50 shades of procurement: The European defense trilemma in defense procurement strategies

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Abstract

This article examines the strategic choices of countries regarding their acquisition of defense equipment, given the strategic and economic constraints that they have faced since the end of the Cold War. As Augustine's laws make it increasingly complicated to develop and produce all the necessary weapons for a single country, countries must balance the wishful thinking of preserving industrial strategic autonomy with the cost of doing so under the constraint of meeting the needs of their armed forces. European countries' procurement strategies are mapped against a trilemma of autonomy, manageable costs, and economic spinoff. Several procurement alternatives are analyzed, including national production, European cooperative production, licensed production, off-the-shelf purchase, leasing, and capacity abandonment. Maximizing both strategic and economic advantages is a myth; there is no "silver bullet" in terms of acquisition choice, and the returns on investment depend on countries' preferences, goals, and markets.

Defense procurement is the process whereby "states acquire goods and services required by their armed forces".[1] Deciding on the appropriate mode of procurement is a complex process combining strategic anticipations, planning, and industrial–economic imperatives. The long story of France with unmanned aerial vehicles (UAVs) with its twists and turns, is illustrative. France deployed its first UAVs during the first Gulf War in 1990–1991 and then in the former Yugoslavia.[2] However, it was not until the commitment to temporary platforms in Afghanistan at the end of the 2000s, that the country was truly convinced of the need for UAVs in military operations. Specifically, in the medium-altitude long endurance (MALE) UAV segment of the market, France has thoroughly questioned the most appropriate procurement model that should be adopted after having unsuccessfully launched and then abandoned several projects, such as the EuroMale, Advanced UAV, Talarion, Telemos, and F-Heron TP.[3] In 2013, after this long trial journey, the country decided to purchase the American Reaper UAVs from General Atomics, first for Intelligence, Surveillance and Reconnaissance (ISR) missions, and then starting in 2018, for bombing missions. Finally, in 2022, the collaborative Eurodrone (Gryphon) program was officially launched. Eurodrone entails that a minimum of 60 UAVs should be bought by the states cooperating on the project (France, Italy, Germany, and Spain) for a total value of EUR 7.1bn. The first objective of this UAV is to replace the Reaper UAVs in service in the French, Italian, and Spanish air forces. This more-than-15-year-long story shows how different modes of procurement (from national programs to off-the-shelf purchases, including cooperation, along with a still pending leasing option[4]) were envisaged by a country with industrial skills, significant operational needs, and a strong desire

1 Uttley (2018, p. 72).
2 Zubeldia (2012).
3 Faure (2020).
4 It is of note that in 2020, General Atomics proposed to the French Ministry of defense a leasing option for Reaper or SkyGuardian drones, based on the model of cars or trucks fleet leasing.

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for sovereignty.

This article aims to understand how the different acquisition choices made by a country can evolve according to economic criteria, such as the increase in R&D costs, production costs, Augustine's laws and constrained budgets, the existence (or not) of a defense industrial base (DIB), and finally strategic criteria, such as alliances or operational needs. It is therefore useful to question the different dynamics at work since the end of the Cold War that can explain the current choices of the European countries. In this respect, the economic and budgetary stakes relative to the costs of programs, and when compared with previous generations, play a strong catalytic role. In addition, while they are not in the scope of this article, political frictions are a significant feature.

Since the end of the Cold War, European countries have had to cope with many different constraints on their procurement processes. However, the way they deal with them depends on their preference for sovereignty-related issues such as maintaining (or developing) industrial capabilities. Their procurement strategies are mapped against a trilemma of autonomy, manageable costs, and economic spinoff—upon which, several procurement alternatives are analyzed, including national production, cooperation, licensing, off-the-shelf purchase, leasing, and capacity abandonment. The lack of coordination regarding defense procurement has severe consequences for the industrial fragmentation of Europe. The war in Ukraine modifies the trilemma such that acquisition costs are less critical because the European response to the war requires weapons procurement at an accelerated rate.

The main trilemma is that the solution of "a national production by a national firm", which gives the highest level of sovereignty and industrial strategic autonomy, as well as generating the highest level of technological and economic spinoffs, is also the more expensive option. Here, for a given country, industrial strategic autonomy can be understood as the situation of not being dependent on foreign actors—but even more, as the capacity to manufacture, produce, sell, and use defense equipment without constraints other than those that the country has set for itself under its regulations and the treaties it has signed. Thus, in the quest for industrial strategic autonomy, European countries have to balance dependency and the economic costs and benefits calculus of procurement. A wide spectrum of possibilities seems to arise between a costly choice of national production with limited (or even no) foreign dependency on the one hand, and a leasing option with a high level of foreign dependency on the other.

The article further seeks to put together all the reasons that influence a country's choice in order to illustrate the plurality of situations in terms of the "model of procurement". Faced with the increasing cost of equipment, countries are likely to implement different procurement strategies. Some of them can be novel in the "procurement landscape" (e.g., leasing options), but all of them imply renouncing some strategic advantages. These different strategies are reviewed and the fundamental trade-offs underlying each of them are highlighted. The following areas in the related literature are studied: the historical dimension of industrial choices; the problems of cooperation as a way to solve the trilemma; the economics or international relations cost issues in terms of production; and the issues relating to the variety of capitalism in political science. The article highlights that there is no unique model of acquisition but only "models" that fit a country's needs at a given moment in its history, and in a given institutional context.

The first part of this article outlines the major issues of fleet management in the European context. Then, an examination is undertaken of the fundamental trade-off between maximum sovereignty and foreign dependence as seen in the literature. The article introduces the idea of a "trilemma" to map where procurement options lie versus three "ideal" criteria—the lowest cost, maximum autonomy dividend, and maximum economic and technological advantages (spinoffs). Several cases of public procurement involving trade-offs are presented as illustrations to support this framework.

Fleet management fleet issues

According to the existing literature, three main categories of factors influence the procurement process (Table 1): the external strategic environment (i.e., the threat); the internal strategic environment (i.e., the political situation); and the economic constraints, including budgetary ones.

Table 1: Main factors influencing the procurement process

External strategic environment	*Internal strategic environment*	*Economic constraints*
External threats. Alliance network.	Domestic political agenda. Presence and size of the defense industry.	Level of wealth. Defense budget. Cost escalation.

First, external strategic considerations (i.e., the existence and intensity of a threat) justify the need for states' procurement. In the event of a common threat, countries may cooperate more easily to either develop and produce their own aircraft or buy off-the-shelf from allies (notably, the United States, and to a lesser extent, the European Union). Besides, the changing nature of the threat may require adaptability to a diversity of missions rather than specialized equipment for a specific mission. Combat aircraft constitute a good example to substantiate this point—during the Cold War, these aircraft were specialized for specific air missions (air-to-air combat, and air-to-ground strikes, and ISR), while their latest generation (produced since 2000) encompass the entire scope of air missions.[5]

Second, the internal environment is related to the presence of firms within the DIB that are capable of building and supporting the required equipment. This is a critical industrial constraint as states may be reluctant to give up industrial capabilities on the grounds of sovereignty or because recovering lost industrial skills is both uncertain and costly. In this regard, Kluth shows the extent to which the procurement process may suffer from a "national bias"[6]; countries tend to favor their national DIB for both sovereignty-related and economic reasons. This constitutes a major reason that explains industrial fragmentation in Europe.

Third, budget constraints are stringent; thus, defense budgets are widely used as expandable lines (especially just after economic crises, such as after the 2008 subprime economic crisis). According to SIPRI data, the increase in defense budgets in Western European countries since the end of the Cold War is 7% and is the least among all the regions of the world. Christie shows that "fiscal space" is a major determinant of the European defense budget, and more recently[7], Droff and Malizard conclude that economic factors remain crucial in determining the demand of defense spending.[8] Moreover, the economic crisis after 2008 dealt a huge blow to defense procurement budgets; according to the European Defence Agency (EDA) database, defense procurement budgets decreased by 22% between 2008 and 2014. Budgetary constraints include inflationary pressure. Given that defense equipment requires high-level technology, defense inflation is higher than civilian inflation[9], and the purchasing power of governments for defense equipment decreases over time for a constant budget. Bongers and Torres evaluate the quality-adjusted fighter aircraft cost in the United States and conclude that the technological process constitutes the main explanation for defense inflation (an 80% increase in aircraft cost).[10]

Countries require defense equipment to fulfill their strategic needs. Before considering procurement choices, one may also consider fleet management to maintain a certain level of defense capability. Some countries may suffer a lack or shortage of capabilities due to budget constraints. For those with capabilities, streamlining the fleet is considered a way of preserving operational skills. Three options are identified below.

The first option, "being under a capability shelter" can be considered when a country has certain needs but cannot afford to purchase the required military equipment. In this case, the option is to benefit from the capabilities of an alliance; for example, the Baltic States received main battle tank capacities from the NATO forces. This can also be a temporary solution when the capability gaps have been identified but the corresponding program has not yet been

5 Droff, Malizard and Noël (2020).
6 Kluth (2017).
7 Christie (2019).
8 Droff and Malizard (2022).
9 Hartley (2020).
10 Bongers and Torres (2014).

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finished, or the country has not decided on a preferred option—as with the end of NIMROD, a domestic program in the United Kingdom, where France and other NATO countries helped the United Kingdom in maritime surveillance missions. Eventually the United Kingdom opted to buy the American Poseidon aircraft "off-the-shelf".

The second option is that a country can either abandon a given capacity or optimize and rationalize the existing capacity. In this vein, Neuman identifies several paths, such as retaining the old-generation equipment, reducing the size of the fleet, and at the extreme, giving up capabilities.[11] Abandoning capabilities is simple and tempting because the resulting short-term savings are often significant. Important examples of countries that have adopted this approach include the following: Denmark with its submarine capability; New Zealand with combat aircraft capabilities in 2011; Belgium, Canada, and the Netherlands with their main battle tanks; and the United Kingdom, which gave up the air component of its nuclear deterrence at the end of the 1990s. France has decided not to maintain coastal batteries and to abandon short and medium-range ground-air defense systems (in the mid-2000s). All these choices imply a renunciation of sovereignty. Important to such decisions is that it is difficult and very costly to turn back the clock, given the loss of required knowledge and know-how.

The third option is that optimizing and rationalizing capacity is possible, for example, by modernizing fleets or improving their maintenance efficiency. This approach is evident in France in the ambitious policy to modernize the maintenance of military aircraft in 2018. However, this strategy has time limitations because eventually the cost of capability ownership increases (due to aging equipment), which by definition is not at the technological frontier—investment will again be required. The countries experiencing this situation include Germany, which has decided to extend the life of its Tornado aircraft, and France, with its Mirage 2000 modernization program. For both these countries, modernization with new equipment will be inevitable; the F-35 in the case of Germany and the Rafale fighter at the F4 standard in France.

Trilemma in the procurement process

There are different possible procurement strategies, ranging from national preference (and autonomy) to international preference (and dependence). Several intermediate strategies lie in-between these poles—including international cooperation in its various forms, extending from a collaborative program (with, for example, shared development costs) through to licensed production.

Figure 1 represents these possibilities by postulating a fundamental trade-off between sovereignty and costs, while accounting for the economic and technological advantages countries may benefit from. On the x-axis, is the degree of external dependence of an acquisition modality, and on the y-axis lies different economic and technological spinoffs, unit cost and strategic autonomy dividends that can be associated with the same modality/degree of dependence.

For example, with the option of a national program (number 1 in the graph), a country supports a large cost of R&D and production, but its dependence on foreign partners is low.[12] Toward the other end, when a country purchases off-the-shelf equipment (number 4 in the graph), it benefits from a lower price, given the economies of scale of the foreign producer; however, its dependence on foreign partners is very high.[13]

11 Neuman (2006).

12 Note that the approach is based on the main platform and does not account for the "value chain" inside the platform. The issue of dependency would also require investigating the systems, sub-systems, and components for a more in-depth analysis that goes behind the scope of this article.

13 Often the United States but also Russia or even China or Turkey for some markets, such as that of UAVs)

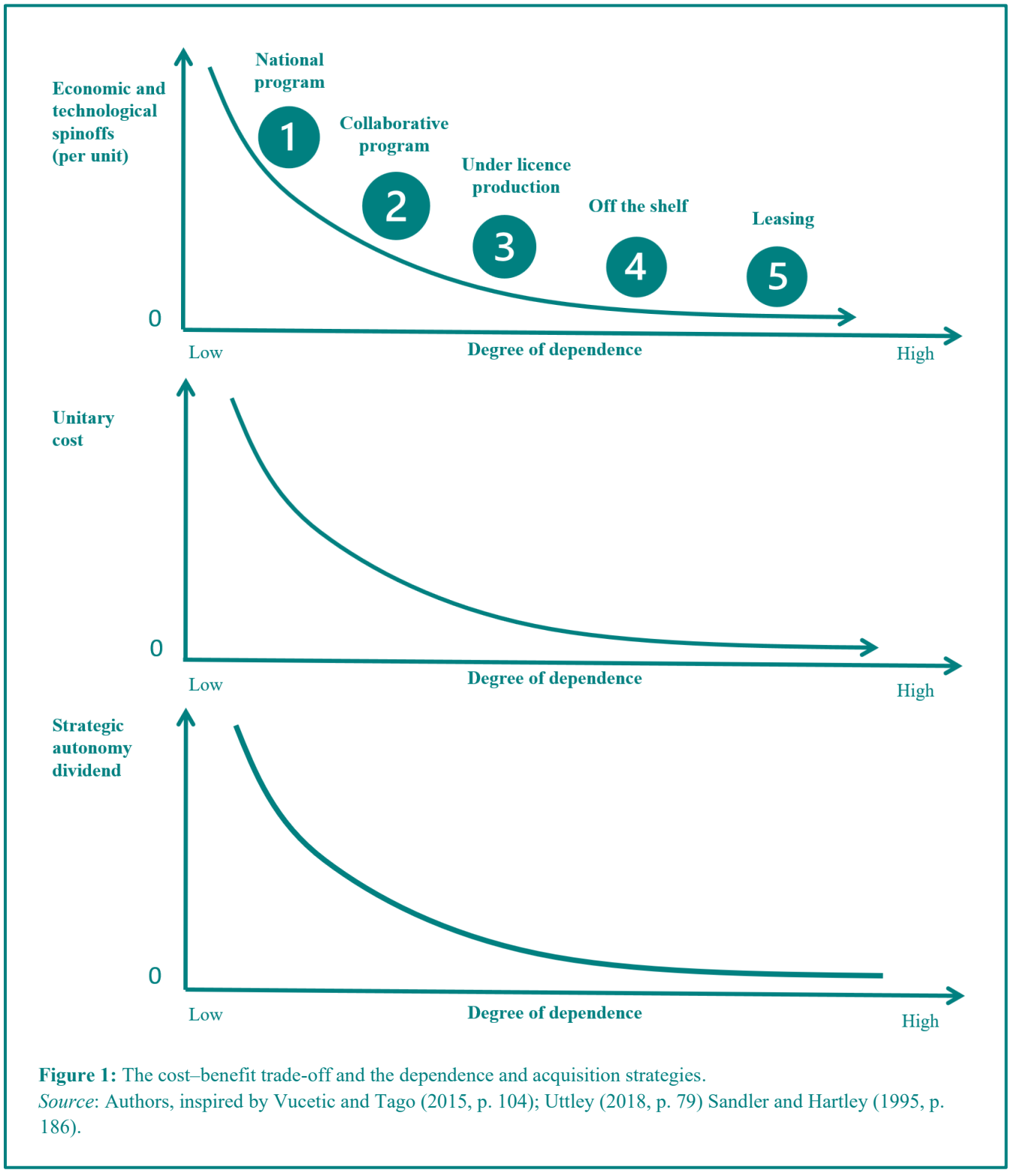

Figure 1: The cost–benefit trade-off and the dependence and acquisition strategies.
Source: Authors, inspired by Vucetic and Tago (2015, p. 104); Uttley (2018, p. 79) Sandler and Hartley (1995, p. 186).

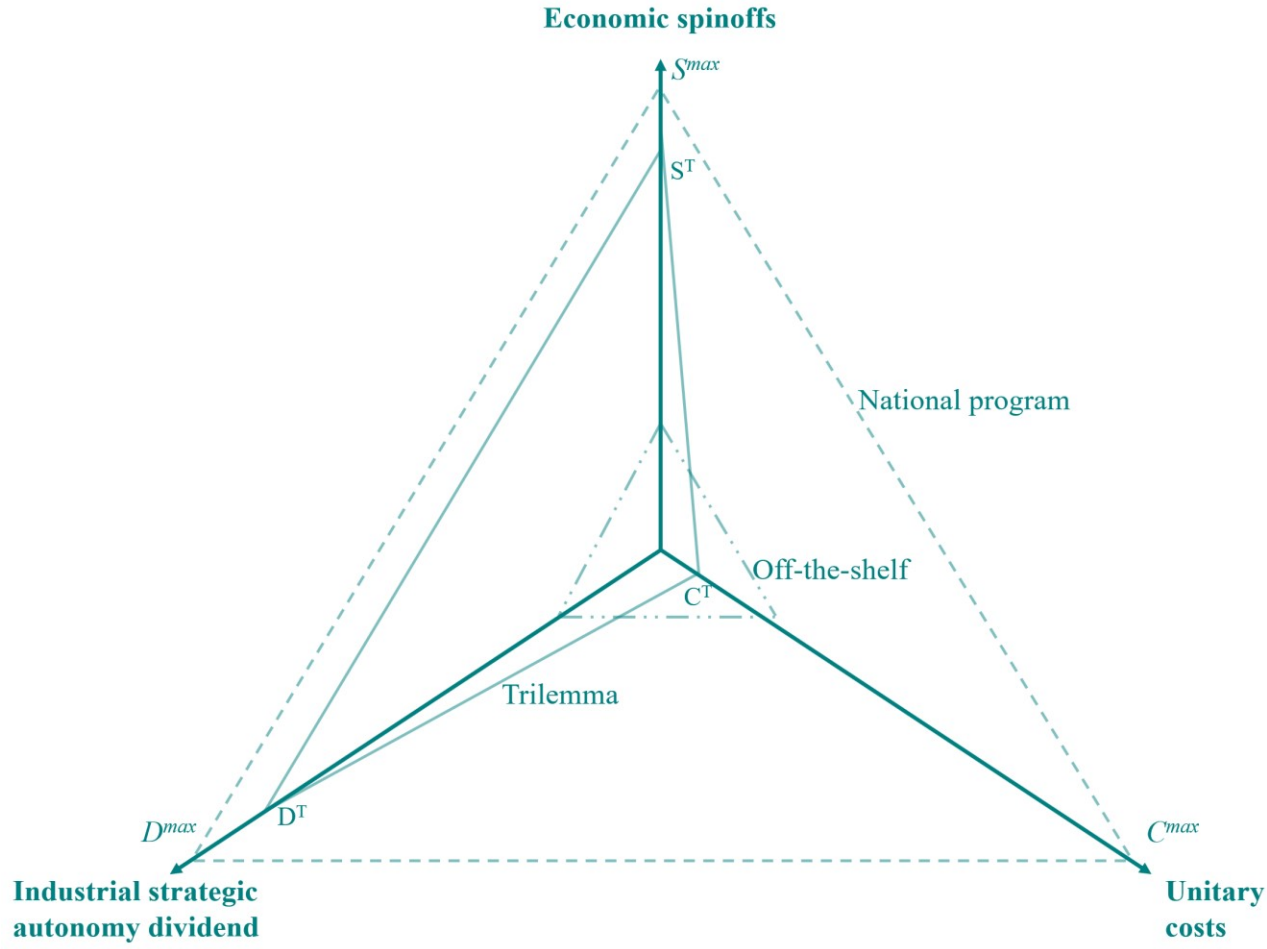

Figure 2: Spinoffs, industrial dividends, and cost nexus.

Furthermore, there is a form of trilemma between autonomy (independence), cost, and advantageous economic and technological spinoffs, in that no country can simultaneously obtain all the three "ideal" criteria—the lowest cost, total autonomy, and maximum economic and technological advantages. On combining the three dimensions of the trilemma, Figure 2 emerges, where all procurement options can be depicted along these dimensions.

For ease of reading only two procurement options (national program and off-the-shelf) are plotted, but all the five procurement options analyzed in this article can be represented with regard to industrial strategic autonomy dividends, economic spinoffs, and unitary costs. This article argues that a national program maximizes both industrial strategic autonomy dividend *(*D^{max}) and economic spinoffs (S^{max}), but it comes with the highest cost (C^{max}). Under these circumstances, the trilemma implies that there is no variant of the national program option in which the cost is dramatically reduced (C^T). Countries must form their procurement choices based on the trade-off between unitary costs, industrial strategic autonomy dividend, and economic spinoffs.

This being considered for European countries in the current context (high cost of systems, reduced size of the defense market, budgetary constraints, competition between budgets within states, etc.), procurement necessarily becomes an adjustment process with strategic trade-offs. Comparing the European and American markets (as is often

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the case in the literature[14]), only the United States can simultaneously meet the three objectives because of the size of its market, its economic and financial power, and its unified decision-making structure, which homogenizes demand and therefore favors scale and learning effects.

The inter-temporal dimension of the industry as well as the issues of path dependency must be accounted for; given the economic and technological barriers to entry, it is indeed very difficult to create industrial capacities out of nothing.[15] The countries that tend toward national production (1) and collaborative programs (2) generally have the highest strategic ambitions (3), whereas countries that tend toward off-the-shelf purchases (4) or leasing options (5) generally have less strategic ambitions and do not consider the defense industry as a priority or a political objective in need of support. What is interesting, however, is examining the trade-offs in terms of capacities and showing the extent to which some countries maintain a given capacity (i.e., by choosing options 1 or 2) at the expense of another capability (i.e., by choosing options 3, 4, or 5). What also complicates this analysis is that countries sometimes start their procurement process with off-the-shelf purchases or production under license (options 4 or 3) and move up the industrial chain and acquire the necessary skills over time. The following section details each strategy and illustrates them with examples, highlighting some of the strategic trade-offs observed.

National preference and the search for autarky

In the case of national preference, the defense *industrial* policy is a central element of defense policy enabling a country to technically design, produce, and provide operating support of systems. The country aims at maintaining and developing its DIB, which can be defined as the set of companies that enable the armed forces to conduct their operations, which include both the armament firms (production of weapon systems and lethal equipment) and those that supply all the goods necessary for the functioning of the armed forces (food, fuel, etc.).[16]

A national DIB offers numerous advantages. Initially, of course, there are issues of "strict sufficiency" to avoid depending on foreign actors[17], but today there are other major issues in terms of jobs (difficult to offshore) or value-added industrial activities. In France, for example, 90% of the value added of a strategic nuclear submarine (SSBN "Le Triomphant" class) is located on national soil;[18] and, given the French preference for nuclear deterrence, this result can be considered the upper limit of the value added associated with defense production.

National DIBs also help in mastering technologies that ensure spinoffs in various sovereign sectors connected to defense activities, such as computational capabilities, energy, electronics, materials, and so on.[19] At a more operational level, an autonomous DIB guarantees better reactivity and adaptation to changing needs.[20] This is the case, for example, with anti-IED vehicles—the fight against IEDs has become one of the largest public programs in U.S. history.[21] The mass production of mine-resistant ambush-protected (MRAP) vehicles can be seen in the American context as an attempt to solve a strategic problem through a technological response—mainly possible because of a national, reactive, and large American DIB.

14 Hartley (1983, 1987).
15 Apart from the inclusion of Chinese firms and name change, the main firms in the top 100 published by SIPRI are remarkably constant. This situation indicates that barriers to entry are a key feature of the defense industry, especially on major defense platforms such as aircraft, ships, and armored vehicles.
16 Dunne (1995, Chap. 14, pp. 401-402).
17 Dunne (1995, Chap. 14).
18 Hérault (2020).
19 Ruttan (2006).
20 DeVore (2017).
21 Goya (2007).

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There is a strong desire for strategic autonomy[22], which can be linked to the objective of autonomy from the outside world, in particular the United States and certain European countries. This desire can also be linked to operational needs that require a full capacity for action (for example, aircraft capable of carrying a nuclear weapon or being the first to enter a theater of operations).

However, national preference comes at a high cost, especially in terms of economic costs—costs inherent to all stages of the product's life cycle with regard to Augustine's laws must be supported (although being closest to the technological frontier is a strong driver). In addition, monopolistic situations created by the specificities of the defense market generate an extra cost required for preserving domestic activities; this is the "'sovereignty price'; that is, the profit a State agrees to grant to its defence firms to perpetuate their domestic activities".[23] The price is not only monetary but also includes an opportunity cost—for example, in France, preserving industrial capabilities in combat aircraft has consequences for other aircraft (helicopters, transport aircraft, and UAVs), which are developed and produced in cooperation even though France has a long history of firms' presence in these markets.

Note that autarky is very theoretical and often idealized in a world where trade has become greater in value than GDP and where value chains are largely globalized.[24] Even if the platform is produced domestically, the systems, subsystems, and components can be supplied by foreign companies. Interdependencies do not only concern components and equipment but also services, including industrial production services, such as expertise, engineering, and so on. For example, the Gripen Swedish combat aircraft is nationally produced in Sweden but many subsystems are obtained from the United States. In naval systems, the F-100 frigate, S-80 submarine, and future F-110 are nationally produced by the Spanish firm Navantia, but the combat systems are provided by the American manufacturer Lockheed Martin. The dependence is sometimes nestled in the smallest details of processes or products. For instance, in 2022, Lockheed Martin had to stop deliveries of the F-35 after an alloy of cobalt and samarium from China was discovered in a magnet used in a pump of the aircraft. This illustrates that even when developing and producing an entire system nationally, countries are often dependent on inputs (raw materials, parts, or subsystems) that can only be obtained from a very limited number of countries, which are sometimes not allied.

One may note that focusing only on the main platform is problematic, considering the modularity of defense equipment. For instance, Moura shows that France is specialized in the production of final defense equipment, but it relies on imports of intermediate equipment.[25] For some countries, national preference is associated with the "niche production" of such intermediate defense equipment.

While aircraft tend to be increasingly developed and produced in cooperation (especially for the latest generation of aircraft[26]), land and naval platforms remain widely supplied by national firms in Europe. For instance, in the main battle tank (MBT) market, France, Germany, Italy, and the United Kingdom have their national programs.[27] The situation is similar in the medium and light armored vehicles market, with the experience of cooperation limited to intra-country collaborations. In the European naval industry, the main submarine programs (France, Germany[28], Spain, Sweden, and the United Kingdom) are national; the same applies for frigates, except for cooperation (limited to development) between France and Italy for the class "Bergamini-Aquitaine" FREMM multipurpose frigate. This situation has severe consequences for defense industrial fragmentation for both the naval and land-based military

22 Note that even though European treaties favor competitive bids for public tenders, the case of defense is specific as argued by the article 296 of Rome Treaty (consolidated version Consolidated version 2002). Hence, for strategic autonomy reasons, some countries prefer over-the-counter bids.
23 Laguerre (2009, p. 305).
24 Hérault (2021).
25 Moura (2021).
26 See Droff (2017) regarding helicopters and Droff, Malizard and Noel (2020) regarding combat aircraft.
27 France (Nexter), Germany (KMW), Italy (Fiat-Leonardo), and the United Kingdom (BAe systems).
28 German designed T212 submarines have been produced under license in Italy.

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industries.[29]

On the other hand, there is the option of not maintaining industrial skills. Vertical take-off and landing (VTOL) naval combat aviation in the United Kingdom reveals the decline in industrial capabilities (not military capabilities) of the country. The Sea Hawk Harrier was developed and produced nationally, followed by the Harrier II, which was produced in cooperation with the USA, and finally, the F-35B to equip the Queen Elizabeth class aircraft carriers. However, the country has succeeded in being a tier 1 partner in the F-35 project, which means that technological spinoffs and jobs are assured in the medium term, but this is at the expense of long-term sovereignty. This example illustrates the shift of the country on the curve in Figure 1 from left to right.

The collaborative program: Sharing costs along with sharing problems

Next is the collaborative option. Between the policies of the 1960s–1970s and the 2000s, "collaboration moves from being a form of back-up organization in case of economic difficulties to a normative form of development."[30] Collaboration is therefore a kind of "club" whose advantages are led by economies of scale.[31] First, cooperation enables the sharing of R&D effort, along with its associated risk. This incentive to share costs is all the stronger as the literature shows that the weight of R&D in defense equipment has become intrinsically important (defense equipment as "tournament good")[32]. Scale effects are also observed in terms of the infrastructure and work force required for production, and in terms of raw materials and intermediate products. On adding a temporal dimension, the increase in the quantity produced also favors learning effects. This can be amplified through specialization effects as each country should theoretically specialize in the stages of production where it is relatively the most productive and competitive. Cooperative programs allow for a form of standardization of equipment, which promotes interoperability and provides "military value added".

Given the trilemma discussed above, cooperation can be theoretically viewed as a means to manage the procurement cost, while maintaining some economic and technological spinoffs at the expense of limited loss of autonomy. In this regard, choosing (rather than undergoing) collaboration is a manageable way of controlling dependencies.

Among the disadvantages of cooperation, specification changes contribute to increased total development costs, longer development and manufacturing times, and an overall increase in the complexity of the industrial supply chain. In some extreme cases, specification discrepancies can lead to cooperation abandonment. Setting up programs and monitoring their progress increase the administrative procedures, which tend to increase the costs of program coordination (cooperation costs and control costs).[33] Second, states can use cooperative programs to meet their national industrial policy objectives—particularly by acquiring technological and industrial skills during the development phases that they do not master or master poorly. Specialization is observed, but it is inefficient because it is mainly viewed as having access to technology and specific skills rather than pooling it.[34] European armaments cooperation is structurally characterized by the rule of "juste retour", which aims at ensuring that each participant in a program must have an industrial benefit equal to its financial participation or initial orders in the program. Following this principle leads to the multiplication of production sites, thus limiting economies of scale and learning economies.

Several aircraft programs have been developed and produced in cooperation with European partners. Calcara discusses three recent programs: NH90 (helicopters), Eurofighter (combat aircraft), and A400M (transport aircraft)[35];

29 Naval military industry, Bellais (2017). Land-based military industry, Klecza, Buts and Jegers (2021).
30 Hébert and Hamiot (2004).
31 Hartley (2019).
32 Hove and Lillekvelland (2016).
33 Matthews and Al-Saadi (2021).
34 Hébert and Hamiot (2004).
35 Calcara (2020).

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each partner has different reasons for cooperation in line with the trilemma: Italy, and to a lesser extent, Germany, wants to maximize economic spinoffs; France favors projects with a higher level of autonomy, and the United Kingdom prefers "best value for money". In helicopters and combat aircraft programs, Italy views cooperation as a way of improving its industrial capabilities while acknowledging its inability to run a national program. On the contrary, the United Kingdom supports cooperation owing to its belief in savings in the total costs of the program while defense firms lobby for national production. France has accepted to cooperate in the NH90 program because both the firms and the government believe this would give them a high level of spinoffs after the British withdrawal from the program. The diversity in the point of view also reflects the "varieties of capitalism" as discussed by DeVore and Weis; France and Italy represent the statist approach with strong ties between industrial and governmental visions, while Germany and the United Kingdom symbolize the liberal approach with the government imposing its vision on the industry.[36] The lack of a common vision from an industrial viewpoint leads many countries to support the "juste retour" policy, despite this approach being highlighted as quite ineffective.[37]

It is of note, however, that "there is no evidence that efficiency as measured by development times is adversely affected by the number of partner nations".[38]

Licensed production: Accepting dependence with the hope of spinoffs

There are situations in which a country produces under-license systems designed by another country. Licensed production offers states defense equipment as well as an industrial package that includes production work and technological spinoffs. Contrary to collaborative programs, licensed production favors international collaboration via sharing production, but not design work, in a form of a co-production scheme. Generally, with licensed production (which are often American licenses), the foreign nation builds equipment only for its own orders[39].

Production capacity exists in the country hosting the licensed production, but this is characterized by a form of dominance by the country that designed the aircraft. In Europe, in the case of combat aircraft, the United States is usually the "dominant" partner, but some forms of collaboration very similar to Soviet-licensed production can be found in some countries, such as the Czech Republic.[40]

By acquiring this type of weapon system under-license, states see the opportunity to structure and develop their DIB. This is due to the upstream effects (R&D and suppliers) and the downstream effects (services, maintenance, updates, retrofits, etc.). An excellent example of such advancements in competence is provided by Italy with respect to the helicopter market. After World War II, the transfer of U.S. helicopter technology through licensing agreements (e.g., production of Agusta Bell helicopters in the 1970s and 1980s), progressively consolidated the Italian helicopter industry until the merger of Agusta (an Italian firm) and Westland Helicopters (a British firm) in 2001. This finally led to the creation of Leonardo Helicopters in 2016, a large company with major economic spinoffs for the country—capable of competing with Airbus in the European market and others in the United States and elsewhere.

Another relevant example includes the countries that benefited from the F-16 memorandum of understanding signed in 1975 between Belgium, the Netherlands, Denmark, Norway, and the United States. Following this "deal of the century" concluded by the United States, two assembly lines were settled in Europe (in Belgium and the Netherlands).[41] Owing to this contract, Belgium (which is not a major traditional supplier with regard to defense platforms) has developed an aeronautics industry practically from scratch. For SABCA, the oldest Belgian aerospace

36 DeVore and Weis (2014).
37 Hartley (2008).
38 Hartley and Braddon (2014).
39 Hartley (1983).
40 Pernica (2020) ; Ženka, Pernica and Kofron (2021).
41 Hartley (1983).

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group, the F-16 contract enabled it to acquire tools (stripping and painting booths, non-destructive testing, test benches, etc.) and to develop specific skills. Finally, the contract has enabled SABCA to enter the defense market with maintenance and production of spare parts for many combat aircraft (A-10, F-5, Mirage F1, and F16) and helicopters (Seakings). SABCA has also seen a gradual diversification into the civil and space markets.[42] Another Belgian company, SONACA, created in 1978 to contribute to the assembly of the aerostructure of the Belgian F-16, has become a competitive company in the civil sector with 25 factories worldwide; it has also become highly specialized in metal and composite aircraft parts.[43] Finally, owing to the industrial and technological "push" for the F-16 contract, Belgium has established strong aerospace connections beyond its borders (e.g., France and Germany).

Off-the-shelf procurement: Assumed dependence and the best value for money

At the other end of the spectrum is the purchase of "off-the-shelf" equipment on the world arms market; the cost is often lower, but this entails certain technological or even operational dependence on the supplier (for example, the United States). For countries with no DIB or a DIB specialized in "niche" markets, the choice of importing equipment through purchase at a lower price from a third country is the only relevant option. The military protection of the United States and the perspective of being part of a strategic alliance (e.g., NATO) provide strong incentives for countries to buy U.S. military equipment. From an economic perspective, the United States is a particularly well-positioned supplier of combat aircraft owing to its scale cost competitiveness. These scale and serial effects explain much of the United States' dominance in the arms export market.[44]

Given this option, a country can benefit from global competition, although not all markets in the field of defense are competitive in the true sense. For example, Laguerre suggests a division of the global fighter aircraft market into four categories: "captive" markets, which are nationally protected for many reasons, including operational ones and the support of a defense industrial base; "outlaw" markets, which are prohibited by international laws and sanctions; "dilemma" markets, where a producer is prevented from selling defense products to two potential export customers that are the parties to military, economic, or political tensions; and "open" markets which are competitive[45]. He concludes that "there are few open markets."

Apart from scale effects, one alternative reason to procure from abroad is the hierarchical effect, as stated by Vucetic and Tago[46]. They suggest that the more integrated a state is in the U.S. economy and security hierarchies, the more likely it is to purchase U.S.-made military equipment. The U.S. dominance in both security and trade is crucial for the combat aircraft market.[47]

Both scale and hierarchical effects are relevant for explaining foreign procurement in Europe. This is the case in the aircraft market, where the United States provides a large chunk of equipment, even for aircraft-producing countries (such as the United Kingdom, Germany, Italy, and France) because they fulfill demand in areas where European supply is non-existent. This is particularly the case with naval aviation in the United Kingdom (with VTOL capabilities of the F-35), heavy helicopters in Italy, Spain, and the United Kingdom (Chinook), and UAVs (France, Italy, Spain, and the United Kingdom). In line with management fleet issues already discussed, many European countries decide to procure a single type of defense equipment to streamline their fleet. This is particularly the case with off-the-shelf procurement. In the aircraft market, for example, Finland, Norway, Netherlands, and Denmark have a single supplier of combat aircraft (the United States) with fleet regeneration in the commissioning of F-35s in

42 As a supplier to Airbus and, for example, supplying parts of the Ariane rocket.
43 Guilhem (2018).
44 Tocoian (2015).
45 Laguerre (2009).
46 Vucetic and Tago (2015).
47 Hellemeier (2019) and Willardson and Johnson (2021) reach similar conclusions.

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the mid-2010s. In the MBT market, Germany has gained a comparative advantage (Leopard MBT, first and second generations), and it is the main supplier for many European countries, including neighbors with strong economic ties (Austria, Denmark, Netherlands, and Poland).

Leasing, new procurement for states, going downstream in the value chain for firms

Leasing defense equipment is an innovative and developing mode of procurement; however, it is not a very widespread practice in Europe. Leasing is developing with the evolution of business models of defense companies toward servitization.[48] This is a shift from product-oriented activities toward service-orientation. For example Babcock is a British manufacturer that now offers services in fleet management, maintenance, training, and simulation. However, more often it is a combination of complex products and services, such as the Rolls-Royce strategy in the United Kingdom.[49]

Leasing has several advantages. First, the price can be advantageous if resources are insufficient for the initial investment; such a strategy can be found in the combat aircraft market for countries with limited financial resources. For example, the Swedish Saab company leases the 14 JAS 29 Gripen to Hungary and the Czech Republic, with an all-inclusive service covering hardware modification and upgrade of systems, as well as several years of maintenance. In times of strong budgetary constraint, countries with relatively high defense budgets can also undertake leasing. For example, in the United Kingdom, Air Tanker is a consortium that provides the Royal Air Force with nine tanker aircraft. Examples of leasing are less numerous in other domains. Germany offered to lease submarines from its manufacturer TKMS to Poland, although the deal did not materialize.

Second, leasing offers flexibility; it provides fast access to ready-to-use equipment and crew training. Leasing is also available for equipment with short life spans, such as UAVs, which have a higher probability of being destroyed on the battlefield. In the mid-2000s, the United Kingdom leased a fleet of around 50 surveillance UAVs for military operations in Iraq. Drones are now frequently offered under leasing options proposed by defense manufacturers for a range of activities. Examples include the leasing of Heron UAVs by Greece for border surveillance missions and the Italian Leonardo's offers of leasing services with its Falco Xplorer UAV (a small MALE UAV).

The leasing option is also suitable for "in-between situations" that involve waiting for a delivery of a program. Recently, Bulgaria selected U.S. F-16 fighters to replace its aging Mig-29s, but it also considered a leasing option until the F-16s could be delivered. This solution was also proposed to France by the American firm General Atomics in 2020, with the possibility of leasing UAVs to fill the capability gap in terms of ISR solutions owing to the delay in the Eurodrone collaborative program (in the end, France chose to accelerate the program). In 2020, Germany operated six Heron 1s on a lease, waiting for their replacement by five Heron TPs. The French Navy currently leases H160 helicopters, which are the civil version of the future H160 military Guepard expected in the French armed forces in the 2030s.

Third, there is the so-called "test option". Leasing allows users to evaluate whether the equipment is suitable before buying (or further leasing). For example, Switzerland leased a C295 transport aircraft to test its capability and eventually to adjust its needs and switch to another aircraft. In the United Kingdom, the British coast guard leased Elbit Hermes 900s to test the contribution of UAVs to their missions. The French Navy leased a maritime patrol boat named Adroit (Gowind class) between 2012 and 2017; the vessel was finally sold to Argentina in 2018 with three other units planned for Argentina but none for France.

48 Vandermerwe and Rada (1988).
49 Smith (2013).

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Table 2: Summary of the main acquisition strategies

Acquisition strategy	*Strengths*	*Weaknesses*
1. National program	Strong strategic autonomy and large political freedom on the international scene. Large economic and technological spinoffs. Adaptability and reactivity of the industry to the armed forces' needs.	High R&D costs. Long-term planning issues and path dependency. Limited diversification of supply.
2. Collaborative program	Reduced unitary cost (compared to a domestic option).	Higher coordination and transaction costs. Important weight of constraints and political objectives (for example, the policy of juste retour).
3. Under-license production	Opportunity to acquire or maintain industrial skills and know-how.	Expected spinoffs depend on the absorptive capacity of the country (skills, training, and human capital). Costs of negotiation.
4. Off-the-shelves	Reduced unitary cost (compared to a domestic option).	Limited adaptability to the armed forces' needs. High dependence on foreign suppliers.
5. Leasing	Possible industrial and technological spinoff leading to the development of an indigenous industry.	Increased control of the manufacturer on the systems. Increased asymmetries of information.

Finally, leasing is an innovative market and a way of developing and diversifying the assets of firms, especially in services. In the Czech Republic, for the manufacturer Aero Vodochy, leasing is an option for maintaining aviation skills in a perhaps less technological but expensive market, such as aircraft pilot training or red teaming missions. The rising cost of operating modern combat aircraft is a major driver of this market based on the use of decommissioned aircraft and modern but lighter aircraft. For example, with their latest version of the L-159 T2X demonstrator, the firm offers a training aircraft for future pilots of fifth-generation aircraft such as the F-35. In 2022, Draken Europe signed a cooperation agreement with Aero Vodochody to use the L-159 as an aggressor in RAF fighter pilot training, including for the F-35 jet fighter. The European red teaming market is a growing and very competitive market, with about 10 European and four American companies (which constitute a large part of the market).

Table 2 summarizes the main strengths and weaknesses of each procurement option.

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Conclusion

Since the end of the Cold War, European countries have had to cope with many different constraints on their procurement processes. However, the way they deal with them depends on their preferences on sovereignty-related issues such as maintaining (or developing) industrial capabilities.

There is no "silver bullet" in terms of acquisition choice, and the returns on investment depend on countries' preferences, goals, and markets. A trilemma is inherent to any procurement decision process, and some trade-offs have to be considered. Only two of the three benefits can be obtained simultaneously: maximizing economic and technological spinoffs; minimizing procurement costs; and autonomy vis-à-vis foreign platforms. Among the arms-producing countries, the Cold War paradigm ensured autonomy and spinoffs, but budgetary constraints and Augustine's laws favor cooperation over minimizing costs. This situation may lead to tensions between partners as they often prefer national solutions. Among nonproducing countries, there exist "niche" defense industries supplying components or systems. Competition among suppliers leads them to authorize technology transfers and customer-local production, which, eventually, helps these European countries to develop their industrial capabilities.

The lack of coordination regarding defense procurement confirms the European state of "cacophony"[50]. This situation has severe consequences for the industrial fragmentation in Europe. Although defense firms in Europe are more productive than their American counterparts[51], they are less profitable and are relatively small with national bias preventing firms from reaching a critical size. MBDA is an interesting case of a successful European consolidation in the missiles market as a result of cooperative programs and exports[52].

The war in Ukraine constitutes another challenge for European procurement—the trilemma is modified such that acquisition costs are less critical in the decision-making process because the current strategic environment requires faster weapons procurement. It may be regarded as unfortunate that the latest decisions made by the European governments confirm reliance upon the United States (e.g., F-35 procurement and American anti-missile systems). Future research could look at the possibility of fostering cooperation to avoid the trilemma by focusing on comparative advantage rather than the *juste retour* policy.

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50 Meijer and Brooks (2021).
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