Lessons in Restructuring Defense Industry: The French Experience

INTRODUCTION

Throughout the post-war era, France has sought to remain a strong and independent military power. Beyond the defense of the homeland and overseas interests, French military forces serve a political role: to confirm France's international status as a major power, to preserve its independence in foreign and security policy, and to restore a sense of national pride after the bitter military defeats in World War II and Indochina and the loss of Algeria and the rest of the colonial empire. To these ends, successive French Governments have developed a small-scale version of a superpower arsenal with three distinct elements:

- an independent nuclear deterrent based on a "triad" of submarines, bombers, and ballistic missiles;[1]
- conventional land and air forces, manned largely with conscripts, for the defense of the French homeland and Central Europe; and
- a largely professional Rapid Action Force (established in 1983) and a blue-water Navy for intervention in overseas crises of limited scope and intensity, mainly in France's former African colonies, the Middle East, and the Persian Gulf.

The U.S. defense budget is about 10 times the size of the French allotment, and the two defense industries are structured very differently. Whereas the French defense industrial base consists mainly of sole-source contractors owned wholly or in part by the state, the U.S. base is dominated by competing firms in the private sector and enjoys a much larger domestic market. Nevertheless, the two defense industries share some basic characteristics that make the French case relevant to U.S. policy. Like the United States, France supports a large military establishment with overseas responsibilities; produces the full spectrum of major weapon systems, including fighter aircraft, main battle tanks, nuclear-powered submarines, aircraft carriers, and tactical and ballistic missiles; and invests heavily in military research and development, devoting more than a third of all government R&D spending to defense-related programs.

Over the past few years, France has also accumulated some useful experience in restructuring defense industry. The United States pursued a military buildup during much of the 1980s and has only recently begun to react to cuts in defense spending resulting from the end of the cold war. France, in contrast, has had to rationalize its defense industry since the late 1980s in response to economic constraints, including overcapacity in the broader European industry and slumping export sales. For this reason, France has implemented a number of strategies for restructuring its defense-industrial base while preserving core technological assets and strengthening its competitive position in world markets.

Although the French system of military procurement evolved in response to a different set of economic and political conditions than those in the United States, several aspects of France's experience with restructuring its defense industry are relevant to U.S. policymakers facing a similar challenge in the coming years. This paper assesses the pros and cons of the French procurement system and draws some practical lessons from the success or failure of various restructuring strategies.

Challenges to the Gaullist Paradigm

French autonomy in defense procurement dates back to the 17th century. During the period immediately following World War II, the United States supplied a large share of France's military equipment, but France returned to its historical tradition of defense-industrial autonomy after 1958, when Charles de Gaulle became President of the Fifth Repub-

[1] The French nuclear strike force *(force de frappe)* consists of 5 *Redoutable*-class nuclear-powered ballistic-missile submarines, which by 1993 will be equipped with a total of 80 M-4 missiles carrying up to 480 warheads; 18 *Mirage* IVP bombers carrying *Air-Sol Moyenne Portée* (ASMP) air-to-surface missiles; and 18 S-3D intermediate-range ballistic missiles equipped with single l-megaton warheads, deployed in fixed silos on the Albion Plateau in southeastern France. France also possesses a sizable arsenal of tactical ("prestrategic") nuclear weapons, including 45 *Mirage 2000N* and about *20 Super Etendard* aircraft *armed with the* ASMP missile. The current force of *Pluton* short-range ballistic missiles, with a range of 120 km, will be replaced with 40 *Hadès* missiles having a range of 480 km, but the new missiles will be stockpiled rather than deployed. Source: Diego A. Ruiz Palmer, *French Strategic Options in the 1990s*, *Adelphi Papers No. 260* (London: International Institute for Strategic Studies, Summer 1991), pp. *6-8.*

lie. De Gaulle's 1966 decision to withdraw France from the integrated military structure of the North Atlantic Treaty Organization (NATO) symbolized the national independence sought by fostering a defense industry capable of producing the full range of major weapon systems.[2]

Since then, two "Gaullist" principles have shaped the French approach to weapons acquisition: reliance on nuclear deterrence as the basis of French security, and the maintenance of a broad defense-industrial base to preserve France's freedom of action in foreign and security policy. The priority given to nuclear deterrence has resulted in the investment of about 30 percent of the French defense budget for the acquisition, operation, and maintenance of nuclear weapons and delivery systems. At the same time, the pursuit of national autonomy has led to procurement of the lion's share of weapons from French sources (sometimes in collaboration with other countries), even when technically superior or less expensive alternatives were available from abroad. In order to reduce the unit costs of French weapon systems to acceptable levels, the defense industry relies on export sales, which make it possible to amortize the costs of research and development (R&D) and industrial overhead through longer production runs.

Since 1989, however, the traditional Gaullist policies of nuclear deterrence and autonomy in defense procurement have been called into question by a nexus of economic and political factors, including growing financial constraints, the process of European economic integration, and three major geopolitical changes that have transformed the global security environment.

The first of these major changes was the dissolution of the Warsaw Pact and the disappearance of the Soviet military threat to Western Europe. With the end of the cold war, the French defense industry faces significant cuts in defense spending and shrinking export markets. Over the next few years,

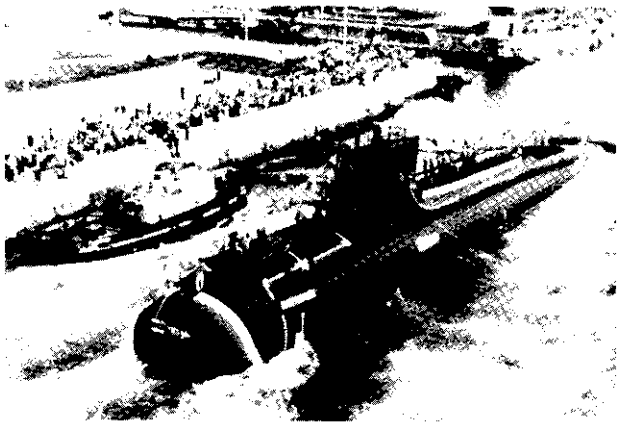


Photo credit: DGA/COMM

An Amethyste-class nuclear-powered attack submarine is comissioned at Cherbourg Naval Shipyard.

spending levels will remain fairly steady because several major weapon systems are still in the acquisition pipeline, including the *Leclerc* main battle tank, the *Rafale* fighter, the *Charles de Gaulle* aircraft carrier, the *Amethyste-class* nuclear-powered attack submarine, the *Triumphant-class* ballistic-missile submarine, and the France-German *Tiger* antitank helicopter. Nevertheless, the French armed forces will be reduced in size by about 20 percent by 1997, with a parallel drawdown in major weapon systems.[3] The French Air Force, for example, plans to cut its fleet of combat aircraft by more than 10 percent over the next 5 years, from 450 to about 390 aircraft.[4]

The 1992 French defense budget totals 195.5 billion francs ($37.7 billion) excluding pensions, a nominal increase of 0.5 percent over the previous year but a net decline of 2.3 percent after inflation. Although 1992 procurement spending will remain unchanged at the 1991 level of F103.1 billion ($19.9 billion), this figure represents a shortfall of F8.4 billion ($1.6 billion) from the last 5-year planning target approved by the French Parliament in 1990.[5] The downward trend in French defense spending becomes more apparent when viewed as a percent-

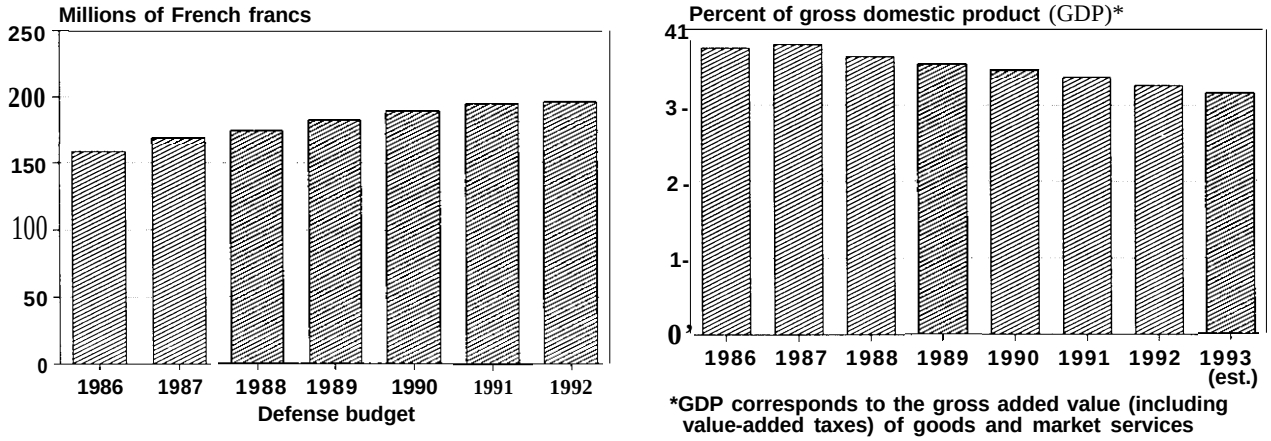
2 Despite France's withdrawal from the integrated military command, it has remained a member of NATO and continues to participate actively in alliance political forums such as the North Atlantic Council and the Senior Political Committee. Although France is not a member of the Conference of National Armaments Directors (CNAD), which coordinates NATO collaborative arms development and production programs, it does belong to the Independent European Programme Group (IEPG) including all NATO allies except Iceland, Canada, and the United States. The IEPG was established in 1976 for the specific purpose of bringing France into European collaborative armaments programs.

3 "French Army to be Split," *London Financial Times,* Nov. 15, 1991, p. 2.

4 Giovanni de Briganti, "French Cutbacks Will Squeeze Tiger, NH-90 Copter Projects," *Defense News, vol. 7, No. 8,* Feb. 24, 1992, p. 54.

5 Giovanni de Briganti, "French Opposition Rails Against Defense Policy," *Defense News,* vol. *6, No. 47, Nov. 25,* 1991, p. 8. All franc-to-dollar conversions are based on an exchange rate of F5.1834 to the U.S. dollar, the rate in effect on Jan. 6, 1992.

Figure l—French Defense Budget Trends



SOURCE: French Ministry of Defense

age of the gross domestic product (GDP). (See figure 1.) Between 1981 and 1992, the French defense budget declined from 4.2 percent to 3.26 percent of GDP, and Defense Ministry sources suggest that the budget will fall to 3.15 percent of GDP after 1993.[6] To support the modernization of its nuclear deterrent within a restricted budget, France will have to limit its investment in conventional forces, causing many weapons programs to be stretched out and delayed. For example, the anticipated cuts in defense spending will cause initial production deliveries of the France-German *Tiger* antitank helicopter to be delayed by 2 years, until 1999.[7]

The second geopolitical change was the unification of Germany in October 1990. Although France and Germany have been close allies since the 1960s, France seeks to anchor an increasingly powerful and assertive Germany within multilateral European economic, political, and military structures so as to preclude a resurgence of the rivalry that proved so disastrous to French security in the past. The ongoing process of France-German security cooperation is likely to include a deliberate effort to integrate the two countries' defense industries, with the political aim of strengthening bilateral military ties at the core of an increasingly unified European Community. This trend was reflected in the joint proposal in October 1991 by French President Francois Mitterand and German Chancellor Helmut Kohl for the creation of a European army corps built on the basis of an existing France-German brigade.[8]

The third geopolitical change was the Persian Gulf War, which increased the salience of "out-of-area' threats to French security. After the loss of the colonial empire, the clear priority of French defense planning shifted to deterring aggression by the Soviet bloc, and Paris never envisioned the large-scale use of conventional forces outside Central Europe.[9] Instead, French expeditionary forces were designed for rapid, small-scale interventions in Africa, the Middle East, and other trouble-spots. As a result, France was not prepared for a contingency like the Gulf War, which required the deployment of heavy conventional forces over long distances against a well-equipped adversary, and where nuclear deterrence was not politically credible. In the coming years, France must decide if it can afford both a sophisticated nuclear deterrent and large

6 Giovanni de Briganti, "Top French Officials Debate Changes in Military," *Defense* News, vol. 6, No. 36, Sept. 9, 1991, p. 42. For purposes of comparison, the U.S. defense budget peaked at 6.5 percent of GDP in 1985, fell to 5.5 percent in 1992, and is expected to drop to about 3.4 percent by 1997.

7 De Briganti, op. cit., footnote 4.

8 Jacques Amalric and Jean-Pierre Langellier, "MM. Mitterrand et Kohl proposent de renforcer les responsabilités européennes en matière de défense," *Le Monde*, Oct. 17, 1991, p. 1.

9 According to David S. Yost, the anticipated uses of French conventional forces within Europe are to demonstrate Political solidarity with allies, perform a crisis-management function, test the intentions of the adversary, and conduct a national deterrent maneuver to force the adversary to reassess his objectives. See David S. Yost, *France's Deterrent Posture and Security in Europe: Part Z: Capabilities and Doctrine, Adelphi Papers, No. 194* (London: International Institute for Strategic Studies, Winter 1984/5).

conventional forces capable of carrying out major interventions overseas.

France played a relatively minor supporting role in Operation Desert Storm for a number of reasons, both political and technical.[10] Constraints included France's lack of investment in conventional military readiness and its heavy reliance on conscripts, which created political inhibitions on their deployment outside Europe.[11] Earlier French arms sales to Iraq further complicated the situation. During the air campaign, for example, top-of-the-line French *Mirage* fighters deployed to Saudi Arabia were not used in combat because of concern that they might be confused with Iraqi *Mirages* and shot down by coalition forces.

The Gulf War also revealed deficiencies in French weapons and power-projection capabilities. France's small fleet of transport aircraft was not sufficient to sustain an operation requiring heavy logistical support, and the French Air Force's obsolescent *Jaguar* attack aircraft were not equipped with night avionics or advanced radar systems and thus could not fly sorties at night or in bad weather. In addition, French forces suffered from a shortage of stockpiled munitions, such as laser-guided bombs. Although the French Army's 6th armored ("Daguet") division successfully carried out a flanking and screening maneuver during the ground campaign to liberate Kuwait, its relatively light equipment made it incapable of conducting a frontal assault against Iraqi armored units. Finally, the decision to defer replacement of the French Navy's aging carrier-based aircraft until the next-generation *Rafale* fighter becomes available meant that France's two aircraft carriers lacked an effective self-protection capability. As a result, the carriers were either kept in port or served as cargo ships for delivering trucks and helicopters to the theater of operations.

In sum, a nexus of economic, political, and technological factors will necessitate a major restructuring of the French defense-industrial base if France is to bridge the growing gap between the prominent role it aspires to play in world affairs and its limited economic resources.

INDUSTRIAL STRUCTURE

While competition exists at the level of subcontractors and suppliers, the French domestic market for military airframes, aero-engines, and armored vehicles is not large enough to support more than one prime contractor in each of these sectors. As a result, the French Government has promoted the consolidation of those portions of the defense base considered vital both to national security and the country's overall economic growth. Since military aerospace and defense electronics are closely linked to "strategic' civil industries (aeronautics, space satellites, telecommunications, computers, and electronics), many defense prime contractors and their associated civil-sector industries have been combined into large conglomerates known as "national champions.

The national champions dominate the domestic defense business in their sectors, and each is the sole depository of design and systems-integration know-how for an entire category of defense equipment.[12] Examples include Dassault Aviation for fighter aircraft, Aerospatiale for helicopters and ballistic missiles, GIAT Industries for main battle tanks and artillery, Matra for air-to-air missiles, and the National Company for the Design and Construction of Aircraft Engines (SNECMA) for military aero-engines. (See table 1.) At the same time, the French Government believes that vertical integration of defense industries is not desirable and has sought to maintain a diverse vendor base of competing subcontractors and suppliers, many of them small and midsized fins.

Nearly four-fifths of the French defense industry is owned directly or indirectly by the state, either in the form of government-owned and operated arsenals, nationalized companies (e.g., Aerospatiale,

10 The United Kingdom, with an army two-thirds the size of France's, deployed to the Persian Gulf an expeditionary corps of 35,000 troops, compared with the 11,000 troops in the French Daguet division. Moreover, French Defense Minister Jean-Pierre Chevènement did not want to put French forces under U.S. operational control and thus deployed them at Al Asha-far from the U.S. and British forces stationed at Dhahran—so that they could undertake operations in an autonomous fashion Chevènement resigned on Jan. 29, 1991, soon after the start of the coalition's major air offensive. He was replaced by Pierre Joxe, who agreed to put French forces under U.S. command during the ground campaign to liberate Kuwait.

11 In the aftermath of the Gulf War, France has taken steps to reorganize more of its conventional forces into all-professional units suitable for use in military operations outside Europe.

12 U.S. Congress, Office of Technology Assessment *Global Arms Trade*, OTA-ISC-460 (Washington DC: U.S. Government Printing Office, June 1991), pp. 72-73.

Table I—Major French Defense Contractors

Sector/company	Types of production	Examples of products
Aerospace		
Aerospatiale	Ballistic missiles	S-3, S-4 ICBMs M-4, M-45, M-5 SLBMs
	Prestrategic missiles	Pluton, Hades, ASMP
	Tactical missiles	Antitank (HOT, Milan) Ground-air (Roland, Aster) Air-ground (AS-1 5, AS-30, Exocet, ANS)
	Helicopters	Gazelle, Dauphin, Lynx, Super Puma, Tiger, NH-90
	Transport aircraft	Transall, Epsilon
Dassault Aviation	Fighter aircraft	Mirage F1, Jaguar, Mirage 2000, Rafale
	Trainers	Alpha Jet
	Maritime patrol planes	Atlantic 2
SNECMA(National Company for the Design and Construction of Aircraft Engines)	Aero-engines	ATAR, M53, M88, Tyne
Matra	Airdelivered missiles	Air-air Magic, Super 530, MICA
	Tactical missiles	Ground-air Crotale, Mistral
	Military satellites	Syracuse, Helios
SEP(European Propulsion Company)	Solid-fuel propulsion	Solid fuel for ballistic and tactical missiles
Turbomeca	Aircraft and helicopter engines	Arriel, Makila, RTM 322, MTM 390
Naval construction		
DGA/Directorate of Naval Construction	Submarines, warships	Ballistic missile submarines, attack submarines, nuclear aircraft carriers, frigates
Chantiers del'Atlantique (GEC-Alsthom)	Frigates, corvettes, support ships	Test and measurement ships, patrol frigates
Constructions Mecaniques de Normandie	Ships of less than 1,500 metric tons	Rapid patrol boats
Societe Francaise reconstructions Navales	Ships of less than 1,000 metric tons	Various ships
Land armaments		
GIAT Industries	Armored vehicles, tanks, artillery, munitions	AMX-10, AMX-30, Leclerc, 155mm AUF1
Renault Industrial Vehicles	Armored vehicles, tactical vehicles	Armored reconnaissance vehicles
Thomson-Brandt Armaments	Mortars, munitions, air-delivered bombs	BAP-1OO bomb
Creusot-Loire Industries	Armored vehicles	AMX-13
Panhard et Levassor	Armored vehicles, tactical vehicles	Light Armored Vehicle (VBL), Light Auto-Machinegun (AML), P4 tactical vehicle
Defense electronics		
Thomson-CSF	Command-control systems, antiair weapon systems, radars, sonars, optoelectronics, simulation, telecommunications, electronic warfare, components	
SFIM(Company for the Fabrication of Measuring instruments)	Stabilized sighting systems	
Dassault Electronique	Radars, seekers, calculators, counter-measures	
SAGEM (Company for General Applications of Electricity and Mechanics)	Navigation systems, fire-control systems, optoelectronics	
Societe Anonyme deTelecommunications (SAT)	Radio communications, optoelectronics	
Sextant Avionique	Avionics, navigation systems, fire-control, automatic testing	
Alcatel Thomson-Faisceaux Herziens	Microwave links, satellite communication earth stations	
Alcatel Espace	Satellite communication systems	
Unilaser	Lasers	
Sogitec	Simulators	
Other		
SNPE(National Companyfor Powder and Explosives)	Solid fuel, powder and explosives	
Constructions Industrielles de la Mediterranee (Calm)	Combat engineering equipment, welded assemblies	
Messier-Bugatti	Landing gears	
Hispano-Suiza	Aeronautical equipment	
Auxilec	Motors and electric generators	
SAFT(Company for Fixed Accumulators and Traction)	Batteries, power supplies	
Intertechnique	Fuel systems, air conditioning, oxygen	
Labinal	Cable, connectors, motors	
Sochata-SNECMA	Engine repair	
Sopelem	Optics, night-vision systems	
Sogerma-Socea	Various aeronautic equipment, aircraft maintenance	
Souriau et Cie	Connectors	

SOURCE: DGA/COMM, *L'Industrie Française* de *Défense*, June 1990, pp. 20-21.

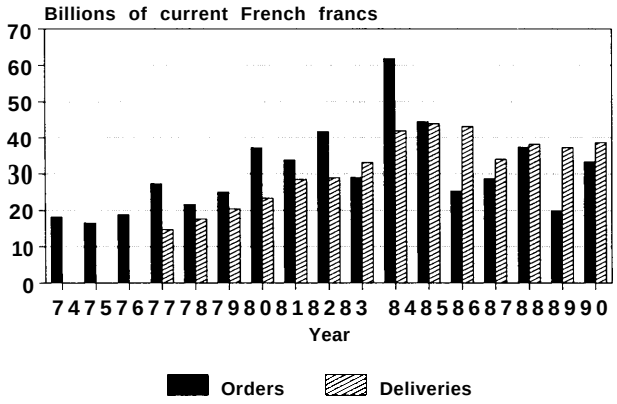
GIAT Industries, and SNECMA[13]), or firms in which the government owns a large share of the stock (e.g., Dassault Aviation, Matra, and Thomson-Brandt Armaments) .14 The nationalized French defense firms do not face the same pressures as private firms to provide a short-term return on investment and can also obtain loans and government subsidies that private firms would not receive. In recent years, however, the downturn in defense spending has caused the nationalized companies to have relatively little capital compared to private firms.

Since 1981, when Francois Mitterrand became President, the French Government has only partially nationalized the private defense sector so as to give these firms continued access to capital markets. Thus, although the government holds 59 percent of the stock of the defense-electronics firm Thomson-CSF and 49 percent of the stock of Dassault Aviation, both companies are still listed on the Paris stock exchange. At the same time, ownership of a large share of the stock gives the government considerable influence over the semiprivate defense fins. In the case of Dassault, the state is a minority stockholder but controls more than 50 percent of the voting rights by virtue of some double-vote shares. The government has yet to exercise its majority voting power, but Dassault management must take this possibility into account.

Export Dependence

The small size of the French domestic arms market means that the defense industry relies heavily on export sales to permit the economic procurement of weapons for France's own use by amortizing research and development (R&D) and overhead costs over longer production runs. Because of the spiraling cost of defense R&D, the export dependence of the French industry has grown rapidly: exports accounted for 18 percent of defense production in 1970, rose to 42 percent in 1985, and stabilized at about 33 percent in 1988.[15] Some

Figure 2—French Arms Exports, 1974-90



SOURCE: DGA

defense-industrial sectors are heavily dependent on exports: Aerospatiale sells 90 percent of its helicopters and Dassault 60 percent of its combat aircraft to other countries. Because of this structural dependence on foreign sales, the French Government takes export potential into consideration when launching a new development program, and the timing of French military procurements is often tailored to meet the needs of overseas customers.[16]

Despite such efforts, however, French arms exports have declined sharply in recent years, particularly since the end of the Iran-Iraq war in 1988. (See figure 2.) From a highpoint of F61.8 billion ($11.9 billion) in 1984, orders fell to F25.3 billion ($4.8 billion) in 1986 and F20 billion ($3.9 billion) in 1989. Although the industry recovered some lost ground in 1990 with orders of F33.4 billion ($6.4 billion), they declined again in 1991. For Dassault Aviation, for example, 1991 sales dropped 16 percent and new orders by 25 percent from their 1990 levels.[17] (See figure 3.) Aerospatiale's new orders in 1991 also plunged 50 percent from the year before.[18] SNECMA is facing an all-time low in

13 In the case of SNECMA, the French state owns 97.11 percent of shares, United Technologies Corp. 1.73 percent, and others 1.16 percent. Source: SNECMA, *Annual Report 1990,* p. 25.

14 Andre Collet, *Les Industries d'Armement* (Paris: Presses Universities de France, 1988), p. 30.

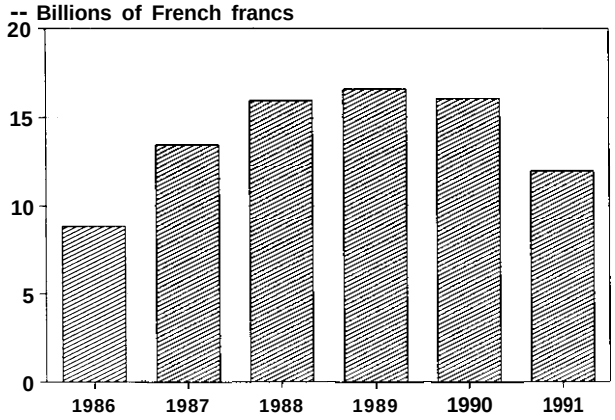
15 U.S. Congress, Office of Technology Assessment, op. cit., footnote 12, p. 40. See also, DGA/COMM, *L'Industrie Française de Défense* (Paris: DGA, June 1990), p. 12.

16 Of course, nuclear-weapons programs are completely independent of the export perspective.

17 Gionvanni de Briganti; "Dassault, BAe Expect Contracts on Anglo-French Fighter," *Defense News,* vol. 7, No. 8, Feb. 24, 1992, p. 20.

18 "Aerospatiale in the Black," *Jane's Defence Weekly,* vol. 17, No. 14, Apr. 4, 1992, p. 555.

Figure 3-Dassault Aviation Annual Orders, 1986-91



SOURCE: Dassault Aviation

orders of military aero-engines, and Matra's sales of tactical missiles have declined because missile exports are linked to purchases of military aircraft. Moreover, France will probably have to write off more than F7 billion ($1.4 billion) in unpaid arms sales to Iraq. According to one analysis, "With inflation factored in, France's arms industry has been losing ground year after year."[19] A forecast of aerospace sales by the Group of French Aerospace Industries (GIFAS), an industry association, predicts a decline in defense business until after 1995, when some weak growth is expected because of the need to replace current-generation equipment.[20]

French arms exports have been adversely affected by a number of factors, including falling oil prices, growing competition from traditional suppliers (the United States and Britain), the emergence of new competitors (Israel, Brazil, and China), and the dumping of used East European weapons on the world market. The effectiveness of U.S. armaments combat-tested in the Gulf War may also reduce the competitiveness of French products. Finally, the leading Western supplier nations may agree to limit arms transfers to the Mideast, historically France's largest export market. Indeed, the French role in providing 20 percent of Iraq's major weapon systems between 1980 and 1989 has provoked at least a temporary reassessment of the wisdom of large-scale arms transfers to areas of conflict.

The decline in French arms exports has affected the defense-industrial base both directly, by reducing levels of production, and indirectly, by undermining the funding mechanism for defense R&D. Although the government pays for most defense-related research, industry must cover a significant share of the costs of weapon-system development out of profits from foreign sales. During the negotiation of an R&D contract, the government and the company make an initial assessment of the system's export potential and determine on this basis a formula for an equitable sharing of R&D costs. Thus, the greater a system's predicted export sales, the larger the share of development costs that must be borne by industry. This cost-sharing formula may be renegotiated later if the export prospects of the system improve or worsen significantly. On average, government funding for weapon-development programs covers only about 40 to 60 percent of industry needs--compared to about 80 percent in the United States. The precise funding split can vary considerably, however, depending on the industrial sector, the firm, and the system being developed. (Funding splits for Thomson-CSF and SNECMA are shown in figure 4.)

The requirement that defense contractors internally finance a significant share of their development costs has given rise to a number of problems. First, joint funding has created strong pressures for arms exports, leading to some questionable sales. Second, company financing of R&D has enabled the French Government to launch more weapons-development programs than it can afford to carry through to completion, resulting in costly stretch-outs and delays. (This problem has also been common in the United States.) Third, the recent decline in arms sales has reduced the pool of money available for company-funded R&D.

As long as arms-export markets were strong, the structural problems associated with corporate funding of development out of profits from foreign sales were not apparent. Dassault's export profits, for example, enabled the company to finance 50 percent of its R&D costs and gave it the flexibility to pursue independent programs like the *Mirage 2000-5*, which was developed strictly for export without

19+ 'No Long-Term Optimism for Arms Sales,' FBIS translation of article by L. Main *Libération*, Paris, Dec. 26, 1990, p. 5 (FBIS-WEU-91-013, Jan. 18, 1991, pp. 33-34).

20 "French Aerospace Firms Report Orders Down in 1990, But Deliveries Increased," *Aviation Week & Space Technology*, vol. 135, No. 13, Sept. 30, 1991, p. 25.

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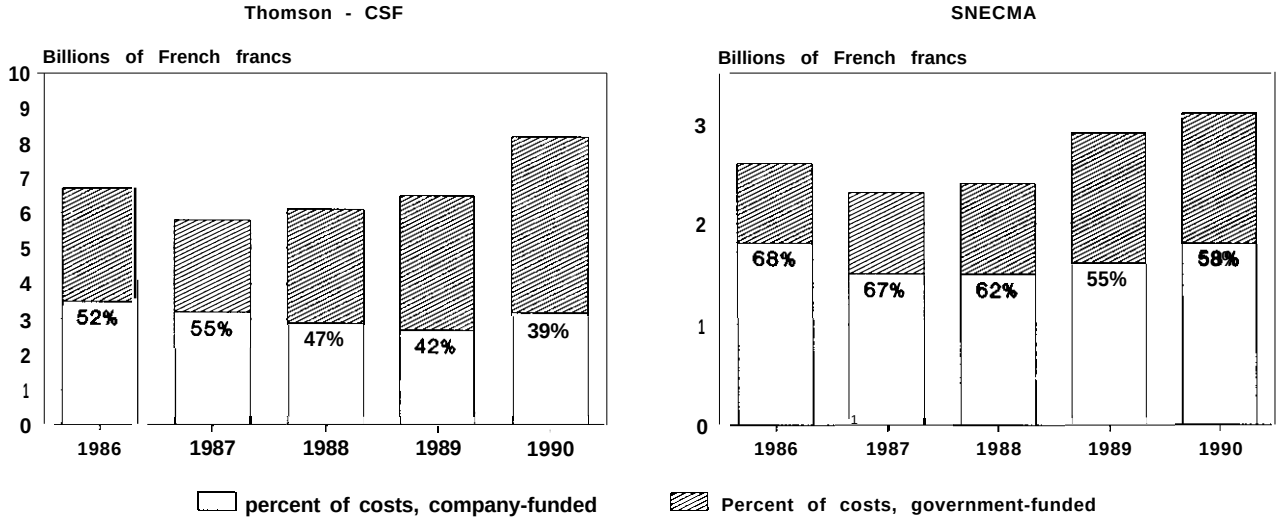
Figure 4-Funding of Defense Research and Development



SOURCE: Thomson-CSF, *1990 Annual Report*, p. 4; SNECMA, *Annual Report* 1990, p. 3.

state assistance. (Ironically, Dassault was unable to sell this aircraft because foreign customers were reluctant to buy a system that the French Air Force did not plan to procure.) As export sales decline and firms are less able to finance their development work internally, the French Government will either have to assume a greater share of the burden or engage in more collaborative development programs with foreign partners.

MANAGEMENT OF THE BASE

The French Government, as favored customer and owner of a large portion of the defense-industrial base, has two partially competing objectives: maintaining a broad defense-industrial base capable of furnishing the full range of equipment required by the armed forces (even when superior or less expensive weapons are available from foreign sources); and procuring military systems at an affordable cost. Because of the central importance of the arms industry to the country's independent defense posture and technology policy, France places considerable emphasis on identifying and preserving key design and manufacturing skills in the major defense fins. The results of this comprehensive planning, programming, and budgeting effort are embodied in the 5-year military programming law (which sets financial targets for defense procurement) and the annual defense budgets.

The French Government takes a broad view of national defense as covering military forces, civil defense, and their economic and industrial underpinnings, and integrates defense-industrial policy with other industrial, economic, and social policies. Thus, while the Ministry of Defense has the lead in defense-industrial policymaking, several nondefense agencies also play important roles. At the highest level, there is a division of responsibility between the French President and Prime Minister. The President is supreme commander of the armed forces and in charge of formulating national security policy, whereas the Prime Minister coordinates the more routine aspects of defense planning, including industrial mobilization, wartime rationing, and civil defense. Reporting to the Prime Minister is the General Secretariat of National Defense (SGDN), an advisory body analogous to the U.S. National Security Council staff, whose activities include geopolitical analysis, export controls on arms and dual-use technologies, and nonproliferation policy. The Ministry of Economics, Finance, and the Budget exerts a significant influence over the extent and content of French defense spending; the Ministry of Industry and Foreign Trade is responsible for the supply and rationing of industrial raw materials in wartime; and the Ministry of Transportation controls the air and sea transport fleets. Oversight functions are performed by the Cour des Comptes, an investigative agency similar to the U.S. General

Accounting Office, which audits the accounts of the nationalized firms and ensures that defense funds are spent within the guidelines of the law.

The French weapons-acquisition system reflects France's "statist" political system, with a strong executive and a relatively weak legislative branch. In contrast to the U.S. political system, which is based on the principle of checks and balances among competing power centers, the French parliamentary system involves a greater fusion of the legislature and the executive. Thus, while each chamber of the French Parliament (National Assembly and Senate) has a Committee on National Defense and Armed Forces, these bodies exert much less oversight of defense and procurement policy than the Armed Services Committees of the U.S. Congress.[21] The French Parliament votes the annual defense budget and a 5-year military programmingg law providing financial targets for future procurement, but these bills are largely spending envelopes and permit little if any legislative control over individual weapons programs.

The General Delegation for Armaments

De Gaulle's political goal of achieving national autonomy in the full range of armaments—particularly nuclear weapons—in the face of tight budgetary constraints required the careful husbanding and allocation of resources. To this end, in 1961 de Gaulle replaced the weapons directorates reporting to the individual armed services with a centralized procurement agency known as the General Delegation for Armaments *(Delegation Generale pour l'Armement,* or DGA).[22] This organization includes all of the services and organizations within the Ministry of Defense responsible for the research, development, and production of defense equipment. The DGA is the linchpin of the French arms-procurement system, mediating among the political authorities, the defense industry, and the military operators. After the Parliament votes the defense procurement budget, the DGA allocates funds among specific weapons programs. Because of this power of allocation, DGA can ensure multiyear funding of high-priority systems even within a shrinking defense budget.

The director of the DGA reports directly to the Minister of Defense and "has greater control over research, engineering, and industrial matters than any other European-or American-defense official. ' '[23] He oversees a staff of about 54,000 people, including career military or civil servants in scientific, technical, and management positions, and several thousand workers in the government-run arsenals, depots, and factories. Thanks to an elaborate system of recruitment and training, the senior management positions in the DGA attract some of the best and brightest French students of engineering and administration, who become specialists in developing sophisticated armaments and selling them abroad. At the top of the hierarchy is an elite corps of about 1,000 "armament engineers,' 80 percent of them graduates of the prestigious Ecole Polytechnique in Paris and 20 percent recruited internally. Increasingly, armament engineers also occupy the top executive positions in the nationalized and semiprivate sectors of the defense industry.

According to political scientist Edward A. Kolodziej, the DGA's primary mission is "the preservation and promotion of an ever-modernizing arms industry within an internationally competitive French industrial system."[24] The major tasks of the DGA are

- to manage the definition, development, and production of military equipment for the French armed forces and for export;
- to certify that technical performance and costs are acceptable;
- to supervise the government-run arsenals and guide the nationalized and semiprivate defense firms;
- to ensure the long-term health of the French defense industry; and

21 See David S. Yost, "French Defense Budgeting: Executive Dominance and Resource Constraints," *Orbis,* vol. 23, fall 1979, pp. 579-608.

22 Another important motive for de Gaulle's decision to shift authority over arms procurement from the individual armed services to a centralized agency reporting directly to the French President was to help gain control over the rebellious officer corps, which had brought down the Fourth Republic in protest over the loss of Algeria and threatened to destabilize the Fifth Republic as well. See Edward A Kolodziej, *Making and Marketing Arms: The French Experience and Its Implications for the International System* (Princeton, NJ: Princeton University Press, 1987), p. 243.

23 U.S. Congress, Office of Technology Assessment, *Holding th Edge: Maintaining the Defense Technology Base,* OTA-ISC-420 (Washington, DC: U.S. Government Printing Office, Apr. 1989), p. 101.

24 Kolodziej, op. cit., footnote 22, p. 258.

- to adapt the defense industry to France overall industrial needs.[25]

Since France relies primarily on single-source national champions for most of its major weapon systems, the DGA must impose administrative controls on price and quality, while simultaneously cooperating with industry to maintain profits, employment, and investment in new technologies so that France will remain internationally competitive. In order to preserve the competencies of the defense industry, DGA officials often balance long-term industrial considerations, such as the need to preserve design teams or to keep production lines open, against the operational requirements of the French military. The DGA's industrial-policy goals must, of course, be harmonized with the interests of the Ministries of Defense, Foreign Affairs, and Economics and Finance. When interagency conflicts arise, they are decided at the political level.

The DGA is divided into functional and technical units. (See figure 5.) Reporting to the director are two policymaking bureaus. The Delegation for Armament Programs (DPA) draws up plans for weapons development and procurement over the annual and 5-year budget cycles, while the Delegation for International Relations (DRI) negotiates foreign arms sales and collaborative agreements with other countries for the joint development and production of military equipment. In order to facilitate arms sales, the DRI arranges attactive credit and finance terms for foreign arms buyers, guarantees loans, and provides insurance for companies and banks against the special risks of the arms trade.

The DGA's program-management functions are the responsibility of five functional directorates and services (for defense research, personnel, industrial affairs, cost accounting, and quality control) and five technical directorates (for ground armaments, naval construction, aeronautics, missiles and space, and electronics and computing). The technical directorates function in different ways depending on the defense-industrial sector. Whereas the Directorate of Naval Construction directs a complex of government-owned shipyards that produce, maintain, and overhaul most of the French Navy's warships and submarines, the Directorate of Aeronautics negotiates contracts with private and nationalized companies.

The technical directorates also coordinate with the French armed services to define R&D and production programs and priorities. Committees made up of service representatives and DGA officials identify operational military requirements and transform them into technical specifications. Although both sides strive to reach consensus, the DGA has the final say in the launching of a development program. As a result, DGA officials may choose to balance short-term military needs against technical feasibility, export potential, and industrial-base considerations.

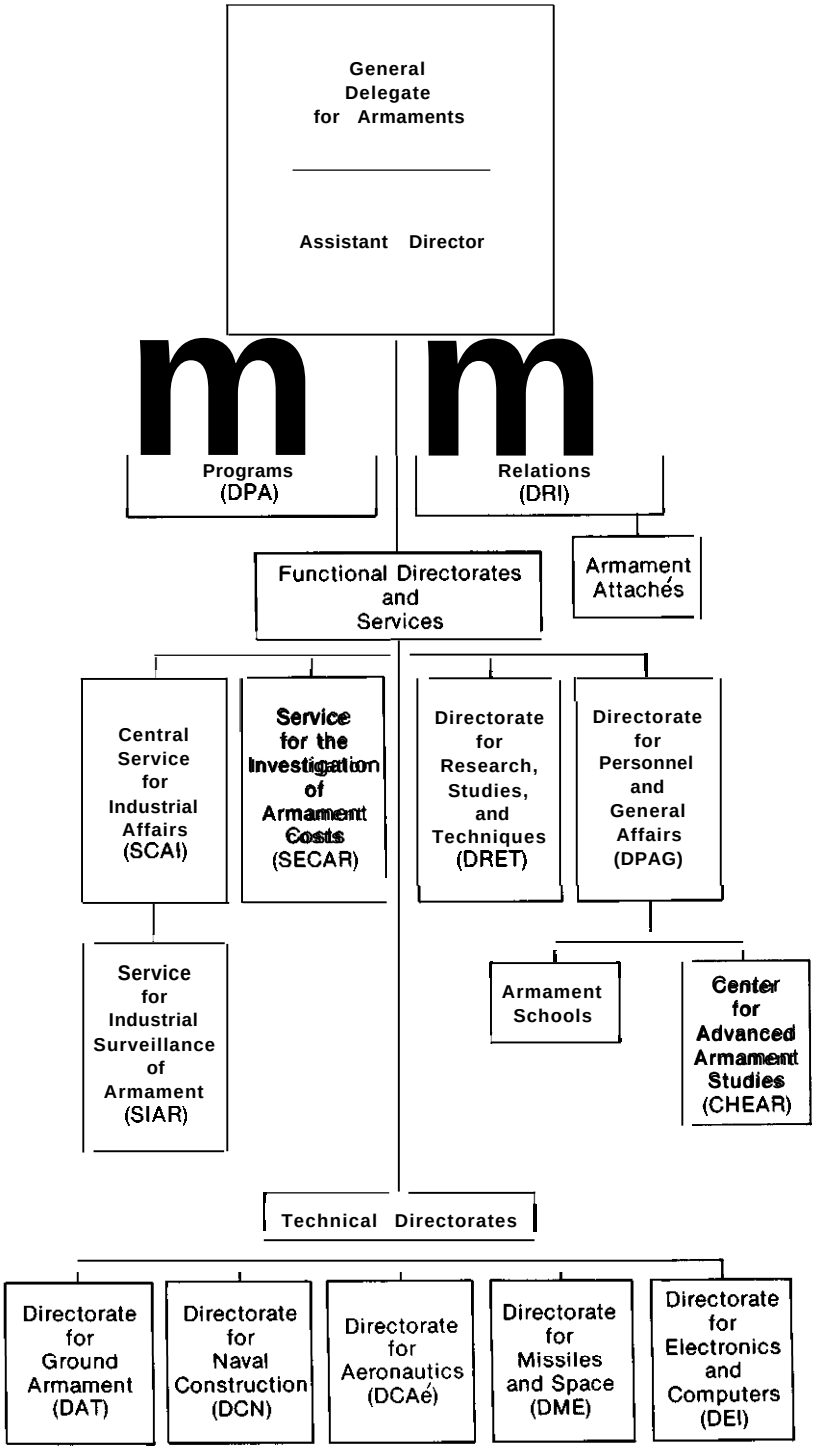
Defense Research

France spends about F30 billion ($5.8 billion) on defense research and development, or more than a third of the government's entire R&D budget. Although civil and defense R&D are budgeted and administered separately, defense R&D is expected to benefit the overall economy. Some F8 billion ($1.54 billion) of the defense R&D budget is allocated to "research,' of which 20 percent goes to nuclear-weapons work under the auspices of the French Atomic Energy Commission and the rest is divided up among other areas. In addition to contracted R&D, the French Government draws on independent research conducted by defense companies. A portion of these R&D expenses are reimbursed as overhead costs on defense contracts, in a manner similar to the U.S. Independent Research and Development (IR&D) program. The reimbursement rate varies from 2 to 6 percent of contract cost, depending on the industrial sector and other criteria.

In May 1977, DGA reorganized its organization for defense research by creating a new Directorate for Research, Studies, and Techniques (DRET). This organization is analogous to the U.S. Defense Advanced Research Projects Agency (DARPA), although it lacks the latter's flexibility and responsiveness. With a staff of about 2,000, DRET coordinates all defense-related research in the public and private sectors, including work on "dual-use" technologies with both military and civil applications. Each year DRET directly funds about 200 medium- and long-term research programs at two government-supervised laboratories: the Institut de

[25] U.S. Congress, Office of Technology Assessment, *Holding the Edge: Volume 2: Appendices* (Washington, DC: U.S. Government Printing Office, 1989), p. 139.

Figure 5-Organization of the DGA



SOURCE: DGA/COMM

Saint Louis (ISL), a France-German center for ballistics and explosives research, and the National Office for Aerospace Studies and Research (ONERA). DRET also awards contracts to industrial labs and to universities, which conduct 10 to 15 percent of French defense research. Since university personnel are paid by the Ministry of Education, DRET can leverage its assets by financing only those additional facilities required for defense research.

In addition to its funding role, DRET is responsible for monitoring defense-related developments in science and technology both within and outside France, and bringing them to the attention of the technical directorates. DRET also defines the nation's defense research priorities on an annual basis. This task is carried out by 30 internal working groups staffed by armed-service representatives and DGA engineers. The working groups are organized according to scientific field (e.g., materials, electronic components, aeronautical systems) and operational area (e.g., air defense, artillery). Eight "synthetic" working groups then assess research priorities for each armed service and allocate finding shares. (DRET attempted to develop a "Critical Technologies List" but abandoned the effort as inconclusive.)

French defense-research priorities are shifting in response to the emerging international security environment. The Gulf War demonstrated the fundamental importance of command, control, and communication technologies; of surveillance from space and on the battlefield; of stealthy weapon systems; and of long-range, precision-guided weapons like the U.S. *Tomahawk* cruise missile. In response to these lessons, DRET is intensifying its research effort in electronics, sensors, space systems, and advanced munitions, while reducing its emphasis on the fining platforms themselves. Funding for military space programs rose by more than 17 percent in the 1992 defense budget. Current plans call for developing a series of military reconnaissance satellites that will be equipped with optical cameras, equipment for intercepting signals and communications, and synthetic-aperture radar for 24-hour, all-weather imaging.[26]

Controls on Price and Quality

Two functional services within DGA are responsible for oversight and control of the defense industry. The Service for Industrial Surveillance of Armament (SIAR) certifies the technical quality of tested French weapons and foreign equipment purchased for the French forces, while the Service for the Investigation of Armament Costs (SECAR) performs cost audits of all major procurement programs. DGA officials contend that because the state is the single dominant customer for defense products, administrative controls on quality and costs are more effective than relying on market mechanisms such as competition. According to this view, competing prime contractors tend to make unrealistically low bids, resulting in cost overruns that must be absorbed by the government. In contrast, if single-source firms are assured of a regular flow of business, they can engage in longer-term planning that reduces overhead costs.

The DGA has used fixed-price contracts successfully by working closely with industry to ensure an equitable sharing of costs based on a system's technical specifications and export potential. Contracts are renegotiated if export prospects change or performance specifications become more demanding. DGA officials also contend that the international competition for export markets creates incentives for quality and price discipline, although they admit that arms sales are greatly influenced by political and strategic considerations. In recent years, however, the costs of some major weapons programs (such as the *Leclerc* tank and the *Charles de Gaulle* aircraft carrier) have spiraled-in some cases 40 percent over initial estimates-raising questions about the effectiveness of administrative controls and the lack of domestic competition at the prime-contractor level.

Control of Arms Exports

French arms-export policy has been formulated since 1955 by an interdepartmental coordinating body called the Interministerial Commission for the Study and Export of War Materials (CIEEMG), chaired by the General Secretariat for National Defense. Made up of representatives from the Ministries of Defense, Foreign Affairs, Economics and Finance, and Industry and Foreign Trade, this group is responsible for advising the Prime Minister on proposed arms sales and for recommending changes in overall arms-export policy. In evaluating proposed sales, the CIEEMG considers both defense-

[26] Giovanni de Briganti and Peter B. de Selding, "France To Widen Space Efforts," *Defense News, vol. 7, No. 5,* Feb. 3, 1992, pp. 4,37.

industrial needs and the political and strategic status of the requesting country. For example, the transfer of French arms to Iraq during the Iran-Iraq War was authorized by the highest political levels for strategic reasons, with industrial considerations playing a secondary role. Even so, the CIEEMG is strongly influenced by the DGA's Directorate of International Relations, which prepares all of the files for commission review and tends to be a proponent rather than an arbiter of arms sales within the French Government.[27]

Defense Industrial Policy

The functional directorate of the DGA responsible for defense industrial policy and planning is the Central Service for Industrial Affairs (SCAI). It monitors the activities and financial health of defense fins, maintains a centralized database containing this information, and prepares analyses of actions aimed at improving the competitiveness and profitability of the French defense industry. SCAI also sets out guidelines for defense contracts and industrial practices and suggests ways to enhance the contribution of the defense industry to France's economic development and the competitiveness of its civil industries.[28]

In contrast to the technical directorates, SCAI has a broad vision of France's defense-industrial needs that focuses on industrial development and the expansion of defense trade over the immediate requirements of the armed services. This emphasis on the long-term health of the French defense industry sometimes conflicts with the DGA's other roles as producer, controller, and customer of military equipment. For example, in order to preserve sufficient industrial capacity to meet national procurement objectives, SCAI might advise the Directorate for Aeronautics to award a development contract on a competitive basis but give the losing bidder a share of the production work to keep both firms in business, even if this approach increases overall procurement costs. Similarly, SCAI might recommend keeping an assembly line open by stretching out the procurement of a current item until the next system enters production.[29]

Administrative Guidance

State directives assign the DGA responsibility for administrative guidance *(tutelle)* of the defense industry. DGA officials seek a balance between giving the industry the freedom to compete in international markets and preserving a national defense-industrial base that responds to French military and social needs. One type of administrative guidance involves the direct management of government-owned and operated arsenals, such as the naval shipyards run by the Directorate for Naval Construction. A second type of guidance derives from the power of the French state as the primary customer of the defense industry and a major shareholder of the nationalized and semiprivate defense companies. The chairmen of the nationalized defense firms are named by the President on the recommendation of the Prime Minister and the Ministers of Defense, Finance, and Industry, and government representatives sit on the companies' boards of directors. While DGA officials do not intervene in day-to-day company operations, they must concur in major strategic decisions such as large investments, new ventures, or international collaborative programs.

When conflicts of interest between government and industry arise, they are worked out in secret, far from the public spotlight. The DGA's influence over the defense industry is offset to some extent by the fact that the national-champion firms enjoy a functional monopoly in their respective industrial sectors. For example, since Dassault Aviation possesses the only design team in France capable of developing combat aircraft, the government must keep it supplied with contracts to preserve its unique skills. In recent years, however, DGA officials have promoted international collaborative programs as a strategy for countering the monopolistic practices of national-champion fins.

Industrial Mobilization

France no longer plans to complement peacetime defense production with reserve industrial capacity that could mobilize in crisis and war. Since the French defense base is increasingly integrated into the broader civil economy, competitive pressures to

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27 Kolodziej, op. cit., footnote 22, p. 266.

28 Ibid, p. 259.

29 Ferdinand Varenne, "Un Complexe Militaro-Industriel Français?" Jean-Christophe Victor (cd.), *ARMES: France 3ème Grand: Nos Strategies, Chercheurs, Fabricants et Vendeurs* (Paris: Autrement Revue, No. 73, Oct. 1985), p. 92.

reduce overhead costs militate against maintaining surplus capacity for wartime mobilization. As a result, surge production of defense equipment in crisis or war would be limited to battlefield consumables such as conventional munitions, food, uniforms, and selected spare parts. France also plans to rely on its European allies to supplement domestic production.

In the belief that the conventional phase of any war in Europe would be short, France has stockpiled relatively small quantities of munitions. Moreover, the armed services typically protect high-priority weapons programs from budget cuts by paring back spending on military readiness. The 1991 munitions budget, for example, was down 28 percent from the year before and contained no money to purchase antirunway bombs, cluster bombs, or laser-guided bombs. As a result, France had to purchase laser-guided bombs and antitank missiles from Germany during the Gulf War; without this external source, there would have been only enough stockpiled munitions for a week of combat.[30] Of course, greater reliance on allies assumes the compatibility of foreign munitions with French weapons, creating a strong incentive for collaborative development.

Pros and Cons of the French Procurement System

France's centralized, professional procurement system offers four main advantages. First, senior DGA officials enjoy high prestige and morale and manifest a strong sense of responsibility to the state. Moreover, whereas military officers move frequently from one position to another, DGA officials remain with major weapons programs for several years, providing managerial expertise and institutional memory. Second, there is a more cooperative relationship between the French Government and the defense industry, in contrast to the largely adversarial relationship in the United States. One reason for the greater apparent harmony in the French case is that in an industry consisting largely of monopoly suppliers and a single buyer, there is little incentive for either party to criticize the system openly.

A third advantage of the French system is that centralization has enabled the French state to engage in multiservice procurements and to consolidate R&D programs to avoid redundancy. In some cases, it has been possible to develop a single weapon system for all three armed services, such as the *Mistral* air-defense system, or a basic airframe that is then modified for Air Force and Navy missions, such as *the Rafale* fighter. More frequently, the DGA funds joint programs to develop technologies of use to all three services, including missile guidance, command-and-control systems, and logistics management; these technologies are then incorporated into service-specific weapon systems.

A final advantage of the French system is that the DGA has pursued a coherent strategy for managing the defense industry. DGA officials seek to balance a variety of objectives, including force requirements, the health of both the defense base and the larger civilian industrial base, and political goals such as France-German cooperation. Because of the need for tradeoffs among these objectives, the French procurement system is not designed to optimize individual weapon systems but rather to further the nation's military, industrial, and political interests.

The frost two benefits of the French system—the high prestige of government service and cooperative government-industry relations—are characteristic of most European countries and Japan, whereas the second two benefits—multiservice procurement programs and a coherent defense-industrial strategy—are unique to France. Despite these advantages, however, the French procurement system suffers from a number of problems. The DGA's mission of preserving an autonomous defense-industrial base has sometimes been achieved by procuring national systems that cost more, perform less well, or take longer to procure than foreign-sourced weapons. France's heavy reliance on exports also tends to overshadow domestic procurement needs; in some cases, foreign contracts for French weapons have received higher priority than national orders.

Thus, while French procurement policy is generally coherent and well-managed, some critics question its overall effectiveness. In particular, the critics argue that the political insulation of the French procurement system has resulted in a defense-industrial base that is too broad to be competitive, either economically or militarily. This overextension is suggested by the undercapitalization of the nationalized defense companies. Furthermore,

[30] Pierre Lellouche, "L'Ecole de Guerre," *Le Point*, MaK. 4, 1991, pp. 35-37.

France's extensive reliance on national champions promotes efficiency but lacks the benefits of competition in promoting innovation and reducing costs. The existence of only one prime contractor in several key sectors also makes the system as a whole prone to a certain brittleness. If a monopoly producer like Dassault Aviation or SNECMA were to go out of business, France would lose a vital piece of its defense-industrial base.

Over the past decade, the French armed services have become increasingly vocal in questioning DGA's continued emphasis on domestic production of the full range of weapon systems, which has led in some cases to serious delays and cost overruns. A well-publicized example was the decision to protect the national program to develop the *Rafale* fighter aircraft despite soaring development costs[31], diplomatic pressures on France to participate in the five-country European Fighter Aircraft program, and the French Navy's preference for purchasing the U.S. F/A-18 *Hornet* to replace its obsolescent *Crusader* carrier-based fighter aircraft. A key motivation behind the decision to forge ahead with the *Rafale program was* to maintain the design teams at Dassault and SNECMA. French journalist Jean Guisnel has described the "collusion" among industry executives seeking to preserve their exclusive know-how, Air Force officers reluctant to compromise their performance specifications, and DGA officials determined to exercise their power and authority .32 Because of the decision to proceed with the *Rafale* program, the French Navy will have to keep its aging *Crusader* fighters in service until around the year **2000,** when the naval version of the *Rafale is* scheduled to replace them. The negative consequences of this decision for the military effectiveness of the French Navy during the Gulf War have already been mentioned.

A final drawback of the French procurement system is its lack of accountability to the Parliament and the public. Hidden behind a veil of secrecy, DGA technocrats make procurement decisions in a top-down manner, and the lack of effective legislative oversight mechanisms enables the DGA and the defense industry to shield themselves from objective criticism. The absence of oversight in this closed, inbred system introduces a higher potential for abuse or error. In addition, a dense network of informalities between the DGA and the defense industry results in a lack of bureaucratic checks and balances. Although France has conflict-of-interest statutes forbidding ''revolving-door' moves between government and industry (known as *pantouflage in* French), these laws have never been enforced. As a result, senior DGA officials have moved to high-level jobs with the major defense firms. (Mobility in the reverse direction also occurs to a lesser extent.) Since many top procurement and industry officials went to the same schools and know one another socially, this old-boys' network gives the arms complex powerful political influence within the French Government and helps insulate it from parliamentary and public scrutiny. According to Kolodziej, the lack of external controls on the French military-industrial complex "hinders attempts to evaluate independently the economic and military performance of the arms industry or to propose feasible and practical alternatives to the heavy reliance on foreign arms exports in maintaining economic productivity and in supporting French technological development and competitiveness. "[33]

Photo credit: DGA/COMM

A test pilot flies a prototype of the *Rafale* fighter, designed and built by Dassault Aviation.

STRATEGIES FOR INDUSTRIAL RESTRUCTURING

Over the near-term, the major armaments programs launched during the 1980s will slow the rate

31 Research and development of the *Rafale* through the demonstration and validation phase has cost approximately F35 billion ($6.75 billion).

32 Jean Guisnel, *Les Généraux: Enquête sur le Pouvoir Militaire en France (Paris:* Editions La Decouverte, 1990), pp. 207-230.

33 Kolodziej, op. cit., footnote 22, p. 298.

of decline in French defense budgets. Even so, the defense-industrial base has already begun to shrink in response to the combined effects of reduced spending, increased competition for export markets, and the growing number of collaborative programs, which require the sharing of development and production work with other countries. Diminished procurement will force a major restructuring of the French defense-industrial base, with far-reaching consequences for employment and regional planning.

In 1989, the French defense industry directly employed about 261,000 people (including about 75,000 engineers), or about 5.4 percent of the country's industrial workforce. Taking account of all the raw materials and components required for arms production, more than 400,000 French workers were employed directly or indirectly by the defense industry .34 As a result of lower export sales and planned cuts in defense spending, many of these jobs may be at risk. A wave of aerospace layoffs in December 1991 was just the beginning; according to unofficial government estimates, defense-industrial restructuring could ultimately result in the elimination of between 10,000 and 100,000 jobs. The French Government and the defense industry therefore face a major challenge in managing the economic and social consequences of cuts in defense spending.

Because of the strength of French labor unions, industrial restructuring is more difficult in France than in the United States. Not only is it costly for French firms to fire workers, but large-scale layoffs can trigger strikes. Thus, while U.S. firms can adjust employment levels on a short-term basis, French defense firms must engage in long-term social planning. Another problem is that, for historical reasons, French defense industries and arsenals are concentrated far from the border with Germany in less developed regions of central and southwestern France, which are heavily dependent on defense production. (See figure 6.) As a result, closing down defense plants may result in severe unemployment in areas that are already economically depressed. In order to develop an economic conversion plan to mitigate the social consequences of downsizing the defense industry, French Defense Minister Pierre Joxe established a "Restructuring Committee" within the Defense Ministry on August 30, 1991.[35]

At the same time, the DGA is pursuing a restructuring strategy that aims to consolidate the defense industry but retain its strengths. The goal is to reduce overcapacity while maintaining sufficient activity in key defense-industrial sectors to exceed the threshold of economic production. According to a parliamentary report, the government's strategy is focused along two axes. The first axis seeks to preserve a broad range of technological competencies in individual firms, while the second axis aims to give the French defense industry a leading role in the restructuring of defense production on a European scale.[36] Although the DGA provides overall guidelines for industrial restructuring and intervenes to ensure the overall coherence of the transition process, it is up to the companies themselves to take initiatives for adapting to the new environment (except in the special case of state-run arsenals). The major restructuring strategies are summarized in the following sections.

Commercializing the Arsenals

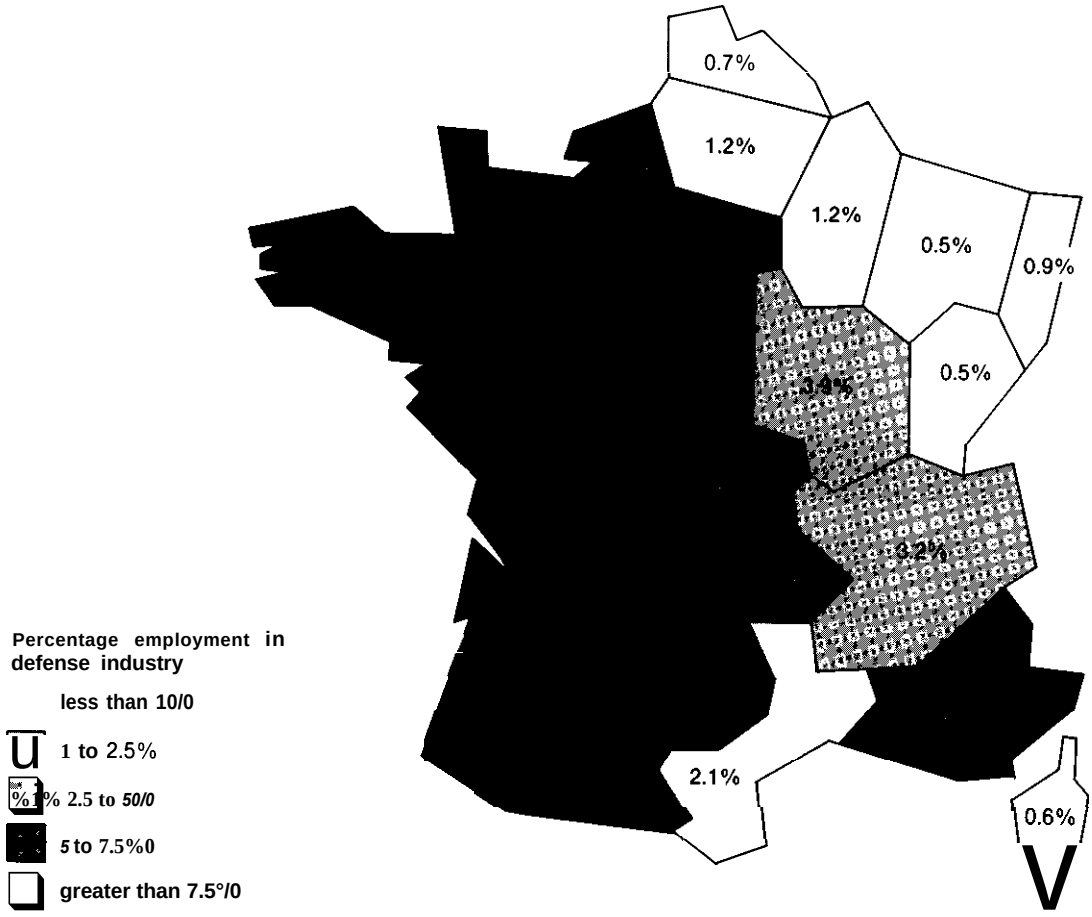
While the aerospace and defense-electronics sectors in France consist of a mixture of private, semiprivate, and nationalized firms, the French Government has traditionally owned and operated arsenals for land armaments and naval vessels. In recent years, however, the government has moved to commercialize these operations, freeing them from legal constraints and burdensome regulations that have prevented the most economic use of equipment and labor. Under French law, government-owned and operated arsenals are not allowed to work for commercial advantage and lack flexibility in accounting practices, inventory control, and investment. They cannot produce goods in anticipation of foreign sales, use export-derived "profits" to finance the development of new products, or keep production lines open between government orders in anticipation of foreign sales. Moreover, each production facility must be managed independently,

34 Délégation Générale pour l'Armement, *L'Industrie Française de Défense* (Paris: DGA/COMM, June 1990), P. 12.

35 De Briganti, op. cit., footnote 6.

36 Jean-Michel Boucheron, *Rapport fait au nom de la Commission de la Défense Nationale et des Forces Armées (1) sur le projet de loi de programmation (no. 733) relatif à l'équipment militaire pour les années 1990-1993,* Assemblée Nationale, Première session ordinaire de 1989-1990, No. *879,* Oct. 2, 1989, p. 683.

Figure 6-Geographical Distribution of Defense-Industry Employment, 1988



SOURCE: DGA/COMM

without an overall corporate strategy. Because of these bureaucratic and commercial inefficiencies, the arsenals have been unable to compete effectively in export markets.

In July 1990, the Army arsenal, or Industrial Group of Land Armaments (GIAT), was converted through legislation into a nationalized company called GIAT Industries.[37] Although the French Government still owns nearly all the firm's capital and retains considerable influence, GIAT has gained financial autonomy, access to capital markets, and decision-making authority. The new company has set up a personnel department and sales office, negotiated collaborative agreements with a network of international partners (including the British firm Vickers and the German firm Rheinmetall), and diversified its industrial activities into new fields, such as aircraft cannon pods and subcontracts for the production of aircraft parts. Nevertheless, the fact that the more than 11,000 GIAT workers retain their privileged job status within the civil-service system still limits the fro's flexibility.

GIAT Industries' largest weapons program is the new *Leclerc main* battle tank, whose prospects are uncertain. When the program was launched in 1978, the French Army planned to purchase 1,400 *Leclerc* tanks to replace its existing fleet of obsolescent AMX-30s on a one-for-one basis. Because of cost overruns and troop cuts, however, the Army now plans to procure only 800 *Leclerc* tanks, and budget

[37] Pierre-Etienne Ranche, "S'armer pour le futur," *Info-DGA*, No. 38, Sept. 1991, p. 23.

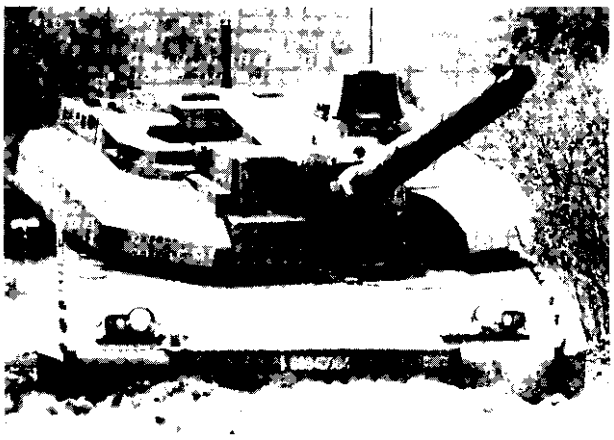


Photo credit: GIAT Industries

The new *Leclerc* main battle tank is produced by GIAT Industries, formerly a government-operated arsenal and now a nationalized company.

cuts are likely to reduce the production rate from 100 per year to less than 40.[38] As a result, the unit cost of the *Leclerc* is expected to reach about F37 million, or more than $7 million-compared to about $3 million for the U.S. M-1 *Abrams* tank. Despite this high price, GIAT Industries still hopes to obtain major orders for the *Leclerc* from Saudi Arabia, the United Arab Emirates, Sweden, and Qatar.[39]

The last remaining French arsenals are the flight-test centers and aeronautical depots operated by the Directorate for Aeronautics, which test, repair, and maintain military aircraft and aero-engines and manufacture spare parts; and the shipyards run by the Directorate of Naval Construction (DCN), which produce all of France's major warships and submarines. In October 1990, DCN established a private subsidiary called DCN International to manage its international marketing and collaborative activities. Even so, full commercialization and rationalization of the naval shipyards will take several years because the DCN's 26,800 employees enjoy lifetime job security under a special statute. Although many of these workers could be paid a bonus to take early retirement or accept a new job status, the cost of the transition would be high.

In addition to commercializing the arsenals, there has been some talk of privatizing the nationalized defense firms. In September 1991, French President Mitterrand approved a partial privatization (up to 49 percent) of the entire nationalized sector, including banks and insurance companies as well as defense contractors. Nevertheless, even partial privatization of the nationalized defense firms faces a number of obstacles. First, it will be necessary to find buyers who are prepared to pay a good price for the shares, despite uncertainties over future government contracts and export sales. Second, since the French Government is bound to remain heavily involved in defense-industrial policy, people may be cautious about buying shares in a state-controlled firm whose priorities and goals may differ from those of the private investor. Because of these difficulties, privatization of the nationalized defense companies remains unlikely.

Preserving Core Competencies

Given the changes in the international security environment and the downward trends in defense spending and export sales, France is gradually moving away from its traditional Gaullist emphasis on national autonomy in arms production. The DGA has concluded that France no longer has the financial means to maintain an independent capability across the full spectrum of weapon systems and must increasingly rationalize defense production on a European scale, while concentrating on its competitive strengths. In an effort to reduce overcapacity and eliminate redundancies, the French Government has urged defense companies to pare back their product lines, collaborate with other European firms that have complementary technological assets, and focus on "poles of excellence' where France enjoys a technical or market advantage, such as fighters, helicopters, defense electronics, and tactical missiles.[40] Other priority areas include those high technologies having both military and civil applications (e.g., optoelectronics, satellites, telecommunications) and sectors considered vital for preserving the independence of the French nuclear deterrent (e.g., nuclear weapons and strategic delivery systems).

Although the DGA is determined to maintain the technological potential of the defense industry to develop the next generation of advanced weapons, it is up to the individual firms to identify their "core

38 Christopher F. Foss, "Leclerc's Future Crucial to GIAT," *Jane's Defence Weekly,* vol. 16, No. 12, Sept. 12, 1991, p. 499.
39 J.A.C. Lewis, "GIAT Urges Army to Speed Leclerc," *Jane's Defence Weekly,* vol. 16, No. 24, Dec. 14, 1991, p. 1141.
40 Palmer, op. cit., footnote 1, p. 42.

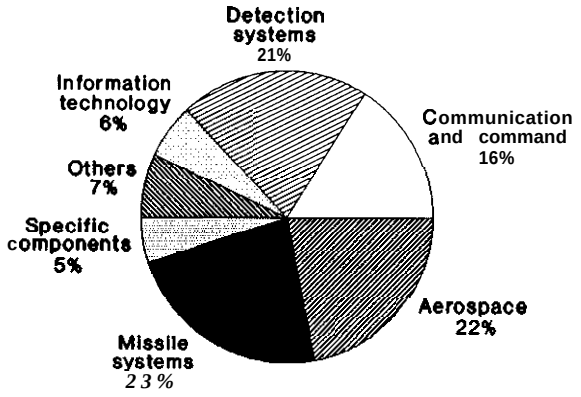
competencies." DGA officials will then help preserve them by selectively awarding procurement and R&D contracts. Dassault Aviation, for example, has established an internal working group to identify the technologies it must keep in-house for the design and assembly of high-performance combat aircraft, while subcontracting out less critical subsystems and manufacturing activities. Dassault's identified core competencies include new materials, stealth, computer-aided design and manufacturing, advanced fabrication technologies (such as superplastic forming and diffusion bonding), and robotics. For Chantiers de l'Atlantique, a shipyard that does both civil and naval work, the firm's core competencies lie in the design of architectural interfaces between a ship and its communications and weapon systems, while taking account of such factors as electromagnetic interference, shock, and noise. Thus, while subcontracting the development of command-control systems, data links, and armaments, Chantiers will focus on integrating these systems with the vessel's superstructure.

Thomson-CSF has chosen several fields in which to focus its efforts, including electronic warfare, flight simulators, sonars, radars, and naval combat systems. For each of these areas, the company has identified technologies, techniques, and manufacturing know-how that give it a competitive edge in current and future markets, so that these core competencies can be preserved and further strengthened. Like Dassault, Thomson-CSF plans to spinoff nonessential activities to subcontractors with whom it will establish long-term partnerships. The company has also streamlined its R&D capabilities by merging design teams in different divisions that do similar work. For example, two divisions at Thomson-CSF were engaged in developing X-band radars: low-power radars for combat aircraft and high-power radars for air-traffic control. Since these systems involve similar technologies and approaches, the merger of the two design teams has enabled the company to reduce the total number of engineers working in this area and to bring some formerly subcontracted work in-house.

Diversification Into Civil Sector

The DGA has encouraged French prime contractors-and their less visible network of thousands of subcontractors and suppliers-to limit their dependence on defense work and expand their market share in commerical areas. In the current environment, those contractors whose economic survival depends on a narrow range of military products will be exposed to sharp fluctuations in procurement, putting them at risk of going out of business. The more a firm is diversified into the civil sector, the better it can survive slowdowns in military or commercial sales-assuming, of course, that both markets do not decline simultaneously. Another factor is that many young French engineers are reluctant to work in the defense industry, either because the commercial sector appears more dynamic or because involvement with specialized defense technologies and military secrecy might prevent them from moving to civil industry later in their careers. Given these concerns, greater diversification of defense firms into the civil sector should make it easier to attract qualified engineers.

Figure 7—Thomson-CSF Revenue by Business Group, 1990



SOURCE: Thomson-CSF

French defense companies differ in their extent of diversification. Thomson-CSF obtains 79 percent of its revenue from defense activities and 21 percent from civilian ones. (See figure 7.) In the 1960s, Matra's business was 100 percent defense, with a strong concentration on tactical missiles. Over the next decade, the firm expanded into watchmaking, automobiles and transport, telecommunications, and space. Although watchmaking proved a failure, Matra was more successful in the space and transport markets, including the production of subway cars and a small family van called the Renault *Espace.* By 1979 Matra had a 50:50 civil-military split, and by 1990 the proportions had shifted to 76 percent civil and 24 percent defense. Today, Matra's business activities are led by automobiles and transport (34

percent of sales), followed by missiles (24 percent), telecommunications and software (24 percent), and space (18 percent). The company's long-term goal is to divide its business equally among the three sectors of defense/aerospace, transport, and telecommunications. Since Matra's corporate identity is closely linked to missiles, however, the firm plans to remain active in the defense sector.

Constructions Industrielles de la Mediterranee (CNIM), a midsize company with about 1,000 employees, is currently divided equally between military and civil work. Its defense products include bridging equipment and floating bridges for the French Army, and submarine missile tubes and launching equipment for the Navy; its commercial products are cogeneration boilers and other environmental systems. Although CNIM's military sales have not yet begun to drop, company executives see defense cutbacks on the horizon and are gradually reorienting the firm toward the civil sector.

The French aerospace industry is already fairly well diversified, falling well below the 60 to 80 percent reliance on defense work characteristic of U.S. prime contractors. In 1991, commercial business accounted for 52 percent of total industry sales, exceeding military business for the first time.[41] Aerospatiale's aircraft division is 100 percent civil, the helicopter division is evenly split between civil and military, the space and ballistics division is 80 percent military, and the tactical missile division is 100 percent military. SNECMA did 75 percent of its business in civil aero-engines in 1991 and is considering a new diversification into industrial turbines. While the volume of military-engine sales has remained roughly constant since 1986, it has fallen sharply as a percentage of total sales. In fact, SNECMA president Louis Gallois wants to increase the company's work on military engines from the current 25 percent of sales to between 30 and 35 percent to attract more government R&D funding and help the company ride out fluctuations in the civil aero-engine market.[42]

Dassault Aviation is also reducing its dependence on defense work from the current level of 72 percent of sales to a target of about 55 percent, while increasing its involvement in civil aeronautics. The military side of the house continues to develop the *Rafale* fighter, which is not scheduled to enter full production for the French Air Force and Navy until the end of the decade. Meanwhile, business aviation has become a major pillar of Dassault's corporate strategy. The company's *Falcon* business jets now account for 25 percent of total sales, and the new twin-jet *Falcon 2000* (developed in collaboration with Alenia of Italy) is expected to increase the firm's civil-aviation activities to 35 percent of sales. In the civil space field, Dassault is participating (together with Aerospatiale) in the European *Hermes* space-shuttle program. Over the next several years, the company plans to increase its space activities from the current 5 percent to 10 percent of sales. Dassault's Systems Division has also developed an extremely successful computer-aided design system called CATIA, which has been widely sold to aerospace firm including Boeing. Finally, although the company has reduced its manufacturing capacity from 16 to 14 plants, it plans to keep the remaining factories busy with production subcontracts such as the manufacture of composite structures for passenger aircraft.

Several French defense contractors are attempting to diversify by developing civil spinoffs of military technologies. Thomson-CSF plans to diversify into commercial niche markets such as videotelephones, while Matra has proposed using its Brevel battlefield-surveillance drone for monitoring borders, forest frees, and the environment. CNIM originally developed an electron-beam welding system to manufacture missile launch tubes for submarines, but the company has since used the system to weld sections of the Ariane 5 commercial rocket and is now pursuing other commercial markets such as welding tracks for high-speed trains.

Shift From Production to R&D

With the decline in volume of defense production and simultaneous increase in complexity of individual weapon systems, the major French defense contractors-with support from the DGA-are streamlining their production operations and reorienting the workforce toward R&D and limited amounts of high-value-added manufacturing. Although fewer weapon systems are under development than in the

41 Giovanni de Briganti, "Martre Says French Budget Cuts Could Cripple Aerospace Industry," Defense News, vol. 7, No. 11, Mar. 16,1992, p. 41.

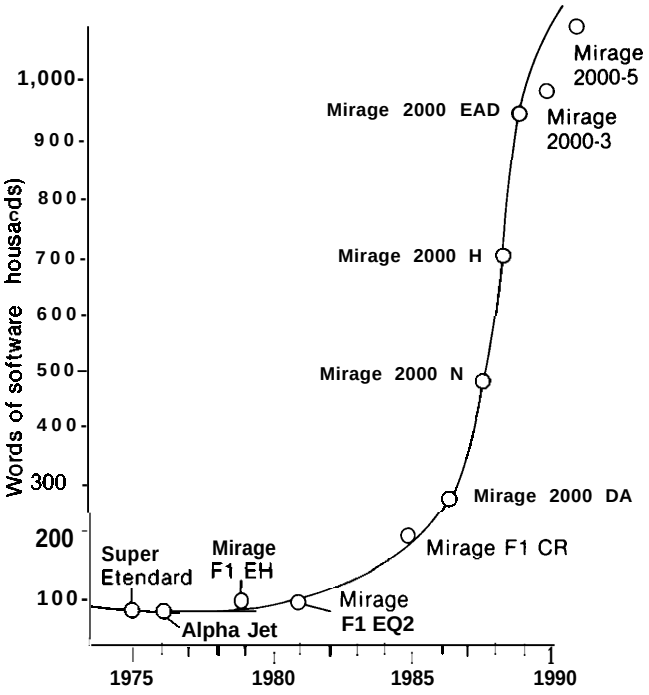
42 Pierre Kerlouegan and Arnaud Rodier, "Le PDG de la Snecma: Il faut des programmes militaires ambitieux, " *Le Figaro Economique*, Oct. 1,1991, pp. 1,2.

past, each one is more complex and highly integrated, requiring a greater investment of financial and human resources. Worldwide, the portion of the cost of a combat aircraft devoted to electronics has tripled over the past 20 years, from 10 percent to nearly 30 percent, and is expected to reach more than 40 percent in next-generation systems. Software engineering has also become central to weapon-system development. Advanced combat aircraft, in particular, require highly sophisticated digital flight-control systems that entail a massive software development effort. (See figure 8.)

As a result of these technological changes, the development of military systems has undergone a major shift in emphasis from hardware to software and from structural and materials engineering to systems integration. The DGA has accordingly sought to maintain the competitiveness of the French defense industry by investing in R&D at the expense of current production. This investment strategy should help French firms preserve their technological strengths, putting them in a position to play a leadership role in future collaborative development programs with other countries. Dassault Aviation, for example, plans to retain "a big brain and a small body" by concentrating on aircraft design, software development, aerodynamic analysis, project management, and final assembly, while engaging in less manufacturing. Similarly, Thomson-CSF is reinvesting 8 percent of its profits in R&D, with an emphasis on design studies, prototypes, software development, and assembly work. At the same time, the company has eliminated a number of machining facilities and subcontracted more of its manufacturing activities.

The overall shift in prime-contractor emphasis from production to R&D is reflected in human-resource policies: French defense firms are hiring an increasing number of graduate engineers and a declining number of production workers. Between 1980 and 1990, Dassault Aviation cut its total workforce from 15,843 to 12,390 employees. At the same time, the firm increased the proportion of graduate engineers and executives from 26 to 38 percent and reduced the share of production workers from 29 to 11 percent. (See figure 9.) Thomson-CSF has also changed the composition of its workforce. In 1986, the company employed 10,000 production workers and 2,000 software developers. By 1991, only 5 years later, the proportions had shifted to 5,000 production workers and 7,000 software developers. The firm also subcontracted 2.5 million hours of software development in 1991, up from zero hours in 1986.

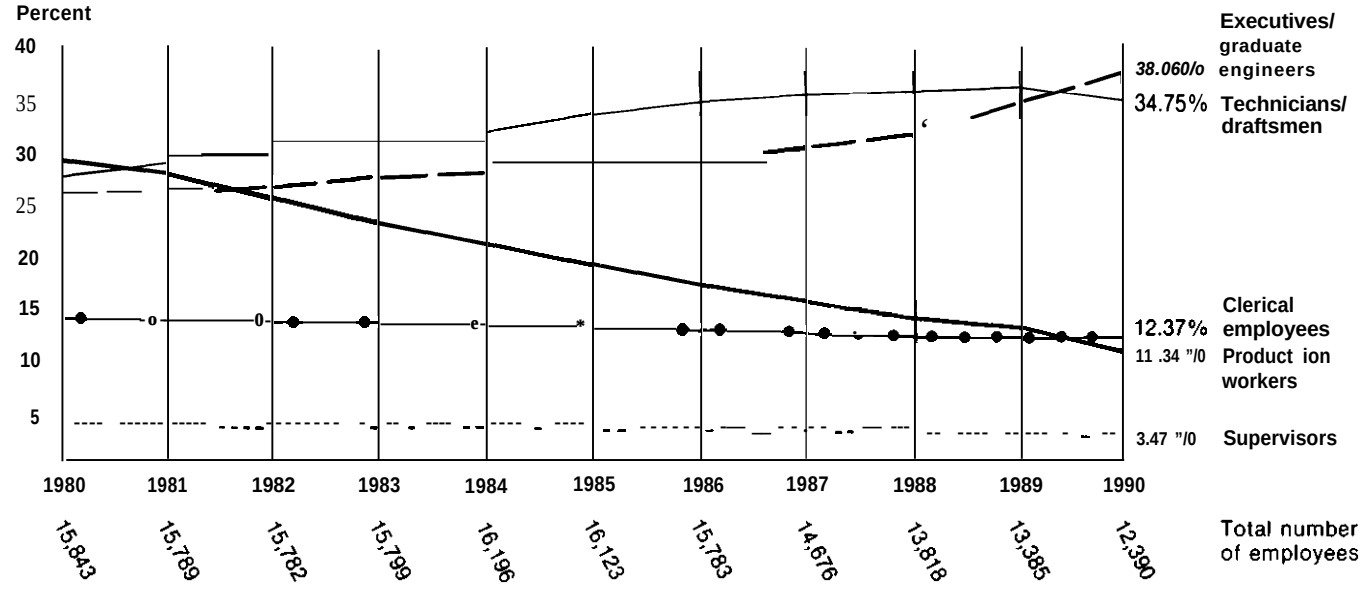
Figure 8--Growth in Complexity of Software for Dassault Military Aircraft



SOURCE: Dassault Aviation

With the diminished military threat to Europe and cutbacks in defense procurement, the length of time between generations of French military equipment will increase, resulting in a greater emphasis on exploratory development and prototyping. This approach is not entirely new: Dassault has traditionally taken an evolutionary approach to fighter-aircraft development in an attempt to minimize technological risk. Since 1945, the firm has developed more than 150 prototype fighters, most of them incremental improvements on previous designs. Prototypes are built around available and proven engines and incorporate no more than two major new design features, which are subjected to exhaustive flight testing before the plane enters production. By adding only a few novel technologies to each new fighter generation, Dassault has achieved significant improvements in performance at relatively low cost and risk, and has been able to adopt innovations developed by competitors into its own designs. Despite the apparent slowness of evolutionary

Figure 9—Changes in Dassault's Employment Structure, 1980-90



SOURCE: Dassault Aviation

development, the progression from the *Mirage III* fighter of the 1960s to the vastly more capable *Mirage* F-1 of the 1970s and *Mirage 2000* of the 1980s indicates that substantial improvements in performance can be achieved without moving to entirely new designs.[43]

Jacques Batistella, vice president for industrial strategy and business development at Aerospatiale, has urged the French Government to finance the development of technology demonstrators that would integrate new design concepts but would not be industrialized or produced in quantity. Each demonstrator would be built by engineers rather than production workers, and would explore technologies and materials for future production aircraft. Thus, while the military customer would procure a new aircraft only about every 15 years, the company's design bureau would develop prototypes twice as often. By permitting two small technological leaps rather than a single giant one, prototyping would reduce the costs and risks of development. Along similar lines, SNECMA president Louis Gallois has called on the European Community to finance the development of technology demonstrators in the field of hypersonic airframes and engines.[44]

Another trend is that as military systems become more complex, defense contractors are increasingly developing upgrades or variants of existing products, such as families of fighter aircraft or engines based on the same design concept. Dassault, for example, has been able to convert a basic fighter configuration-the tailless delta wing—into a large family of variants tailored to specialized missions and export markets. The same applies to the aero-engine sector, where companies frequently engage in modifications and upgrades of existing systems. Indeed, as much as 40 years can transpire between the start of an engine development and the last sale of spare parts. After SNECMA completes development of the M88 engine for the *Rafale*, for example, the company plans to use the engine core as the basis for a family of engines designed for various military and civil aircraft. The engine variants will incorporate new subsystems that improve thrust or fuel-efficiency.

There is also an expanding market for retrofitting existing platforms with improved electronic subsystems and armaments. According to Thomson-CSF, the profit margin from upgrades is equal to that of the first-sale market, although the volume is much

[43] For a detailed analysis of Dassault's design philosophy, see Robert Perry, *A Dassault Dossier: Aircraft Acquisition in France* (Santa Monica, CA: RAND Corp., report No.R-1148-PR, September 1973).

[44] Kerlouegan and Rodier, op. cit., footnote 42, p.1.

lower. While Dassault naturally prefers to sell new aircraft, modernization of the electronics and weapon systems on *Mirage* and *Super Etendard* fighters owned by foreign countries earned the company F3 billion ($579 million) in 1990. Nevertheless, the retrofit market will primarily benefit defense-electronics firms and other subcontractors that produce components and subsystems rather than the prime contractors that integrate and assemble the final products.

Dual-Use Technologies

French industry officials contend that outside the nuclear-weapons field, relatively few technologies are uniquely military. The commercial market has become the primary driver in a growing number of defense-related areas, including satellites, electronic components, computers, flat-panel displays, and telecommunications. It is therefore increasingly possible to integrate civil technology into military systems. A prominent French example is the *Helios* military surveillance satellite, which relies on technology developed by Matra for its SPOT commercial remote-sensing satellites.[45]

Thomson-CSF executives contend that in the future, the defense-electronics industry will be based on dual-use technologies, which will be maintained primarily in the civil sector. As a result, the French Government will need to fund only a limited number of uniquely military technologies to preserve the nation's defense-industrial competencies. Dual-use technologies could also provide a nucleus from which the defense base could be expanded rapidly in case of war. The main constraint on dual-use technologies is the different tradeoff between cost and performance in the civil and defense sectors, as reflected in the more demanding performance requirements of military specifications. Nevertheless, many civil technologies are said to provide 80 percent of the performance of military systems for a fraction of the cost. Efforts at civil-military integration may therefore compel procurement officials to decide which performance requirements are truly critical and to revise the existing military specifications to permit greater use of commercial technologies.

Given these trends, the DGA supports the development of dual-use technologies with promising military applications. Unlike Germany, where research on dual-use technologies is funded by civil ministries, dual-use research in France is the primary responsibility of DRET. The directorate coordinates its funding efforts with the civil ministries to ensure an efficient division of labor and to leverage its investment. For example, while the Ministry of Industry supports research on civil electronics, DRET provides targeted funds for work on products with specific military applications, such as electronic warfare systems and infrared seekers.

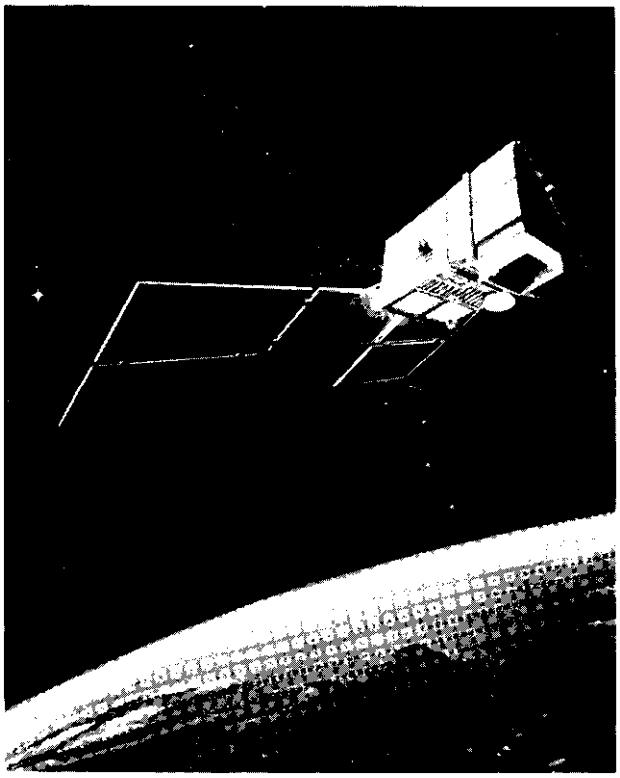


Photo credit: DGA/COMM

The *Hélios* military photoreconnaissance satellite, shown here in an artist's conception, is scheduled for launch in 1994.

Another important factor is that the French Government imposes no legal, regulatory, or accounting barriers to combining civil and military activities in the same facilities (other than security restrictions and military specifications). SNECMA, for example, plans to use the core of the M88 aero-engine being developed for the *Rafale* fighter as the basis for a new civil aero-engine, the M123,

45 SPOT is a French acronym for Satellite Pour l'Observation de la Terre, or Satellite for Observation of the Earth. It is similar to the U.S. LANDSAT Earth-resources satellite but has better spatial resolution.

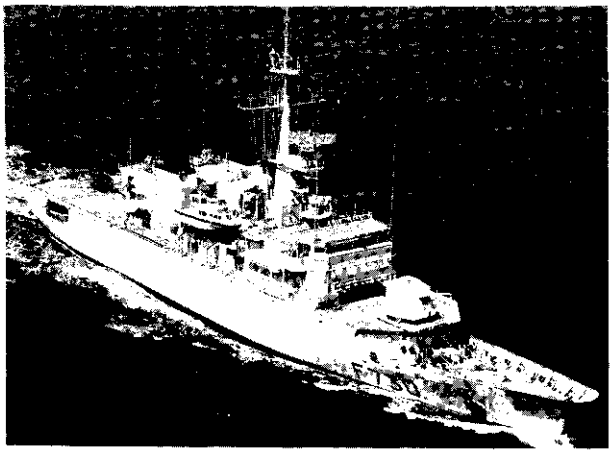


Photo credit: Chantiers de l'Atlantique

The *Floreal,* the first of six ocean-capable patrol vessels for the French Navy, was procured for one-third the cost of a standard frigate by using merchant-marine rather than military specifications.

that will power a 100-seat" passenger aircraft. Some French defense contractors are also consolidating their military and civil design teams to maximize flexibility and reduce the need to hire and fire. At Matra, there is considerable mobility of development personnel among the company's Defense, Transport, and Space divisions. Similarly, all of Dassault's military, civil, and space systems are designed with the same CATIA software, enabling engineers to move easily from one project to another. French civil-military integration is in sharp contrast to the situation in the United States, where specialized auditing and accounting rules and process specifications create high barriers between civil and military production, forcing diversified defense contractors to establish separate commercial and military divisions.

An example of the French military's adaptation to the defense industry's move toward civil-military integration is the development of a new class of naval frigates for routine peacetime missions, such as showing the flag, patrolling coastal fishing areas and oil platforms, drug interdiction, and policing French overseas territories. In the face of significant budget cuts, the French Navy determined that it did not need highly capable and expensive warships to perform these routine missions. Instead it could make do with ocean-going patrol frigates capable of defending themselves against one or two simple threats-such as an aircraft or a few hostile ships—rather than several at once.

As prime contractor for the program, the French Navy hired a commercial shipyard, Chantiers de l'Atlantique (owned by the Alcatel-Alsthom GEC Group), which specializes in the design and construction of passenger liners and had not built a naval vessel in 15 years. In lieu of military specifications, the Navy permitted Chantiers de l'Atlantique to use somewhat less rigorous 'safety of life at sea' norms conceived for merchant-marine and passenger ships. Moreover, while the patrol frigates are equipped with the same cannons and missile systems as standard frigates, they lack a computerized battle-management system integrating them into a naval task force. Because of these economies, the patrol frigates were developed and built at one-third the cost of frigates built to military specifications. (Of course, the limited defensive capabilities of the patrol frigates could prove problematic if they confront missile threats.) Chantiers de l'Atlantique is currently developing a logistical transport ship for the French Navy that will rely on a mixture of civil and military norms.

Consolidation and Foreign Acquisitions

An important question facing the DGA is whether to consolidate the French defense industry further in sectors where there are still two or more prime contractors, such as aeronautics (Dassault, Aerospatiale), defense electronics (Thomson-CSF, Electronique Serge Dassault), and missile systems (Matra, Thomson-CSF, Aerospatiale). While Dassault has so far fought successfully to retain its independence, the company's financial position is precarious, and a merger with Thomson-CSF or Aerospatiale might well strengthen the international competitiveness of the French defense industry. In any event, a decision of this magnitude would be made not by the DGA but by the Prime Minister.

In the meantime, the DGA has used its power of *tutelle* to encourage competing French prime contractors to establish joint ventures for mutual benefit. The purpose of this policy is to reduce the duplication and overcapacity resulting from the parallel development of similar weapon systems, and to enable national firms with very different corporate cultures to learn how to work together. For example, after years of intense rivalry between Thomson-CSF and Aerospatiale in the field of antiaircraft systems, Thomson agreed in September 1991 to transfer production of its new VT1 missile to the Euromissile consortium, made up of Aerospatiale and its German

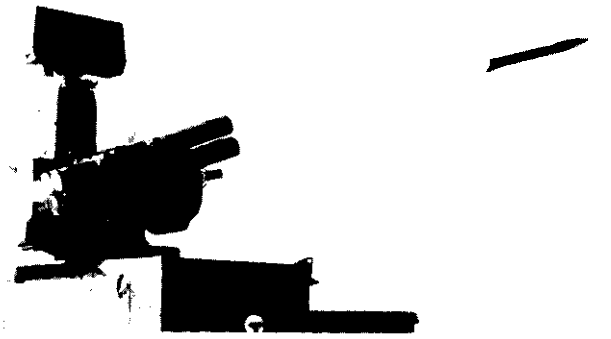


Photo credit: Thomson-CSF

The VT1 antiaircraft missile, developed by Thomson-CSF, will be manufactured by the competing Euromissile consortium, an arrangement benefiting both companies.

partner Deutsche Aerospace. The VTl missile will then be integrated into Thomson's *Crotal* antiaircraft system and Euromissile's competing *Roland* system. This arrangement will benefit both sides: Euromissile will avoid the high cost of developing a new missile for the *Roland,* and the market for Thomson's VTl missile will expand by a factor of 5, enabling the firm to amortize its development costs.[%] Such a rationalization of the national industry should enhance France's ability to compete and cooperate in the broader European defense market.

Leading French defense contractors have also sought to reinforce their technological strengths and penetrate new markets by acquiring foreign firms and creating overseas subsidiaries.[47] GIAT Industries, for example, has been able to expand its market share and offer a full range of defense products by buying out France's two other ammunition manufacturers (Matra-Manurhin Defense and Luchaire) and two Belgian companies (PRB, a manufacturer of large-caliber ammunition, and Fabrique Nationale, a producer of small arms and ammunition) .48 Similarly, Thomson-CSF has sought to achieve a' 'critical mass" in its defense activities by pursuing an aggressive international expansion strategy. The firm has sold off some of its nondefense activities and acquired several foreign defense fins, including two subsidiaries of the Dutch electronics giant Philips, ensuring a sufficient cash flow to continue developing new technologies. In April 1992, Thomson moved to expand its presence in the large U.S. defense market by bidding $255 million for the missile division of LTV Aerospace and Defense Co., an American defense contractor.[49]

Collaborative Programs

Although France has collaborated with allies since the late 1950s on the development and production of numerous items of military equipment, it has recently changed its overall approach. From the 1960s through the 1980s, France emphasized bilateral collaboration with its European neighbors because such projects offered greater control and lower transaction costs. Joint development programs with Britain included the *Puma, Gazelle,* and Lynx helicopters, the *Jaguar* attack aircraft, and the *Martel missile, while those* with West Germany included the *Transall military* transport, the *Alpha Jet* trainer, the *Milan* and *Hot* antitank missiles, and the *Roland* antiaircraft missile system. France also negotiated coproduction arrangements with countries that purchased French weapons to help "offset' procurement costs and thereby promote sales.[5o] But Gaullist imperatives caused France to collaborate mainly on systems of secondary military importance, such as helicopters, trainers, and transport aircraft, while preserving national autonomy in "strategic' areas such as nuclear weapons, nuclear-

[M] "Thomson Aligns VT1 System With MBB-Aerospatiale," *Aviation Week & Space Technology,* vol. 135, No. 10, Sept. 9, 1991, p. 27.

476$EWope '92: Bigger than the Sum of Its parts," Jane' *s Defence Weekly,* vol. *16, No. 4,* July 27, 1991, p. 154.

48 Giovanni de Briganti, "The French Defense Industry: International Expansion is the Key to Future Survival," *Defense News,* vol. 5, No. 49, Dec. 3, 1990, p. 10.

49 The acquisition of a U.S. defense contractor by a firm controlled by the French Government was politically controversial: more than 40 U.S. senators asked the Bush Administration to block the sale on grounds of national security. See "Thomson Wins LTV Unit," *Defense News,* vol. *7, No. 15,* Apr. 13-19, 1992, p. 2; Anthony L. Velocci, Jr., "Thomson Global Expansion Plans Call for Capital, Technology Infusion at LTV," *Aviation Week & Space Technology, vol. 136, No. 16,* Apr. 20, 1992, pp. 64-65; J.A.C. Lewis, "Pentagon Examines Thomson's LTV Offer," *Jane' s Defence Weekly,* vol. 17, No. 17, Apr. 25, 1992, p. 686.

50 Offset arrangements involve partially or fully offsetting the cost of an arms sale to the purchasing country through the transfer of economic or industrial benefits. Such deals may include giving the purchasing country a share of the development and/or production of the weapon system, providing subcontracts to local suppliers, making supplementary transfers of technology, or buying back unrelated goods and services. As arms-export markets have grown more competitive, offset arrangements have become ubiquitous, but they remain controversial.

capable delivery systems, and high-performance combat aircraft.

The legacy of this go-it-alone strategy lingers in several strictly national programs launched during the 1980s, including the *Leclerc* tank, the *Rafale* fighter, the SNECMA M88 turbojet engine, and the RBE-2 airborne radar for the *Rafale, jointly* developed by Thomson-CSF and Electronique Serge Dassault. Nevertheless, these systems appear to be the last of a vanishing breed. In the future, it is unlikely that France will be able to bear the cost of purely national aircraft programs or to support the industrial infrastructure of subcontractors and suppliers built up to support such programs. Indeed, during the ceremony marking the rollout of the first naval prototype of the *Rafale* on December 9, 1991, DGA director Yves Sillard told reporters that all future French combat aircraft will be developed with European partners.[51] Similarly, SNECMA has announced that the M88 aero-engine will be its last independent program. In 1990, the company offered an olive branch to its traditional archrival Rolls-Royce by agreeing to cooperate in basic research on engines for next-generation fighter aircraft.[52]

Despite France's new emphasis on arms collaboration with European partners, however, the DGA remains wedded to a policy of collaboration a *la carte so* that France can retain a foothold in all major defense-industrial sectors, particularly at the system level. DGA officials seek industrial alliances in which both partners benefit synergistically from complementary technologies and know-how. In this way, the French industry can gain access to European defense markets while preserving its competitive strengths in defense electronics, aeronautics, and missiles.[53]

The DGA has also become more amenable in recent years to selective off-the-shelf purchases of foreign systems. During the 1980s, for example, France purchased AWACS early-warning aircraft and C-130 long-range transports from the United States. In addition, the French and British defense ministers signed a reciprocal-procurement agreement in December 1987 under which each country pledged to consider purchases of defense products from the other. While this agreement has failed to produce a major expansion of bilateral defense trade, the stated desire of both governments to cooperate has given French and British firms an incentive to establish joint ventures and other collaborative arrangements. According to Gerard Chauvallon, head of the DGA's Directorate of International Relations, "France and Great Britain are natural partners for defense cooperation because both countries are determined to maintain a technological base and because their industries are of similar size."[54] France-British joint ventures are under way in the fields of airborne radar, sonar systems, surface-to-air missiles, and air-to-air missiles, and the two countries have begun preliminary talks on the joint development of a next-generation fighter, a maritime patrol aircraft, and a new class of anti-air frigate.[55] In another major departure from past French defense policy, which postulated a strictly national nuclear deterrent, Paris and London have discussed the possible codevelopment of a long-range, air-delivered nuclear cruise missile known as the *Air-Sol Longue Portee* (ASLP).

The DGA is also placing a strong emphasis on collaborative R&D with other European countries in order to stretch the French defense budget. Ever since the creation in 1976 of the Independent European Program Group (IEPG) as a forum for planning joint armaments programs among the European members of NATO (except Iceland), France has been a leading proponent of greater European cooperation in defense research. Because the IEPG excludes the United States, France views this forum as a means to strengthen European defense technology and offset American predominance. In November 1990, at France's request, the IEPG nations established a cooperative defense R&D program called EUCLID (European Cooperation for the Long-term in Defense), which is jointly funded by the participating governments and firms. According to a DRET official, France invested F150 million in cooperative defense research in 1990,

51 Giovanni de Briganti, "U.K., France Discuss Fighter," *Defense* News, vol. 7, No. 6, Feb. 10, 1992, p. 37.

52 Alexandra Schwartzbrod, "SNECMA Flirting with Rolls-Royce, " *Les Echos*, Apr. 6,1990, p. 10. (Translated in FBIS-WEU-90-095, May 16,1990, p. 24.) See also, J. A. C. Lewis, "UK, France Plan EFA Successor," *Jane' s Defence Weekly, vol. 17, No. 9,* Feb. 29, 1992, p. 337.

53 Boucheron, op. cit., footnote 36, p. 587.

54 Cited in Giovanni de Briganti, "Frigate Study Heightens U.K.-Franco Cooperation," *Defense News,* vol. *7, No. 7,* Feb. 17, 1992, pp. 11, 16.

55 De Briganti, op. cit., footnote 51, p. 3.

F300 million in 1991, and plans to spend F500 million by 1994. By then, 20 percent of French defense R&D will be carried out jointly with allies.

For French defense companies, international collaboration offers both benefits and costs. On the plus side, joint projects enable firms to share the costs and risks of R&D, lengthen production runs to achieve economies of scale, gain access to foreign markets, and embed procurement programs in a political framework that makes them less likely to be canceled. On the minus side, collaboration is often difficult and time-consuming because of the need to harmonize national military requirements and procurement calendars, negotiate worksharing arrangements, and reconcile different corporate procedures and management styles. Since collaboration inevitably entails economic inefficiencies (e.g., redundant final assembly lines in the participating countries), joint programs tend to be more expensive than strictly national ones, yet because the total costs are shared, each partner usually pays less.[56] In the words of a French aerospace executive, ''international collaboration did not develop because it corresponded to a spontaneous desire on the part of firms, but rather because they could not devise any less unsatisfactory solutions. ' '[57]

Despite such reservations, the French defense industry is responding to economic realities by teaming with other European firms on tactical collaborations involving single projects or long-term strategic alliances over a series of projects. In general, firms must gain some experience in tactical collaboration with a particular partner before they are willing to enter a strategic alliance. Aerospatiale currently collaborates with foreign firms on two-thirds of its products, including 97 percent of its aircraft, 62 percent of its tactical missiles, and 100 percent of its space products, with the sole exception of ballistic missiles. Matra's 5-year business plan downplays export sales to developing nations and seeks instead to carve out a large share of the European market for air-to-air missiles by forming alliances and cross-ownership arrangements with GEC-Marconi (UK), Ericsson (Sweden), Deutsche Aerospace (Germany), and Alenia (Italy). Thomson-CSF has also reached across France's borders to establish joint ventures with several European partners. In May 1991, for example, Thomson and Britain's GEC-Marconi, Europe's two largest manufacturers of airborne radars, announced the formation of a jointly owned company, GEC-Thomson Airborne Radars (GTAR) to develop active-array radars for the next generation of fighter aircraft. Many analysts believe that such a collaboration offers Europe's only hope of maintaining a competitive airborne-radar industry into the next century .58

An important step in facilitating European arms collaboration would be to reform the traditional system of juste *retour (*' 'fair return' '), in which work in a joint program is allocated among the participating national firms in exact proportion to the size of each government's financial investment or anticipated purchase. The rigidity of this formula results in inefficiencies because work is assigned according to each fro's nationality rather than its qualifications. Moreover, the design and production of a complex weapon system is often divided arbitrarily among the participating firms on the basis of financial rather than functional criteria. For these reasons, the DGA seeks greater flexibility in the application of *juste retour.* Instead of dividing up work in exact proportion to national investment on each project, France would prefer a proportional allocation of work *averaged* over several collaborative projects carried out during a period of 5 to 10 years.

In contrast to the expansion of French arms collaboration with its European allies, Franco-American programs have remained largely elusive. For many years, Paris's pursuit of national autonomy in defense production and its political rivalry with Washington created major obstacles to collaboration between French and U.S. defense fins, but the French industry has evinced a growing interest in transatlantic ventures. The most successful example has been the codevelopment of the CFM56 aircraft engine by SNECMA and GE. Launched by the U.S. and French Presidents in the early 1970s, this program has been a remarkable commercial success in both the civil and military transport markets, with

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[56] For an in-depth analysis of collaborative armament programs, see **U.S. Congress, Office of Technology Assessment, *Arming Our Allies: Cooperation and Competition in Defense Technology,* OTA-ISC-449 (Washington, DC: U.S. Govemrnent Printing Office, May 1990).**

[57] Jean-Claude Malroux, Director of International Business at SNECMA, cited in Y. Cochennec, ''Collaboration Internationale dans l'Aérospatiale,'' *Air et Cosmos, No.* **1148, June 20, 1987, p. 12.**

[58] Giovanni de Briganti; ''Thomson, GEC Team on Airborne Radars,'' *Defense News,* **vol. 6, No. 43, Oct. 28, 1991, p. 16.**

sales of some 10,000 engines worth approximately $38 billion.[59] The SNECMA-GE collaboration has functioned well because of the quality of the product, the complementary technical strengths of the two partners, and the lack of direct competition between them in other areas.[60] Recently, SNECMA and GE launched the development of the GE90, a new civil engine with potential military applications; the worksharing arrangement is 25 percent for SNECMA and 75 percent for GE.

To date, however, the successful SNECMA-GE alliance remains the exception rather than the rule. Other transatlantic programs have been hindered by the structural mismatch between the French and U.S. defense-procurement systems, nontariff barriers such as 'buy American" regulations and security restrictions, and the reluctance of U.S. defense contractors to transfer advanced technology to potential competitors. When the United States has entered into large collaborative arrangements with its European allies, it has usually done so under NATO auspices or because Congress has fenced off money for this purpose (e.g., the Nunn Amendment programs). Even in such cases, transatlantic programs have generally involved low-priority weapon systems and have often failed to reach fruition. A recent example is the NATO program to develop a terminally guided warhead for the Multiple Launch Rocket System, from which the Pentagon withdrew in favor of a strictly national development effort. Because of such experiences, the French have come to view the United States as an unreliable partner in collaborative arms programs.

Integration of European Defense Industries

Despite the rapid growth of European arms collaboration, true cross-border mergers between defense firms are rare. In 1990, the helicopter divisions of Aerospatiale and the German firm Deutsche Aerospace merged to form a joint-venture company called Eurocopter, which is developing the *Tiger* antitank helicopter. (Eurocopter is also collaborating with the Italian firm Augusta and the Dutch firm Fokker on the NH-90 utility helicopter, scheduled to enter service in the late 1990s.) A joint venture, however, is not a truly independent entity with its own stockholders and full power of decision. Since the two parent companies own all of Eurocopter's shares, the firm must take account of their respective interests. Obstacles to true cross-border mergers are the lack of European business law governing translational companies and the difficulty of integrating state-owned French defense firms like SNECMA and Aerospatiale with their British and German counterparts, which are primarily in the private sector.

Photo credit: DGA/COMM

The *Tiger* antitank helicopter is being developed by Eurocopter, a joint venture of Aerospatiale and the German firm Deutsche Aerospace.

Another barrier to the rationalization of the European defense industry is lingering nationalism. Instead of buying the best or cheapest defense equipment available on the market, European governments protect inefficient national suppliers for economic and political reasons, such as a reluctance to eliminate jobs in national defense industies or to spend taxpayers' money on foreign weapons. These policies have resulted in massive overcapacity, high procurement costs, and incompatible military specifications. In the coming years, the growing financial demands of military R&D programs and the need for extended production runs will create pressures for an integrated European defense market. But although the European Community (EC) plans to remove all remaining trade barriers by the end of 1992 and to strengthen joint security organizations like the Western European Union, major political barriers

59 "SNEW and the U.S.A.—A Dynamic Relationship," Briefing at SNECMA Headquarters, Paris, Oct. 1991.

60 Keith Hayward, *International Collaboration in Civil Aerospace* (London: Frances Pinter Publishers, 1986), p. 136.