War?", in *Oliver Wyman Insights*, November 2020, https://www.oliverwyman.com/our-expertise/insights/2020/nov/manufacturing-industries-2030/by-sector-new-challenges/defense-industry.html.

[55] Ekaterina Turkina, Ari Van Assche and Raja Kali, "Structure and Evolution of Global Cluster Networks: Evidence from the Aerospace Industry", in *Journal of Economic Geography*, Vol. 16, No. 6 (November 2016), p. 1211-1234, https://doi.org/10.1093/jeg/lbw020.

[56] Interview, 22 November 2022.

[57] Interview, 4 April 2022.

[58] Caspar Dohmen, "Besondere Beziehung von Staat und Industrie" (podcast), in *Deutschlandfunk*, 21 March 2023, https://dlf.de/hRS12H.

[59] Interview, 23 March 2023.

[60] The case of Rheinmetall is telling: this enterprise will need to hire between 1,500 and 3,000 workers (implying a 19-28 per cent increase) in order to face the foreseen surge of orders. This would represent a challenging goal even in an ordinary context, not marked by the current shortage of qualified workforce in the labour market. See "Deutsche Rüstungsunternehmen wollen Produktion deutlich steigern", in *Die Zeit*, 3 March 2022, https://www.zeit.de/wirtschaft/2022-03/bundeswehr-aufruestung-ruestungsindustrie-produktion-ukraine-krieg.

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to the fact that working for arms producers is frowned upon by parts of society and by European public opinion at large. In fact, working in the defence sector also imposes limitations to employees that are unique to this industry, such as the obligation for some professionals to acquire security clearances issued by government authorities. Additionally, many defence companies tend to operate within geographically concentrated productive districts, thus restricting the pool of employable workers.[61] Such aspect is further exacerbated by low levels of European labour mobility, notwithstanding a marginal increase that has taken place within the EU[62] as well as a trend towards more geographically distributed aerospace value chains.[63]

2.2.3 Issues related to raw materials

Raw materials and components present additional issues that should not be underestimated. The defence sector relies on markets, such as the ones for steel[64] and semiconductors,[65] regulated by profoundly different cycles and challenges. For instance, French analysts highlighted that the missile sector depends on very heterogeneous supply chains, so much so that that minor supply issues could provoke delays of orders up to 36 months.[66]

Commodity markets are structurally unbalanced. The amount of resources needed to produce weapon systems, especially in terms of metals and alloys, is proportional to its complexity. A multirole fighter usually requires more than 14 different metals, including graphite for sensors, dysprosium for electro-optic systems, and aluminium for wings.[67] In this regard, Europe is prisoner of its own geography, as the European defence industry is totally dependent on imports for 19 out of 39 critical materials.[68]

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[61] Ibid.

[62] European Commission, *Intra-EU Labour Mobility at a Glance. Main Findings of the Annual Report on Intra-EU Labour Mobility 2021*, Luxembourg, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2767/475059.

[63] Ekaterina Turkina, Ari Van Assche and Raja Kali, "Structure and Evolution of Global Cluster Networks", cit.

[64] Vivienne Machi, "Europe's Defense Firms Feel the Squeeze of Shortages, Sanctions", in *Defense News*, 11 April 2022, https://www.defensenews.com/industry/2022/04/11/europes-defense-firms-feel-the-squeeze-of-shortages-sanctions.

[65] Yuka Hayashi, "Chip Shortage Limits U.S.'s Ability to Supply Weapons to Ukraine, Commerce Secretary Says", in *The Wall Street Journal*, 27 April 2022, https://www.wsj.com/livecoverage/russia-ukraine-latest-news-2022-04-27/card/pCWERV2HkSPzTdQG4CRI.

[66] Raphaël Briant, Jean-Baptiste Florant and Michel Pesqueur, "La masse dans les armées françaises: un défi pour la haute intensité", in *Focus stratégique*, No. 105 (June 2021), p. 34, https://www.ifri.org/fr/node/19981.

[67] Benedetta Girardi et al., *Strategic Raw Materials for Defence. Mapping European Industry Needs*, The Hague Centre for Strategic Studies, January 2023, p. 33, https://hcss.nl/report/strategic-raw-materials-for-defence.

[68] Claudiu C. Pavel and Evangelos Tzimas, *Raw Materials in the European Defence Industry*, Luxembourg, Publications Office of the European Union, 2016, https://data.europa.eu/doi/10.2790/0444.

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As far as the processing of said materials is concerned, issues related to production cycles also occur when raw materials are available. For instance, ballistic steel requires extreme heating and cooling processes whose length – and energy consumption – represent obvious productive bottleneck.[69] The ownership of foundries and infrastructures for the processing of raw materials is increasingly relevant for companies, too. The acquisition of the Friedrich-Wilhelms-Hütte foundries by KMW in Germany for instance,[70] as well as the presence the Benevento foundries in Italy and of important hydraulic extrusion presses in France[71] are all considered strategically relevant features to safeguard Europe's defence industrial processes. The same applies to investments in promising alternative production methods, such as 3D printing.[72]

2.2.4 Business incentives and investment risks

The transition from large scale production to the manufacturing of few advanced assets, as well as the diversification of value chains, have put some additional pressure on defence companies. The defence sector is remarkably capital-intensive, as it requires large non-recurrent investments in both infrastructure and physical capital. From a business perspective, it seems appropriate to limit capital investments only to those machineries and assembly lines needed to evade realistic order volumes. Clearly, the price to pay is the impossibility to quickly restart inactive productive capacities to respond to sudden surges in volumes of orders.

This dilemma was particularly evident after the rise in military expenditures in the Euro-Atlantic area. Different countries, including the United States[73] and Germany,[74] are experiencing intense discussions on the need to spur the defence industry to carry out enough capital investments to open new production lines, especially for ammunition. On this matter, it has been remarked that several European procurements agencies still need to accelerate the bureaucratic processes leading up to the signature of new supply contracts.[75]

[69] They reportedly reach temperatures between +900 and -70 degrees Celsius. See: Swebor, *Was ist Panzerstahl?*, 10 March 2020, https://www.swebor.se/de/was-ist-panzerstahl.

[70] Georg Ismar and Friedrich Bungert, "Die Renaissance des Panzerstahls", in *Süddeutsche Zeitung*, 1 February 2023.

[71] Interview, 28 February 2023.

[72] Developments in terms of alternative production processes such as 3D presses have been acknowledged by the sector, while they still are in an adoption and standardisation phase with authorities. In some countries, such as France, 3D presses are considered a partial response to repatriate the production of some components. See Nathan Gain, "Ces autres projets de relocalisation à l'étude au sein de la BITD", in *Forces Operations Blog*, 16 April 2023, https://www.forcesoperations.com/?p=27086.

[73] Jen Judson, "US Army Document Details Plan to Update WWII-era Ammo Plants and Depots", in *Defense News*, 18 April 2022, https://www.defensenews.com/land/2022/04/18/us-army-document-details-plan-to-update-wwii-era-ammo-plants-and-depots.

[74] Till Bücker, "Wie die Rüstungsindustrie dasteht", in *Tagesschau*, 3 February 2023, https://www.tagesschau.de/wirtschaft/unternehmen/ruestungsindustrie-branche-waffen-101.html.

[75] Christina Mackenzie, "How France Aims to Streamline, Simplify Arms and Ammo Acquisition",

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An additional constraint is the lack of specific tools to reasonably limit business risks, which could stem from a potential future decrease in demand in case of easing international tensions. This issue is particularly acute in countries like Italy, which lacks a stable multiannual financing framework for defence expenditures.[76] Rome's situation is worsened by the fact that the approval timeline for the yearly Italian Multiannual Planning Document is highly volatile and is mainly linked to the state's regular annual budget. Moreover, many European countries lack financial tools such as subsidised loans, state guarantees and trade credits purchase programs for SMEs, which would be useful to support the large initial investment required to jumpstart increased productive capacities.[77] The lack of guarantees particularly affects SMEs operating in the defence sector, whose dependence on a limited number of clients exposes them to the risk of bankruptcy in the case of demand fluctuation.[78]

Dual technologies partially contribute to counterbalance said limitations. Most industrial stakeholders use their own supply chains to produce assets for both civilian and military uses, to widen and diversify their reference markets, to capitalise on their investments in research and development and to create synergies that lower the production costs of a significant number of basic components (e.g., industrial screws). The integration process between civil and military sectors has often stabilising effects on those enterprises that can easily convert civilian production to satisfy demand spikes in the military sector.[79]

3. The response of France, Germany, and the European Union

3.1 The French solution: Conceptualising the war economy

Thanks to a parliamentary inquiry conducted in 2021–22, France anticipated some points that were later discussed in other national contexts, mainly concerning the limitations of ammunition stocks and the role of "mass" in combat.[80] These

in *Breaking Defense*, 22 September 2022, https://breakingdefense.com/2022/09/how-france-aims-to-streamline-simplify-arms-and-ammo-acquisition; Matthias Zimmermann and Walther Rosenberger, "Die Bundeswehr hat noch keine Panzer bestellt", in *Augsburger Allgemeine*, 11 February 2023, https://www.augsburger-allgemeine.de/id65462806.html.

[76] Michele Nones, "Difesa: Italia, spese in gestione confusionale, allarme rosso", in *AffarInternazionali*, 23 April 2019, https://www.affarinternazionali.it/archivio-affarinternazionali/?p=73790.

[77] ASD, *Designing Financial Instruments to Support the EDTIB within the Next MFF*, Outcomes of the 2nd Workshop, 6 June 2019.

[78] Interview, 28 March 2023.

[79] Interview, 4 April 2023. In a few words, the presence on civil markets allowed many enterprises to maintain both their know-how and productive capital throughout the years in which the European military expense stagnated. In this way, they preserved fundamental resources aimed at accommodating a new demand increase in this sector.

[80] Patricia Mirallès and Jean-Louis Thiériot, "La préparation à la haute intensité", cit.

reflections stem from both experiences on the battlefield[81] and live exercises. This is also why some ideas, such as the automatisation of assembly lines and the miniaturisation of components, were already circulating among specialists in order to structurally achieve higher production levels.[82] After 24 February, Macron explicitly talked about the essential need to adopt a "war economy" in order to be prepared for potential crises.[83] Macron's declarations are reflected in the 2022 National Strategic Review, which states the intention to "reduce production and support cycles for gradually gearing up to a 'war economy'".[84]

The rhetorical hyperbole was complemented by concrete initiatives on behalf of the French armament general directorate (DGA), which identified some priorities aimed at adapting the French defence industrial base to the current contingency. Among them are a general simplification of weapon systems in order to simplify and streamline production processes; the identification of alternative suppliers of raw materials in order to introduce a modicum of redundancy in the value chains; finally, the creation of a network of banking referents to improve access of defence industrial stakeholders to private credit.[85] A further request put forward by the DGA, which would however require action by lawmakers, is legislation allowing the requisition of civilian industrial materials in emergency situations,[86] a process modelled after the American Defence Priorities and Allocations System.[87] This will probably be partially detailed with policies aimed at stocks reconstruction in the upcoming *Loi de programmation militaire* 2024–2030.[88]

[81] See the missile shortage already experienced by the United Kingdom and France during operations in Libya in 2011. Cfr. Karen DeYoung and Greg Jaffe, "NATO Runs Short on Some Munitions in Libya", in *The Washington Post*, 15 April 2011, https://www.washingtonpost.com/world/2011/04/15/AF3O7ElD_story.html.

[82] Jean-Baptiste Jeangène Vilmer, "La haute intensité : limites du concept et implications pour la France", in *Le Rubicon*, 30 June 2022, https://lerubicon.org/?p=5121; Raphaël Briant, Jean-Baptiste Florant and Michel Pesqueur, "La masse dans les armées françaises", cit.; Antoine Pietri and Benoît Rademacher, "Impact des nouveaux modèles économiques industriels sur les équipements des armées", in *Études de l'IRSEM*, No. 64 (December 2018), https://www.irsem.fr/institut/actualites/etude-de-l-irsem-n-64-2018.html.

[83] "'Economie de guerre' : Emmanuel Macron va demander aux industriels une 'prise de risque accrue' lors d'un mini-sommet sur l'armement à l'Élysée", in *Franceinfo*, 28 March 2023, https://www.francetvinfo.fr/economie/emploi/metiers/armee-et-securite/economie-de-guerre-emmanuel-macron-va-demander-aux-industriels-une-prise-de-risque-accrue-lors-d-un-mini-sommet-sur-l-armement-a-l-elysee_5737193.html.

[84] French General Secretariat for Defence and National Security (SGDSN), *National Strategic Review 2022*, 9 November 2022, p. 38, https://www.sgdsn.gouv.fr/publications/revue-nationale-strategique-2022.

[85] French Ministry of Defence, *Économie de guerre : les 5 chantiers pour « produire plus et plus vite »*, 9 February 2023, https://www.defense.gouv.fr/actualites/economie-guerre-5-chantiers-produire-plus-plus-vite.

[86] Jean-Michel Bezat, Cédric Pietralunga and Elise Vincent, "Le Ministère de la Défense réfléchit à réquisitionner du matériel du secteur civil pour refaire ses stocks d'armes", in *Le Monde*, 13 June 2022, https://www.lemonde.fr/international/article/2022/06/13/defense-le-ministere-reflechit-a-requisitionner-le-secteur-civil-pour-refaire-ses-stocks-d-armes_6130033_3210.html.

[87] Renaud Bellais, "Économie de guerre : réalité d'un concept et enjeux pour la France", in *Fondation Jean-Jaurès Publications*, 3 October 2022, https://www.jean-jaures.org/?p=38164.

[88] French Ministry of Defence, *LPM 2024-2030. Les grandes orientations*, 6 April 2023, https://www.

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Overall, France has shown a particular interest in the role the EU could play when facing the industrial challenge. On the one hand, Paris regards the war in Ukraine as a catalyst for European defence cooperation. On the other hand, the acquisition of US military equipment, as well as protectionist tendencies embraced by several European countries, could be detrimental to European cooperation.[89]

Another French peculiarity is the doctrinal endeavour explicitly carried out by the Chief of Defence Staff to overcome risks derived from insufficient industrial production. France's new body of doctrine particularly emphasises "economy of forces",[90] as the French army currently favours a wide distribution of troops on the field and strong coordination abilities in order to minimise losses and the use of ammunition. There has also been an expression of interest in the substitution, when possible, of high-tech weapon systems with more rudimental assets that can be more easily be replaced and produced.[91]

3.2 The German solution: A special budget and administrative reforms

In theory, Germany was the first European country to carry out a significant change of pace to adapt the technological and industrial base to the new strategic framework, defined by chancellor Olaf Scholz as a "*Zeitenwende*" (historical shift). Nevertheless, this effort mostly comes down to financial allocations rather than a conceptual rethinking, along the French lines. This approach also foresees the institution of a one-off special fund for the Bundeswehr (*Sondervermögen der Bundeswehr*), amounting to one hundred billion euro complementing the regular defence budget. The 2023 regular budget will amount to 50.1 billion euro, to which 8.4 billion euro from the special fund will be added.

As of now, Germany will hardly be able to address both pre-existing capability gaps – especially in terms of scarcity of vehicles and systems obsolescence – and parallelly adopt policies aimed modernisations, reserves reconstruction and widening of ammunition stocks. The parliamentary *rapporteur* for the armed forces (*Wehrbeauftragte*) pointed out that at least three hundred billion euro will be necessary to reach an adequate operational readiness and close some significant capability gaps. The period between 2024 and 2028 foresees 1.8 billion euro for

defense.gouv.fr/actualites/livret-presentation-loi-programmation-militaire-2024-2030.

89 Benoît Rademacher, "Les industries françaises de défense", in *Cahiers français*, No. 428 (July-August 2022), p. 78, https://www.vie-publique.fr/parole-dexpert/286199-les-industries-francaises-de-defense-par-benoit-rademacher.

90 Center for Doctrine and Command Teaching (CDEC), *Précis de tactique générale*, April 2022, https://www.c-dec.terre.defense.gouv.fr/index.php/fr/actualites/322-rft-3-2-1-precis-de-tactique-generale.

91 Commission de la défense nationale et des forces armées, "Audition conjointe sur les enseignements du conflit ukrainien", in *Comptes rendus de l'Assemblée Nationale*, No. 25 (30 November 2022), p. 5, https://www.assemblee-nationale.fr/dyn/16/comptes-rendus/cion_def/l16cion_def2223025_compte-rendu.

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ammunition,[92] contributing to reach twenty billion euro worth in "Battle-Decisive-Ammunition" by 2031.[93] This increase has been accompanied by changes to official defence reporting, now also including an analysis of the availability of replacement parts, small adjustments to tendering processes (aimed at pursuing a comprehensive de-bureaucratisation)[94] and further simplification measures.[95]

The uncertainty surrounding the *Sondervermögen* resources has strained the relationship between the federal government and industrial stakeholders. A survey published in September 2022, involving the representatives of 60 enterprises active in this sector, reports that most companies already received orders tapping the *Sondervermögen* funds, but that the federal military procurement agency (BAAINBw) had reached the limits of its administrative capacity.[96]

While Berlin repeatedly requested contractors to increase their productive capacities, representatives from German industry complained about the uncertainty surrounding ammunition procurement policy.[97] A lack of contractual guarantees, in particular, sparked some controversies. This is due to the fact in that other NATO allies had already begun to sign supply agreements with German enterprises, which have thus allocated a share of production chains to the processing of foreign orders, especially ammunitions.[98]

Despite these issues, it is clear that the necessity to modernise and reconstitute stocks will still require an expansion of current productive capacities.[99] Scholz pointed to the future need for a "permanent" production of ammunition and of the

[92] Thomas Wiegold, "Weg für Verteidigungshaushalt 2023 und Sondervermögen frei – Aufstockung der Mittel für Munition (Neufassung)", in *Augen geradeaus!*, 11 November 2022, https://augengeradeaus.net/?p=62348.

[93] German Parliament Research and Documentation Services, *Munition in der Bundeswehr – Aktueller Sachstand, Bedarfe und Planungen* (20/4509), 14 November 2022, https://dip.bundestag.de/vorgang/munition-in-der-bundeswehr-aktueller-sachstand-bedarfe-und-planungen/292305.

[94] Federal Ministry of Justice, *Gesetz zur Beschleunigung von Beschaffungsmaßnahmen für die Bundeswehr*, 7 November 2022, https://www.gesetze-im-internet.de/bwbbg/BJNR107800022.html.

[95] "Acceleration of Bundeswehr Procurement - A New Attempt", in *Europäische Sicherheit & Technik*, 1 March 2023, https://esut.de/en/2023/03/meldungen/40265.

[96] Hans Christoph Atzpodien, "The industry is waiting for the boost - survey of the defense technology industry", in *Europäische Sicherheit & Technik*, 2 September 2022, https://esut.de/en/2022/09/fachbeitraege/36192.

[97] Thomas Wiegold, "Protokollnotiz: Kein Gipfel, kein Ergebnis", in *Augen geradeaus!*, 29 November 2022, https://augengeradeaus.net/?p=62494.

[98] "Rheinmetall Receives an Order Worth Millions for 40mm Ammunition", in *Europäische Sicherheit & Technik*, 12 January 2023, https://esut.de/en/2023/01/meldungen/39238.

[99] These bottlenecks are less severe in the acquisition of vehicles such as the Boxer tank, which take advantage from being subject to mid-life upgrades from several years, allowing to keep the assembly sites open. See: Tim Martin, "Boxer Armored Vehicle Production Sets up Tension between Rising Demand and Supply Bottleneck," in *Breaking Defense*, 26 January 2023, https://breakingdefense.com/2023/01/boxer-armored-vehicle-production-sets-up-tension-between-rising-demand-and-supply-bottleneck.

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most important weapon systems,[100] as well as the intention to establish long-term cooperation formats with the industry.[101]

Beyond these difficulties and the irritation of German industrial stakeholders,[102] it is clear that the latter are getting ready for a significant increase in orders. Hensoldt's CEO has announced that, starting from April 2023, the company will produce one TRML-4D radar per month in order to increase stockpiles and to shorten shipment times.[103] Similarly, Rheinmetall has announced the building of an artillery ammunition factory in Hungary.[104]

3.3 The European Union

The European Commission has announced several instruments to face the surging demand for military goods. These coordination policies are crucial, especially in a context in which the European Union has already reached a consensus on the need to increase defence cooperation and integration (as enshrined in the Strategic Compass approved by the Heads of State and Government in March 2022.) The invasion of Ukraine presents important challenges also to the path towards a stronger European defence. As shown by the Polish case, it is highly likely that, in the absence of coordination, member states will opt for rapid procurement solutions offered by non-European producers, mainly the US, but also Israel and South Korea.[105] This would further fragment the European defence market, as well as the stock of weapon systems currently in use and related logistical support chains.[106] This development would damage both the efficiency and the sustainability of European militaries, as well as the productive capacity and the competitiveness of the European defence industrial basis.[107]

[100] "Chancellor Scholz: 'We Need Permanent Production of Our Most Important Weapon Systems'" in *Europäische Sicherheit & Technik*, 17 February 2023, https://esut.de/en/2023/02/meldungen/40052.

[101] "Chancellor Scholz Wants to Expand Cooperation with the Armaments Industry", in *Europäische Sicherheit & Technik*, 16 January 2023, https://esut.de/en/2023/01/meldungen/39306.

[102] "Zwischen Frustration und Zuversicht. Rüstungsbranche wartet auf Aufträge aus 100-Milliarden-Paket", in *Tagesspiegel*, 25 February 2023, https://www.tagesspiegel.de/politik/zwischen-frustration-und-zuversicht-rustungsbranche-wartet-auf-auftrage-aus-100-milliarden-paket-9415013.html.

[103] Patricia Nilsson, "Defence Industry's Business Model Transformed by War, Says German Contractor", in *Financial Times*, 18 January 2023, https://www.ft.com/content/d63f7298-f6e8-4b1d-95e1-92437747d67e.

[104] "Rheinmetall to Build Ammunition Factory for Military Platforms in Hungary", in *Army Technology*, 17 January 2023, https://www.army-technology.com/?p=277104.

[105] Michele Nones, "The Risks to European Defence of Non-coordination", in Alessandro Marrone et al., *The Russia-Ukraine War, Security in Europe and European Defence*, Rome, IAI, November 2022, p. 29-32, https://www.iai.it/en/node/16243.

[106] The risk is particularly marked when considering that a military good purchased today produces a "lock-in" effect. Namely, it will block the acquisition of alternative goods due to its average long timespan in service, often lasting for decades.

[107] Felix Arteaga et al., "To Face the Russian Threat, Europeans Need to Spend Together – Not Side by Side", in *Euractiv*, 19 April 2022, https://www.euractiv.com/?p=1745658.

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3.3.1 EDIRPA and EDIP

The Commission has launched several initiatives to overcome the risk of fragmentation. These were initially covered by the legislative instrument called EDIRPA (European defence industry reinforcement through common procurement act).[108] Furbished with 500 million euro, this tool should support joint procurement projects when participated by at least three member states, and cover the administrative and technical costs related to common tender procedures.[109] Due to the limitations imposed by EU treaties, the instrument is presented as industrial policy rather than defence policy. In the draft currently going through the approval process, aid is merely limited to legal entities registered on EU territory and in the EFTA (European Free Trade Area).[110]

This represents a significant obstacle for those countries whose defence enterprises operate outside the EU/EFTA bloc (such as Leonardo UK), and it would rule out synergies with British or American companies. Starting from 2027, a more extensive program called EDIP (European Defence Investment Program) should substitute EDIRPA in order to anchor joint procurement in the European practice.[111] This would allow the formation of the so-called European Defence Capability Consortia (EDCC). EDCCs should allow the coordination of purchases by groups of countries interested in a given provision, recurring to EU-based suppliers and benefiting from a VAT exemption.[112]

The complicated negotiation for EDIRPA suffers from the legacy of a debate which contrasts member states (mainly France)[113] more in favour of closing-off of the European defence market to extra-European producers, to countries like Italy and Germany, more prone to embracing a progressive approach aimed at rendering European industries more technologically competitive on the global market through common research and development policies.[114] Delays in the launch of EDIRPA is also due to internal dynamics of the European Parliament, which risk reducing the efficacy of instrument vis-à-vis national choices already in place.

[108] Currently still in the approval process.

[109] European Commission, *Proposal for a Regulation on Establishing the European Defence Industry Reinforcement through Common Procurement Act* (COM/2022/349), 19 July 2022, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:52022PC0349.

[110] EFTA is composed by Iceland, Liechtenstein, Norway and Switzerland. Sebastian Clapp, "European Defence Industry Reinforcement through Common Procurement Act (EDIRPA)", in *EPRS Briefings*, May 2023, https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2023)739294.

[111] European Commission, *EU Steps up Action to Strengthen EU Defence Capabilities, Industrial and Technological Base: Towards an EU Framework for Joint Defence Procurement*, 18 May 2022, https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3143.

[112] In this regard, see Michele Nones, "L'Europa della Difesa fa un altro passo avanti", in *AffarInternazionali*, 23 May 2022, https://www.affarinternazionali.it/?p=98205.

[113] Suzanne Lynch, Eddy Wax and Jacopo Barigazzi, "France Pushes Protectionism in Ukraine Defense Plan", in *Politico*, 13 March 2023, https://www.politico.eu/?p=2756670.

[114] Interview, 23 March 2023.

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3.3.2 A new common procurement initiative through the European Peace Facility

Given the delay in approving EDIRPA, the Council and the Commission launched an initiative based on the use of the European Peace Facility (EPF). This instrument had been designed well before the war to finance the equipment and training for extra-EU allies. The new initiative relies on the supply of ammunition for missile systems and artillery, the joint procurement of 155mm artillery shells (the standard NATO calibre most used by Kyiv), and generally the ramp-up of the European productive capacity for ammunition.[115] More in detail, this initiative managed by EDA consists in a 2-year window to simplify tenders for artillery shells and reimburse member states via the EPF, together with a 7-year framework project aiming at coordinating ammunition procurement.[116] Furthermore, the Commission announced it will allocate five hundred million euro in own resources, moreover allowing for the use of some resources from the Recovery and Resilience Facility to finance artillery ammunition production. This should occur through the Act in Support of Ammunition Production (ASAP), which includes a tool aimed at mapping out and anticipating potential bottlenecks in shells production.[117]

Since the start of the war, the EPF has become the main channel through which EU military support to Ukraine has flowed,[118] reaching a value of 8 billion euro for the 2021–2027 period.[119] Nevertheless, there are some disadvantages in using the EPF. First, one needs to distinguish the pursuit of two different objectives, namely the supporting Ukraine on one hand and the consolidation of the European defence architecture on the other. Until now, the EU has adopted an approach that consisted in partially reimbursing member states that had donated their stocks to Ukraine. However, it is not at all obvious that a tool designed to support Ukraine, whose current efforts require a very specific kind of aid (such as 155mm shells), is suitable to satisfy complex future requirements put forwards by EU armed forces. Moreover, some member states have voiced scepticism regarding the EDA's ability to manage these novel procurement processes.[120] Finally, a joint procurement policy founded on a technologically rudimental requisite such as artillery shells may be unrelated to the analysis carried by the CARD. This risk undermining the work that since

[115] Council of the European Union, *Delivery and Joint Procurement of Ammunition for Ukraine*, 20 March 2023, https://data.consilium.europa.eu/doc/document/ST-7632-2023-INIT/en/pdf.

[116] European Defence Agency (EDA), *EDA Brings Together 25 Countries for Common Procurement of Ammunition*, 20 March 2023 (updated May 2023), https://eda.europa.eu/news-and-events/news/2023/03/20/eda-brings-together-18-countries-for-common-procurement-of-ammunition.

[117] Suzanne Lynch and Jakob Hanke Vela, "Brussels Unveils Plan to Boost EU Defense Industry", in *Politico*, 3 May 2023, https://www.politico.eu/?p=2995803.

[118] Council of the European Union, *Ukraine: Council Agrees on Further Military Support under the European Peace Facility*, 2 February 2023, https://europa.eu/!JNTjgQ.

[119] European Commission's Service for Foreign Policy Instruments (FPI) website: *European Peace Facility*, https://fpi.ec.europa.eu/what-we-do/european-peace-facility_en.

[120] Ibid.; Paul Taylor, "Ammo for Ukraine? EU Might Not Be up to the Task," in *Politico*, 23 March 2023, https://www.politico.eu/?p=2810103.

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2016 has tried to define common European capability requirements,[121] and which has jumpstarted the development of common weapon systems by allocating to the resources of the European Defence Fund (EDF) since 2020.[122] One should remember that in the medium term, both CARD and EDF have the potential to avoid costly duplications and to allow a more efficient use of production plants in Europe.

4. Seven implications for Italy

It is likely that over the next few years the European and transatlantic industrial base will be required to achieve high levels of production. Regardless of differences, most issues tackled by the present study are relevant to all member states of the European Union, as well as the United States and other non-EU NATO allies. This notwithstanding, some of the questions at hand are of particular concern to Italy, which should consider seven implications for its own defence industrial policy.

There is a need for multiannual planning. Italy is one of the countries suffering the most from the lack of a solid financial framework and multiannual planning. The DPP as a programming tool lacks both a financial coverage granted throughout the three years considered by the document and the certainty in its administrative implementation. These elements are necessary to give industrial stakeholders assurances, allowing them to carry out capital investments such as the purchase of new machinery or hiring qualified personnel. The adoption of documents along the lines of the French *Loi de programmation militaire* would ensure clarity and financial certainty, which are fundamental to allow a medium-term programming to both the armed forces and the defence industry.

There is no quick fix. The main risk arising from the current situation is represented by the temptation for European countries to opt for national solutions to rapidly close the respective capability gaps. While understandable, reality suggests that a national "quick fix" would in most cases lead to the procurement of obsolescent systems. This would in turn prevent the development of a mature European industrial and technological base within the next decade, which entails particular dangers in light of the fact that even the most rapid national solution would still require precious years to be implemented. This timeframe could rather be exploited to support European cooperative solutions, necessary to maintain an operational and technological advantage over potential adversaries, not only in the short but also in the medium and long term.

[121] Interview, 12 April 2023.

[122] Already launched in 2020 to finance R&D projects, in the medium-long term the EDF should favour a rationalisation of all available resources in the field of research and technological-military development. This contribution might have positive consequences on the industry if countries will correctly benefit from it. For example, concerning the substitution of short range defence capacity, American producers too are expecting long waiting times for the mass production of new Stinger units.

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Italy will not make it on its own. Italy, as other European countries, must resist the protectionist impulse to go on its own in every domain and rather focus only on those industrial segments where it sports national industrial excellencies. At the same time, these need to be made available to encourage European cooperation, especially with regards to the current priority of land warfare.[123] On this matter, Rome must continue supporting the legislative approval and implementation of EDIRPA and EDIP, as well as contributing to organically integrate new defence initiatives within the existing EU defence architecture. Procurement initiatives through the EPF should contribute to the completion of the existing framework and should be harmonised with existing tools, such as CARD and the EDF.

The Stability and Growth Pact is only part of the answer. From the analysis at hand, it is clear that budget constraints represent only part of the issue, even though significant investments will be needed to fill existing capability gaps. The German case demonstrates that even the allocation of 100 billion euro is insufficient without strategic, organisational, and administrative clarity. While most defence investment gaps have been caused by years of budgetary austerity, it is also true that partially excluding defence expenditures from the rules of the Stability and Growth Pact, in particular when it comes to European cooperation programs, would represent a valid incentive and render such programs more convenient than national options.

There is a need for ad hoc financial guarantees. Industrial stakeholders often lament the absence of adequate financial and credit guarantees necessary to allocate own resources in the increase of productive capacities. More often than not, such instruments are more consequential than a mere budget increase. This is also true when it comes to potential costs associated with the breach of export contracts when choosing to divert production lines towards national clients. The European Investment Bank (EIB) is often referred to as a key institution in this field, but the credits it provides come with their own strings attached.[124] An *ad hoc* initiative for defence financing should be adopted, possibly also including European national promotional institutes like Italy's Cassa Depositi e Prestiti.

There is a need for efficiency, but also for efficacy. As in the United States, European industrial consolidation has been mainly pursued following a logic of efficiency. Like in the US, there is a need to review whether the simple efficiency rationale should be reviewed in light of the current challenges linked to the needed productive surge. It is clear that a logic of efficiency and optimisation should be complemented by criteria such as resilience, efficacy and redundancy, especially concerning second-tier suppliers, through the glasses of a European single market

[123] See for instance: Federico Castiglioni and Michelangelo Freyrie, "European Defence and Italian-German Cooperation in the Wake of Putin's War", in *IAI Papers*, No. 23|12 (June 2023), https://www.iai.it/en/node/17143.

[124] The use of EIB's funds foresees that 51 per cent of the products must be of civil use, as well as the imposition of many regulations to the credit recipient.

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rather than of fragmented national markets.

Alternative production methods will play a role. Finally, there are some structural limitations which prevent the intensification of production cycles. This applies both to physical processes, such as forging, and more traditional manufacturing work. The causes are related to features of the available labour force and the availability of raw materials. In this regard, it would be appropriate to keep on investing on innovative production methods such as 3D printing and the recycling of components and raw materials, adapting the legislation and allowing to take full advantage of the promising advances in the aeronautic field.

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Acronyms

BAAINBw	Bundesamt für Ausrüstung, Informationstechnik und Nutzung der Bundeswehr (German Federal Military Procurement Agency)
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CAESAR	Camion Équipé d'un Système d'Artillerie
CARD	Coordinated Annual Review on Defence
DGA	Direction Générale des Armaments (French Military Procurement Department)
DG DEFIS	Directorate-General for Defence Industry and Space
DPP	Documento Programmatico Pluriennale della Difesa (Italian Multiannual Planning Document)
EDA	European Defence Agency
EDCC	European Defence Cooperation Consortia
EDIP	European Defence Investment Program
EDIRPA	European Defence Industry Reinforcement through common Procurement Act
EFTA	European Free Trade Area
EIB	European Investment Bank
EPF	European Peace Facility
EU	European Union
GBAD	Ground-Based Air Defence
ISR	Intelligence, Surveillance and Reconnaissance
IISS	International Institute for Strategic Studies
KMW	Krauss-Maffei Wegmann
LPM	Loi de programmation militaire (French Multiannual Military Planning Law)
MALE	Medium Altitude, Long Endurance
MANPADS	Man-Portable Anti-Air Defence System
MBT	Main Battle Tank
MoD	Ministry of Defence
pMS	participating Member State
SHORAD	Short-Range Air Defence
SME	Small-Medium Enterprise
UAV	Unmanned Aerial Vehicle
VAT	Value Added Tax

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