The French arms industry and its present problems

Jacques Fontanel

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Fontanel, J.

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Résumé : Industrial advanced States are not often in position to convert notions of national security into comprehensive strategies and programmes for national security. Technologies dictate policy instead of serving them when a national Military industrial complex is powerful. How organize the national production of armaments? What is the minimal level of dependence for some important weapons for the national defence? What is the political and economical importance of exporting arms? What is the burden of armaments useful to develop a deterrence system and what financial burden the nation is prepared to accept for what defence?

Les États industrialisés avancés ne sont pas souvent en mesure de convertir les notions de sécurité nationale en stratégies et programmes globaux de sécurité nationale. Les technologies dictent la politique au lieu de les servir lorsqu'un complexe militaro-industriel national est puissant. Comment organiser la production nationale d'armements ? Quel est le niveau minimal de dépendance pour certaines armes importantes pour la défense nationale ? Quelle est l'importance politique et économique des exportations d'armes ? Quelle est la charge d'armement utile pour développer un système de dissuasion et quelle est la charge financière que la nation est prête à accepter pour quelle défense ?

Military industrial complex, National defence, exportation arms, burden of defence, deterrence strategy, arms systems

Complexe militaro-industriel, Défense nationale, exportation d’armes, fardeau de la défense, stratégie de dissuasion, systèmes d’armes.

Defence costs have always been the subject of theoretical and political debates. Since the industrial revolution, economists have classified military activities as unproductive expenditure. The idea that armaments constitute a waste of world resources seemed self-evident. However, if States want to possess weapons for their own security, the impact of the military effort on their national economies will vary, depending on their structures, their level of development, their openess to the outside world, etc. If in the United Kingdom, the more common analysis of British arms industry has often a negative view of their impact on economic growth and military projects have been considered as a very ineffective form of economic intervention, which has damaged UK economic performance in the past, in France, domestic arms production is often presented as one of the most efficient sector for domestic economic development. Although there remain some disagreements about the implementation of military planning or the distribution of the sums committed among the various types of weapons, the French political parties are not basically in doubt about the strategy of deterrence and the fundamental utility of an independant military industry.

The last "Programmation Militaire" (military programme for five years) put forward in 1987 seems to satisfy everyone and defence has ceased, except for the Communist Party, to be a subject of discord. France has not really been marked by a general revision of the objectives of defence policy. Parliamentary debates have been centered on the proportion of GDP that should be devoted to defence, on the application of long-term plans and on long-term credibility of the deterrent forces. Since 1970, changes have occured slowly and smoothly. If France has given priority to strategic nuclear forces, it should be emphasized that the structure of her expenditure does not make nuclear weapons a financial priority, since the direct costs of the nuclear forces represent only a fifth of total military expenditure (this figure is very high in comparison with UK figures which are

usually lower than 6 per cent of total military expenditures). Nuclear deterrence is a highly centralized process, making use, in the last resort, of the highest authority in the state and, at intermediate levels, of specialists trained in secrecy and discipline. Through there is a large consensus to accept the development of deterrent forces, it is none the less true that the choices between conventional forces and nuclear forces have not yet reached a critical stage in their development. The cost of nuclear deterrence is very low in comparison with its strategical advantages for a medium power like France. The modernization of France's strategic nuclear strike force can be easily achieved, bearing in mind the relatively small percentage of her GDP devoted to defence and the possibility of temporarily holding conventionnal forces as they are. In 1986, France spent no more than 21 billion francs (1981 value) on her new conventional weapons, nearly three times less than the United Kingdom. It is probable that France has had to limit her ambitions as regards conventional weapons and, may be, that the pursuit of the nuclear strategy will be accompanied by painful financial choices.

The answers given by the programmation militaire 1987-1991 are not yet very explicit, even if there is talk of increasing capital expenditure, especially nuclear, in order to continue fitting out missile-launching nuclear submarines (with the M-4 system), to strengthen the communication and command systems of nuclear forces, to construct a new generation of missile-launching nuclear submarines, to develop a new ballistic missile (M-5), to build a nuclear aircraft-carrier and to introduce the Hades tactical weapons system. With the US Strategic Defence Initiative and the US-Soviet agreement on Intermediate Missiles Forces (IMF) in Europe, the government will have to face this a new strategic challenge and the famous consensus that surrounds nuclear deterrence may be threatened. While it is useful to recall that no French long-term defence programmes has ever been fully implemented without any political clash, the new technological challenges in the military sector seem to be particularly dangerous for the consensus on defence in France. The supply of military equipment must be obtained by foreign purchases when French industry is not really competitive, arms exports have to be developed and a collaboration on arms production with FRG is being encouraged. A comparison of the programmation objectives with concrete payments allocations show the government's lack of political will to respect its commitment. Every service received less money to give a total of 3.7 billion francs for 1989 alone. A revision of the programmation must be decided at the end of 1989.

Table 1 - Comparison of the objectives of French military "Programmation" and payment allocations for 1988 (billion current francs)

Section	Programmation	Payment allocations
Common	26.4	26.1
Air	23.2	22.9
Land	22.4	22.1
Navy	20.6	20.4

Very few industrially advanced countries are in a position to convert notions of national security into comprehensiveprogrammes covering all possible paths of technological development. Often technology dictates policy instead of serving it. The second basic question is to know exactly what financial burden the nation is prepared to accept for what defence. It is essential to consider defence costs in relation to the optimum methods of defence and a given budget level. There is in practice a constant interaction between costs and budget, which largely depends on the cost of existing or future hardware.

Table 2 - Initial French military budgets 1980-1989 (in current billion francs)

Year	Capital	Operating costs	Military budget	Percentage GDP
1980	39.84	48.76	88.60	3.76
1981	47.68	56.76	104.44	3.87
1982	56.30	66.55	122.85	3.88
1983	60.98	72.29	133.27	3.92
1984	66.60	75.50	142.10	3.84
1985	71.70	78.50	150.20	3.78
1986	75.68	82.67	158.35	3.72
1987	85.81	83.39	169.20	3.79
1988	90.85	83.43	174.28	3.73
1989	98.00	84.36	182.36	3.69

Given the size and volatility of the international market, the low demand and the entry of many new competitors the likely return from arms exports is not great, particularly in terms of opportunity costs. While defence spending represents a relatively small portion of the overall French Gross National Product, its impact on the French economy's innovativeness and manufacturing sector is more than proportionnate, because of first, the decisive importance of military decisions on some industrial sectors ; second, the influence and the size of military R&D ; and third, the particular role of military exports on France's trade balance.

I. ARMS INDUSTRY ORGANIZATION

France has a powerful arms industry, generally considered to be highly competitive on international markets, in spite of occasionally archaic management and a policy of systematic protectionism. There are no studies on the opportunity costs of France's military industry. The opportunity costs of the military budget is determined by the alternative public or private programmes are not produced because of the military demands on the State budget and on the real resources of the economy. Outlays are often concentrated in a few industries and in these economic sectors they account for a very high fraction of industry output. It is then very difficult to know exactly the costs and the advantages of that industry. In the present case, it seems that French government considers that the independence on the arms equipment supplies is essential, whatever the result may be. This is certainly the case for nuclear weapons, which represent more than 30 per cent of the total annual amount of military equipment in France.

Table 3 - French military equipment expenditures by main categories in 1987 and 1988 (in billion francs)

Categories	1987	1988
Nuclear forces	27.8	30.5
Space	0.8	1.4
Conventionnal manufacture		
- Common section	0.8	0.9
- Air	7.8	7.4
- Land	9.6	9.6
- Navy	7.5	7.9
- Gendarmerie	0.7	0.8
Studies and classical development	11.0	12.9
Ammunitions	6.5	6.6
Material maintenance	5.6	5.7
Personnel maintenance	1.9	2.0
Infrastructure	5.8	5.2
TOTAL	85.8	90.8

There are 300000 workers in the French arms industry (1,25 per cent of active population and 6 per cent of industrial workers, buildings and public works excluded) of which only 100,000 are in export production. There are respectively 81000 and 43500 employees in the aeronautical and electronics industries.

Table 4 - Direct employment in French arms industry in 1987

Activities	Employments
General task of DGA	25000
Industrial activity of DGA	48500
CEA	10000
Public enterprises	108500
Private enterprises	108000

If every job created up-stream were included, then more than 400000 jobs are directly dependent on the arms industry. DGA (Délégation Générale à l'Armement) employs 73500 persons. For the SIRPA, there were 730000 jobs directly or indirectly concerned with the defence

industry. The general turnover of arms industries exceeds 100 billion francs, but in a more *stricto sensu* definition, specific arms market turnover was respectively 65, 73 and 77 billion francs in 1986, 1987 and 1988, with 43 and 34 billion francs of exports in 1986 and 1987.

The French government has an interventionist philosophy and it argues that protection, subsidies and government contracts have an essential role in the maintenance and restructuring of domestic arms production. Thus, in an economic crisis situation, government tries to maintain an independent and large size arms industry, even if present and future export markets do not encourage the maintenance or development of this activity.

A) Nuclear industry

The Commissariat à l'Energie Atomique (CEA) was created on 18 October 1945 by Général de Gaulle and it was présented at that time as an indispensable tool for French nuclear and economic developments. No nuclear military programme was developed till december 1954, when Pierre Mendès France expressed his opinion in favour of a secret research project on nuclear weapons and atomic submarines. Major financial subsidies were then deducted from the Defence budget and transferred anonymously to the CEA without specifying their use. In the French case, civil nuclear R&D was very useful for nuclear weapons, not the opposite. In 1986, the resources devoted to military nuclear and civilian nuclear were almost the same, even if it is difficult to quantify them very precisely, because of the inseparability of some civilian and military uses. There is an osmose between military and civilian research. The plutonium requirements for the new French nuclear weapons programmes will not be met by the output of military reactors alone. Superphénix is therefore important, indeed essential, to support the technical base for France's "force de frappe". Thus civil nuclear energy is still important for the military nuclear sector. Since 1962, military nuclear has probably exerted some positive action on civilian nuclear, in the fields of both fundamental and applied research (uranimum supplies and fuel fabrication, enrichment, reprocessing, reactors, optimalization of the PWR channel). From 1980 to 1988, greater importance was given to nuclear forces, with special support for tactical nuclear forces. In 1989, nuclear and space absorb 34.2 per cent of payment allocations for defence equipement.

Table 5 - Capital expenditure devoted to French nuclear forces in millions of current francs

Year	Strategic nuclear forces	Tactical nuclear forces
1980	11.850	730
1981	13.730	870
1982	16.190	740
1983	17.830	1.470
1984	19.300	2.440
1985	20.214	3.172
1986	20.967	4.301
1987	21.759	6.039
1988	23.651	6.895

Table 6 - Part of the French national budget devoted to CEA

	1980	1982	1984	1986
Civilian subvention/ civilian budget	0,83	0,74	0,76	0,8
Military subvention/ military budget	5,64	5,37	5,02	4,94
Total subvention/ Total budget	1,58	1,41	1,4	1,38

Table 7 - French nuclear expenditures in 1986 (Rapport annuel CEA 1986).

Expenditures	per cent of total
Protection and nuclear safety	6,0
Nuclear programmes	20,9
Common interest programmes	3,1
Innovation and industrial valorization	7,2
Basic research	13,9
Military applications	48,9

The French civilian nuclear industry is in crisis, like the world civil nuclear industry. No orders for exports (except a contract signed in 1987 with China concerning the construction of the Daya-Bay power station), overequipment, social and political opposition are reducing drastically the potential of this industry, which was particularly representative of high technology in modern French growth. This crisis is perhaps certainly a direct consequence of the new developments of military nuclear. If civilian nuclear is, temporarily or not, condemned owing to proliferation and prohibition of material and technology exports, military nuclear is clearly accepted by public opinion,

without any possibility of verifying what it is precisely useful to spend to develop a deterrence strategy. If the French nuclear industry is very competitive and is able to satisfy national demand, the military nature of nuclear reduces the opportunity of important spin-offs from nuclear R&D. Thus the civil usefulness of nuclear R&D is decreased, and perhaps, the new French effort on nuclear weapons is an industrial policy in response to the recession of the civil nuclear sector. The nuclear lobby tries to obtain an increase in useful military nuclear public allocations in order to compensate the decline in civil nuclear orders.

Nuclear weapons are not very expensive. If you compare nuclear expenditures and the strategic importance of this weapon system in the contemporary defence thinking, this conclusion seems to be undeniable.

Table 8 - World Nuclear Military Outlays Forecasts (billion dollars) in 1984

States	Data sources basis SIPRI	USACDA
France	4.8	4.7
United Kingdom	0.5	0.8
United States	39.O	38.2
USSR	28.0	51.6
China	5.7	5.2
Others	2.0	2.0
Total	80.0	102.5

Source : Fontanel & Smith : "Le nucléaire, une arme à moindre coût". Le Monde Diplomatique, Août 1987.

With the new "Programmation Militaire", the nuclear warheads of France will be multiplied four or five times, with the objective for the 21th century of having the capacity to destroy nearly half the human beeings of the world.

B) Main organizational characteristics of French conventional armament industry

- The organization of French weapons productions is very centralized. Not only is the State the only customer of the armaments industry on the domestic market, it also controls exports. This market is a near monopsony (existence of a single buyer on the market). Since 1961,

competition between arms firms has tended to be eroded by the "Délégation Générale pour l'Armement", (DGA) which, through the award of study contracts and the supervision of major programmes, promoted a "bilateral monopoly" with a single buyer and a highly specialized single seller on the market. In fact, competition between arms firms has moved away from simple competition for the sale of products towards competition for research contracts or programmes for new types of armaments. The DGA finances the development of hardware and guarantees a market, especially as it exerts a definite influence on the definition of requirements defined by the General Staffs and on the sales of military hardware abroad, which it controls through the Direction des Affaires Internationales. The contractor's risk is often eliminated and the arms firms very rarely commit themselves to a programme without having received prior financing from the State.

- However, the government's own armaments factories (Arsenaux) are in latent crisis and the Unions are strongly critical of the government's policy which favours private and nationalized companies against their own public interests. For the Unions, with the Arsenals and State establishments, France disposes of a very competitive and effective industrial tool, which avoids a profits race and secures the military equipment needs. But the government is trying to reduce the advantages of public status and, because the private military industrial complex, is clearly in favour of private or nationalized enterprises. There is a commission to organise technological transfers from the Ministry of Defence to private enterprises, to which the unions are opposed. Profits may not be the only factor in arms industry decisions, but it is true that the profit rate is 250 per cent higher in military firms than in civilian enterprises.

For the government, the "Arsenaux" are badly managed, with a very weak productivity and they are not really adapted to the present economic constraints. For the time being, the *status quo* seems to be accepted, but if conventional arms sales continue to fall, the situation could well see further changes in the years to come. Specifically, changes are possible with regard to the status of the workers classed as civil servants in a public restructuring of the naval shipyards and the automatic balancing via the defence budget of the operations of the Direction des Armements Terrestres (DAT) and of its establishments. The Arsenals and States establishments meet only 13 per cent of the army's needs. More than 50 per cent of "Arsenaux" and State establishments' industrial capacity is unused, which for one union (CGT des Travailleurs de l'Etat) represents a waste of more than ten billion francs. For example, the Manufacture d'armes de Saint-Etienne, established in 1764, is in crisis ; it produces light weapons

(such as Famas and Beretta pistol on licence), some parts of tanks and some equipment for nuclear and chemical protection. Orders are declining and the GIAT (Groupement Industriel des Armements Terrestres) hoped unsuccessfully to close this public enterprise but 40 per cent of workers became unemployed. The unions call for the production of a new type of gun, even if, in general terms, they are against the arms race.

- Arms products are made by an immense and diversified industrial structure, with enterprises from various economic sectors. Armament is not at all an activity branch as identified and conceptualized by macoeconomic analysis and thus the national Account concept "Naval Shipyards, aeronautics and armament" (Constructions navales et aéronautiques, Armement), which includes civil and military materials and armament, seems to concern only small weapons from the Arsenals. **La Délégation Générale de l'Armement (DGA)** has the responsability of "Maîtrise d'ouvrage" which concerns the determination of the main specifications of weapons and one partner of the complex organization used to manage the various units of arms systems becomes, by contract with Ministry of Defence, leader of the product (Maître d'oeuvre) for the industrial management of the system. Marcel Dassault Aircrafts undertake the coordination of more than 500 enterprises for their construction (exclusive of engines, equipment and weapons). The "Service Industriel de l'Armement" (Armament Industrial Service) from DGA works with 3,000 enterprises and more than 10,000 enterprises are concerned directly in weapons products.

Table 9 - French arms industrial sectors in 1986.

PARTNERS	Percentage sectors/ Armament Turn over	Percentage armament/ Sector Turn Over
DGA	18	100
CEA (Nuclear)	6	50
Aerospatial Industry	34	69
Professionnal Electronic industry	23	55
Other Electronic Industry	4	6
Naval shipyards	10	50
Others	5	-
Total	100	6

With the process of nationalization, France is making importnt changes in the leadership structure of arms production.

Table 10 - French arms sector's control of work (Maîtrise d'oeuvre) in 1986 (in per cent)

DGA	22
CEA	6
Parapublic sector	58
Private industry	1

Table 11 - Main French arms enterprises in 1986 (billion francs)

Enterprises	Total turnover	Armament turnover
Aérospatiale (without branches)	25.41	15.82
- Branches		
- SOGERMA	0.76	0.37
- SOCATA	0.4	0.2
- SOCEA	0.26	0.15
- SECA	0.43	0.2
- EAS	0.19	0.15
- SFENA	1.4	0.58
AMD.BA	15.6	13.38
ESD	3.17	2.4
Luchaire	1.2	0.5
Matra-Manurhin-Défense	0.97	0.97
Matra	5.84	3.04
Panhard & Levassor	0.66	0.66
Renault Vehicules Industriels	13.72	O.6
SAGEM	4.47	1.59
SNECMA (branches excluded)	10.25	4.62
- Hispano-Suiza	1.58	0.94
- Sochata.SNECMA	0.71	0.38
- Messier-Hispano-Bugatti	1.34	0.61
SEP	2.63	0.98
SNPE	2.90	1.84
Thomson-Csf	21.75	16.71
Thomson-Brandt-Armements	0.88	0.88
Turboméca	2.03	1.24

Table 12 - Importance of armaments by industrial sectors in 1986 (SIRPA, Service d'information des armées).

	% total arms spending	% armament of turnover
Délégation Générale Armement	16	100
Commissariat Energie Atomique	15	50
Aircraft industry	35	69
Electronic	25	18
Mechanic and metallurgy	8	5

- There is a considerable need to manage technology within the framework of the relationship between lead companies and their suppliers. The success of military products unambiguously depends on the company's ability to draw upon the services of others enterprises and its clear understanding of the roles and objectives of the industrial contracts. Technology transfers are a very important problem because subcontractors extend their business across the civil/defence boundary and there are conflicting requirements such as competitive mechanisms, secrecy or special quality of the components. The deployment of nuclear submarines requires the synchronization of a dozen different types of technology.

- An increase in expenditure may reflect only an increase in the state's financial effort and not a substantial improvement in the country's nuclear capability. Conversely, one can easily imagine that priorities may be met while maintaining or reducing military expenditure, if the productivity of the arms industries improves and results in lower costs. The pattern of resource allocation is quite stable, even if, for 1989, spending on aircraft has declined in relative terms. This stability has sustained the group of defence contractors, commonly identified as members of the "military-industrial complex". The same group of firms are maintained in leading positions in the defence market, because of their ability to respond to new technology and military requirements. For ten years, capital expenditures have been growing faster than military personnel costs. The French army is becoming more and more capital-intensive and a wider range of objectives must be set for conscription traditionally devoted to the collective feeling of national defence and the reduction of soldier costs, by reducing the costs of electronic, high technology, scientific or management personnel needed for the effectiveness of an organization with high level equipment and relatively unskilled soldiers. Arms enterprises are really in favour of conscription which reduces personnel costs, permits the increase of military equipment orders and facilitates the introduction and use of complex technologies.

Table 13- Capital expenditure by major French military expenditure categories in billion constant francs (1981 value)

Expenditures	1981	1983	1985	1986
Nuclear forces	14,3	15,7	16,9	17,6
Major programmes	11,8	9,1	9,9	11,1
Basic Research	1,8	1,8	2,4	2,4
Development	3,5	3,1	3,8	3,9
Other production	5,9	9,6	8,1	7,2
Munitions	3,1	2,9	2,7	2,6
Maintenance Equipment	2,8	3,2	3,4	3,5
Personnel Maintenance	1,3	1,2	1,2	1,1
Infrastucture	3,2	3,1	3,3	3,2

Table 14 - French capital expenditure by major forces categories in current billion francs

Forces	1987	1988
Nuclear forces	27.9	30.5
Space	0.8	1.4
Conventional Equipment	26.5	26.5
Conventional Studies and Developments	11.0	12.9
Munitions	6.5	6.6
Maintenance Equipments	5.6	5.7
Personnel Maintenance	1.9	2.0
Infrastructure	5.8	5.2

Table 15 - Main programmes in French "Loi de Programmation Militaire"

Programs	Imputation	% equipment effort
Mirage 2000 DA	Conventional, Air	4.7
SNLE N.G	Nuclear Navy	4.3
Mirage 2000 N	Nuclear Air	3.0
M.4.	Nuclear , Common section	2.9
Atlantic N.G.	Conventional Navy	2.3
Tactic vehicle	Conventional Land	1.7
SNLE improvement	Nuclear Navy	1.7
Cannon 155	Conventional, Land	1.7
Hadès	Nuclear , Common section	1.6
S4	Nuclear , Common section	1.4
AMX 30 B2	Conventional Land	1.3
S.D.A.	Conventional Air	1.2
Aircraft carrier	Conventional, Navy	1.1
ACT	Conventional, Air	1.1
SNA	Conventional Navy	1.0
LRM	Conventional, Land	0.9
Syracuse	Space, Common section	0.8
HAC/HAP	Conventional, Land	0.8
AMX Leclerc	Conventional, Land	0.8
ASMP	Nuclear, Common section	0.7
Hélios	Space, Conventional	0.6

Table 16 - Military capital objectives for French "Loi de Programmation" (in billion francs 1986)

Years	Capital allocations
1987	84.127
1988	89.100
1989	94.450
1990	100.120
1991	106.200

Table 17 - Distribution of financial allocations by the French "Loi de Programmation" in percentages

Technical sectors		Consignees	
Electronics	33	Public and private enterprises	66
Aerospatial	25	DGA	17
Vehicles, arms, powder, munitions	20	CEA	11
Shipyards	10	Exports	6
Nuclear	8		
Others	4		

-The "Loi de programmation militaire" foresaw 474 billion francs (80 billion dollars) for military equipment from 1987 to 1991, with 27,9 per cent for common section (the Hades, ASMP, M4, M5, S4, Hélios missiles, Syracuse network), 24,6 per cent for Air (mainly Mirage 2000N), 23.8 % Land (Conventional armament), 21.9 % Navy (mainly SNLE) and 1.8 per cent for "Gendarmerie".

The "Loi de programmation militaire" hoped to develop the industrial infrastructure of domestic arms production. Some civil enterprises not directly concerned in arms production will be involved in military project, such as Creusot-Loire for the construction of machine parts and Société Alsacienne de Constructions Mécaniques for the tank Leclerc progamme managed by GIAT (Groupement Industriel des Armements Terrestres). This objective is ambiguous, because on the positive side, it can be seen as a public will to reduce monopoly and the power of some arms firms, but on the negative side, as an attempt to expand the military-industrial complex which is already very powerful in France.

Table 18 - Main long term French equipment military programmes

Programs	Long termprogrammes Total costs	Number	Delivery date	1989 Delivery	Orders
Nuclear					
- Missile M4	37	80	1987-93	16	16
- Nuclear submarines rebuilding	14.5	5	1987-93	1	1
- Missile M5	73	96	1999		
- SNLE-Ng	68	6	1994-2007		
- S4 Albion	30	36	1996		
- ASMP	6.7	90	1988-91	20	
- Mirage 2000 N	37	60	1988-91	17	6
- Hadès	13.6	90	1992		
- Astarté-Ramsès	?		1988-96	2	
Espace					
- Hélios	6.6	2	1993-95		
- Syracuse II	4	2	1992-95		
Terre					
- AMX 30B2	12	680	1987-91	67	46
- Char Leclerc	45	1100	1991-92		16
- HAC-HAP		215	1997		
- Canon 155	19	500	1992-94	59	17
- LRM	16.4	45	1989-94		17
- Orchidée	6		1996		
- SATCP Mistral			1988	40	55
- VBL et VAB				280	539
- V.Tact and Log.		17500	1987-91	3418	4030
- Super-Puma AS 332					8
Air					
- Mirage 2000 DA and N'	63	225	1988-92	16	27
- Light Cargos	1.97	25		4	
- AWACS	7.75	4	1991-96		
- ACT Rafale	142	250	1998		
- Missiles AA 530D & Magic					330
Sea					
- Nuclear PA	23.9	2	1996-2001		
- SNA	14	8	1982-97		1
- Light Frégate	6	6	1994-2000		
- Supervision Fregate	2.4	6			2
- BAMO (anti-mines)		10	1992-2000		3
- Crusader modernisation	1.15	20	1993-96		
- ACM Rafale	12	70	2004		
- Atlantique 2	26.3	42	1990	1	5
- Hélico NH 90		60	1998-2008		
- Torpille Murène					30
- Missile SM 39					7
Gendarmerie					
- Terminaux Saphir		15300	1987-90	1100	
- Réseau Rubis	2	22000	1993-97		
- Véhicules				11 VAB 335 VTT 2264 others	

C) Price formation

There are three broad categories of military products : goods destined only for defence market (nuclear warheads) or markets reduced by military secrecy (sonar equipment), common products with significant differences between defence and civilian markets (aeroengines) and products which are identical or nearly identical (memory chips). The military returns to civilian innovation increase with the similarity of products and markets. The present trend seems to develop completely specialised and sometimes unique goods (without any economy of scales) and then military conversions to civilian applications are more and more rare, thus reducing the efficiency of the military sector for national economic development. Military goods are constantly changing in quality over time. This means that the cost structure of military items constantly changes from one period to another.

The prices of military hardware do not therefore reflect the influence of a competitive market and they very often relate to a project under development rather than an immediately available product. There are two main situations :

- controlled expenditure contracts where the price is determined retrospectively on the basis of the accounting cost plus a profit margin,
- and fixed-price contracts in which the prices are fixed from the outset.

The first form of contract is more common when the sums involved are considerable and uncertain. This method of fixing contracts shows the secondary place of prices in the purchase decision. The measurement of military expenditure price change offers some special problems : timing of the price decision, long-term contracts, transportation charges, introduction of new technology. There is a frequent occurence of military outputs without a market price or without adequate market pricing. If there is a price, it may not include all costs. Moreover, it is not uncommon for fixed-price contracts to undergo significant price changes, either because the consumer wants the initial project to be modified or because of unforeseeable factors which call into question the continuation of the project. Development costs are notoriously difficult to control, even in a commercial environment. The DGA has set up a body of price auditors but their practical usefulness has sometimes been questioned.

Since it is costs which respectively fix and control prices, performance criteria mainly depend on the efficiency of the industrial

sectors in directly or indirectly connected to the arms industry. A major influence on the unit cost of weapons is the scale of production. There have been numerous cases in France where costs have overshot forecasts but they have not often been the subject of public debate. It must be said that military secrecy is more developed in France than in the Scandinavian or Anglo-Saxon countries. Arms firms are, for the most part, nationalized, they have a high degree of monopoly in their own production sector, and they are dependent on a price formation system that reduces risks but also reduces their essential economic dynamism. Often, costs do get out of control, but such cases are not affected by direct competition or by any limits to the desire to obtain the government contract at all costs. Overshoots are due to cumbersome bureaucratic management, sometimes seeking to prolong a contract as an additional level of activity during a period of economic recession, to research or technological difficulties which are partly the State's responsibility, to the modification of the project during its execution, or to the risks inherent in any industrial activity. Normally, military products tend to have high costs because of the importance of the research and development element, which is about 30 per cent of the cost of military aeronautical products, compared with 4 per cent of the cost of a car, because of poor economies of scale (doubling the sales of an aircraft would reduce its cost by only 10 per cent on average, which is certainly less than the economies likely to be achieved by strict management of the project) and because of the specific nature of arms production equipment.

Profits from arms activities are very important. For example, in spite of the international crisis, Thomson-Csf has been able to find 12 billion francs for its own financial needs in the three last years. But manpower declined from 78000 workers in 1982 to less than 47000 in 1987. Since 1984, Dassault, Snecma, Aérospatiale have reduced the number of their workers respectively by 1500 (9 % of the total), 800 and 2650 (more than 13 % of the total). In 1987, 94 per cent of the turnover of Thomson-Csf was produced on military products, against 31 per cent in 1982. Alsthom obtained orders for military vessels to the detriment of the arsenals.

D) Trends in equipement costs

- High value technology end products have differing characteristics from civilian consumer goods. The defence industry is obviously more capital intensive and less labour intensive than many civil industries and this characteristic seems to become more and more marked. Defence enterprises require a higher proportion of scientists,

researchers or engineers than civil firms which, when combined with high capital investments, make fixed costs a substantial part of each business.

Other characteristics of the arms industry are :

- high R&D costs,
- rapidly advancing technology,
- extreme complexity of technological and industrial organisations,
- long lead times before deployment,
- government as the only ultimate customer in a semi regulated market,
- a relative low price elasticity of demand,
- marketing and distribution costs lower than for equivalent civilian goods,
- sharply limited spin-off opportunities and
- secure and moderate profit margins.

Defence has historically stressed maximum performance (almost independent of what it costs) and the defence establishment is constantly emphasizing engineering challenges. Because of the high cost of individual weapons and the competition between military services, the annual quantities procured from any given production line tend to be very small and to become extremely intensive in engineers labour. The military's own specifications are not always justified, but there exists a strong belief in the necessity of tailored materials, with very high additional costs for a small technical advantage.

- The acquisition of weapons systems is a time consuming process, combining high technology, high value but limited numbers of end products which substantial programme risks. Military developments may be in the forefront of technology and thus may require proportionately greater expenditure to solve problems. In fact, in the case of two similar pieces of equipment, the more sophisticated and more expensive piece is always chosen ; sometimes, the purchase itself is deferred in order to meet technological and budget constraints at the same time. This behaviour certainly does not lead to the definition, for a known budget level, of optimum security choices ; in effect, over-bidding on technology certainly occurs, encouraging the development of inflationary pressures. The marginal costs of research and technology would therefore seem to be very high for limited military effectiveness. In other words, it would be preferable to eliminate these costly improvements in order to increase the amount of equipment available and, on the whole, to

improve security. The question of the choice and characteristics of equipment should be clearly put, since there are obviously budget constraints. Technological monopoly and expertise can lead to market disequilibrium before technology diffusion occurs. It is important to place greater emphasis on manufacturing efficiency, but this policy may endanger technological advances over time, given tightening resources and limited incentives. Because of the extremely specialized nature of defence products, defence-oriented firms have been created, which are totally dependent on the Ministry of Defence and which develop the so-called "military-industrial complex". Thus politics, rather than military need or economic efficiency, become the main force behind military programmes and the defence budget.

- Is equipment chosen on the basis of lowest cost or under conditions comparable to those that prevail outside France ? It does seem that continual increase in prices is a modern feature of military equipment. The studies which have been carried out on this subject have indicated real rates of growth of prices of 8 per cent and 5 per cent per annum. Military aircraft experience very considerable cost increases, as do fighting ships, and, to a lesser extent, tanks. Development costs are spread over fewer units because of smaller and smaller production runs. It should be noted, however, that it is very difficult to compare the prices of weapons from different generations. These figures are moreover only significant as illustrations, since, in military conflicts, an unsuitable weapon is an obsolete weapon with a low degree of effectiveness. Under these conditions, even if the price of an aircraft has increased five-fold in five years, if this aircraft is capable of destroying more than five aircraft of the previous generation, its effectiveness is beyond dispute. The key question is whether the General Staffs are over-concerned with technology and as a result, anxious to have the best aircraft, end up unwittingly reducing the country's defence capability by reducing the amount of equipment available, by renewing the equipment less often, or by drastically reducing operating costs. The requirement of defence independence implies that when projects arise at intervals, there are overhead costs involved in maintaining teams and facilities in the periods between projects.

- Unit costs of military products are often very imprecise : from 40 to 50 million francs for the Leclerc tank, 65 to 100 million francs for HAC helicopter, 120 to 150 million francs for the Mirage 2000 aircraft, 220 to 350 million francs for the Rafale aircraft, about 1 billion francs for the light frigate, 2 billion francs for the SNA submarine, 11 to 13 billion francs for the nuclear submarines SNLE and about 14 billion francs for an aircraft carrier, without arms costs, ammunition or other additionnal equipments From the

forecasting of costs, there were over-runs of 26 per cent for the Leclerc tank, 19 per cent for the new generation SNLE and 13 per cent for BAMO (ocean anti-mines equipments).

- There are few incentives towards integration of civil and military engineering and production. Even firms working in both fields have tried to specialize in defence products, because of "unique" military requirements and the special weapons markets. Integration would have negative effects on the French trading performance, because of, first, the technical and non-economical nature of modern weapons, second, the unfair advantage of firms which have defence contracts and third the failure of conversion attempts. Sometimes military and civil products are substitutes, especially when critical bottlenecks appear. Although some recommendations have been produced by the public authorities in order to improve "commercial practice" in the whole defence arena, the results of this exercise are not very valuable. Integration would be the result of a State decision, which is not actually strongly based. Ideally, integrated civil and defence productions benefit from economies of scale, introduce cost consciousness and improve the commercial performance through continuous competition. In this kind of argument, civilian enterprise management is supposed to be stronger than military production habits. Unfortunately, after an important improvement at the beginning of dual production, gradually the military contracts advantages tend to pervert the normal functioning of enterprises involved in a competitive market.

E) The industrial decision

the government decision to construct Rafale is very important, for many reasons :

- The Ans (supersonic antinaval missile), which might succeed to Exocet was a good project in collaboration with FRG. This programme between Matra and Mbb has been interrupted for 4 years by Mbb under pressure from German pacifist opinion which condemned it as an offensive weapon. Thus the complete programme is under threat and even the unions accept that France is in danger of technical delays. The question now is wether it is possible to develop this missile alone, as France will have probably to do for the Super-Asmp missile project which meant to re-equip Mirage IV, Mirage 2000 and Super-Etendard. If the national military industry abandons these projects, technical leadership will definitely be lost.

- The French unions are clearly in favour of the Rafale project, with a forecasted total cost of 130 to 180 billion francs (between 20 to 30

billion dollars) because Amd-Ba (Avions Marcel Dassault-Breguet Aviation) is very involved in military programmes (75 to 80 per cent of total turnover) and to drop the project would add 10,000 to the unemployment figures. The Reagan-Gorbatchev process of disarmament is still modest and it is not possible to have defence credibility without national space control. France needs 336 units (250 for the Air force and 86 for the Navy). Thus the forecasted scale of production are not negligible. National independence has a price and unions think that it is useful to maintain a technological know how for the long run.

- The european programme was not so interesting in economic leverage. The United Kingdom, the FRG, Italy and Spain will have to pay 340 billion francs (55 billion dollars) to produce the programme and in this case, cooperation does not reduce the costs. With each country's specifications to take into account its own defence, the Ace aircraft is not adapted to the logic of the deterrence strategy which dominates France's defence effort. The German and British armies want a heavy offensive aircraft (14 tons), even though the French army would prefer a light defensive aircraft (8 tons). If the project had to take account of the French basic specifications, the unit cost would rise and then an economic comparison between Ace and Rafale would not not necessarily be in favour of the european project.

- The missile Mica for Rafale is not clearly defined and nothing has been decided on the location of the plant. It is possible that Matra will decide to produce them in a foreign subsidiary. For example, Matra which is clearly suffering from the crisis of Dassault (it was the main arms equipment supplier for Dassault), has a project to build, in competition with the U.S. Stinger, the Mistral, a light anti-air missile, which can be launched by an infantryman. For many years, the Mistral will represent the major part of the Matra's activity. More than one thousand and eight hundreds units per months would be built, but the Matra's chairman does not want to invest in new plants, although national capacity does not exceed 500 units. Thus the French Mistral could be fit assembled in Italy or Spain.

II. MILITARY R&D

Before the Second World war, modern weapons were the result of civil technology adaptation. Since 1961, the Délégation Ministérielle pour l'Armement (DMA) and since 1977 the Délégation Générale à l'Armement (DGA) have had the main responsibility for military R&D. The most important characteristic of defence research compared with civil research is its very high level of integration, because the executives in charge of the design and development of the weapons and those in charge of their use are under the authority of the omnipotent Minister of Defence. Concertation among all partners is possible. Research is mainly conducted by departments, especially the "Direction des Recherches Etudes et Techniques (DRET), controlled by the Délégation Générale pour l'Armement and the Direction Centrale du Service de Santé des Armées (DCSSA). DRET is entrusted with the co-ordination of upstream programmes and is in charge of conducting research work, in particular basic research. The "Conseil des Recherches et Etudes de Défense" which brings together the Minister (Chairman), the Chiefs of Staff, the General Delegate for Armament and high-level executives in the Ministry determines the main technological and financial directions for military R&D.

Table 19 - French Public R&D Financing in billion ECUs (at current values)

Years	FRG	Italy	U.K.	France	EUR-10	USA		Japan
						Total	Civil	
1980	6.53	1.30	4.14	5.30	19.47	20.6	13.8	4.65
1981	7.06	2.06	5.99	6.76	23.98	30.2	15.3	6.57
1982	8.13	2.26	6.58	7.34	26.59	36.8	14.0	6.84
1983	8.41	2.80	6.81	8.18	28.74	43.6	13.8	8.14
1984	8.67	3.37	7.29	9.08	31.09	56.0	14.9	9.50
1985	9.45	3.67	7.78	9.93	33.66	66.2	16.1	
1986	9.32	3.37	7.89	9.88	33.29	61.1	15.9	
1987	9.94	4.14	7.33	10.65	35.05			

A scientific discovery has generally more than one application and thus it is often not possible to establish a clear distinction between military and civilian technologies at any stage prior to development, testing and procurement, because of the nature of innovation and research.

There has been a very important european R&D effort in recent years, in order to compete with Japan and The United States. In comparison with civil R&D, military R&D does not seem as important for France.

But there is a lot of dual research such as on mineral, oil and natural gas prospecting, transport and telecommunication systems, radioactive polution, fossil fuels and their derivatives, nuclear fission, nuclear fusion, general research on industrial production, products of the chemical industry, aerospace equipment, shipbuilding and repairing, electronic engineering, exploration and exploitation of space, etc.

Table 20 - Public R&D Financing by categories of NABS in 1986 (in million ECUs) for France, the FRG, the U.K. and Italy

	France	FRG	U.K.	Italy
- Exploration and exploitation on the earth	158	206	123	47
- Infrastructure and general planning of land-use	347	187	99	38
- Control of environmental pollution	50	325	54	41
- Protection and improvement of human health	402	296	274	183
- Production, distribution and rationalization of energy use	761	1045	335	719
- Agricultural production and technology	385	197	335	152
- Industrial production and technology	1297	1422	493	793
- Social structures and relationships	315	233	95	45
- Exploration and exploitation of space	625	449	132	286
- Research Financed from general University funds	1256	3160	1092	1185
- Non-oriented research	1617	1172	496	292
- Other civil research	124	12	20	9
- DEFENCE	**3312**	**1236**	**3782**	**349**
- TOTAL	**10649**	**9942**	**7329**	**4140**

A) Military R&D outlays

The concept R&D covers a vast range of various activities, such as basic research or the improvement of production procedures. Military R&D is not exclusively devoted to making advances in the area of destruction but also protection, both swords and shields. But it is very difficult to obtain very precise figures on R&D. In France, official publications give different figures, with the same title. The comparability of data between sectors is not very easy, because for a nuclear submarine it is very difficult to define exactly what is development and what is production. The relative importance of military R&D in the total national R&D programme gives rise to continued debate. Estimates of private funding of military R&D, even when available, are not entirely reliable, either with respect to their accuracy or their coverage. The release of information by private enterprises is determined by a concern for commercial secrecy, to get public contracts or for exports. French industry is not sufficiently involved in the R&D effort (43 per cent vs respectively 59, 58 and 66 per cent for USA, FRG and Japan). Annual licences deposits are 160,000 in Japan, 30,000 in FRG and only 12,000 in France. The importance of military R&D is perhaps a partially explanation of this sate of affairs.

Private French military R&D which was very small before 1975 (less than 20 per cent) grew bigger and bigger (60 per cent for some enterprises) when the international arms market was very active due to the security efforts of the OPEC countries and now it is getting smaller and smaller in the crisis of the arms industry.

Table 21 - French public R&D outlays (Ministry of Finance) in million francs

	1986	1987	1988
Ministry of Research and University			
- Research	21938	21040	21340
- University	7008	7040	9220
Commissariat Energie Atomique (Nuclear)	4016	3761	3890
Telecommunications	3834	3848	4580
Electronic	2865	2543	2310
CNES (Spatial)	4210	4376	4760
Defence	25780	30750	29150
Civil Aeronautic	2662	2192	4410
CEE with CERN (Nuclear)	800	696	1350
Miscellaneous	2588	2551	4680
Total	75671	78797	85690

R&D represents 30 per cent of the cost of the equipment delivered to the French Armed Forces, and upstream studies represent about 35 per cent, at least, of total R&D expenditure

Table 22 - French main military R&D expenditures and programmes

	1987	1988
Programme authorizations		
Nuclear forces	10.55	11.82
Space	1.58	2.39
Conventional forces	14.59	15.49
Total	26.73	20.70
Payment allocations		
Nuclear forces	10.05	11.60
Space	0.53	1.09
Conventional forces	10.96	12.95
Total	21.54	25.63

Table 23 - Main areas of French military R&D

Technological areas	Contents
Computers and automation	Computers Applied mathematics Data processing Guidance, navigation Robots, automatics Big computers with vectorial calculations
Telecommunications and detectors	Telecommunications Radar Sonar Pipes and hyperfrequency apparatus Signal treatment
Enrironment and general physics	Optics Thermics, Acoustics, Measurement Earth science Basic physics ans plasmas Infrared applications
Quantic electronics	Lasers sources Lasers propagation Lasers applications Non linear optics
Semi-conductors and components	Semi-conductors Materials for electronics Components Solid-state physics
Fluid mechanics and physics	Aerodynamics Hydrodynamics Noise and vibrations
Chemistry and Energy, propulsion	Electrochemistry Chemistry Thermic materials Ergols propulsion Electrotechnics Detonics
Materials and technology	Technology Structure arithmetic
Biology and Human Sciences	Chemical-Pharmacology Biology-Physiology Ergonomy Psychology Sociology

It is not very rigourous to compare the productivity of Japan and FRG with French R&D, because the first two countries do not take resposibility for their own defence. Moreover, the efficiency of military R&D must not be measured only on short run economic spin-offs, because improvement of national security, international influence or power, prestige and science progress are also desirable objectives in the long run.

B) Economic role of military R&D

The economic role of R&D is not the same in every country. The United States is very proud of its high technology and it seeks a lot of new directions for research. France discovers what the best avenues of research are, and tries to finance only the most promising innovations, because it is not possible for her to waste her R&D resources and thus only a few technical possibilities are tested. But, ever since the post-war reconstruction period, France's relative weakness in exploiting the results of R&D and her relative slowness in applying new technology in the economy have been apparent. Too often, new technology costs money in France but earns money elsewhere.

Although most analysts have failed to find evidence of a similar direct productivity impact of State R&D expenditures, they nevertheless consider that public R&D may nevertheless have a considerable indirect impact (positive ou negative) on total factor productivity if it influences private R&D investment decisions. There are three main hypotheses : the crowding-out, spillover and demand-pull effects.

- **The crowding-out effect** is predicated on the assumption that military and civil R&D employ similar types of resources, such as engineers, scientists or equipments. In the USA, it has been proved that federal R&D spending had a determinant influence in the starting salaries of engineers and scientists. In France, no study exists on this hypothesis. But, when military and public R&D become a main State objective, then government can try to attract high skilled manpower and to do so improve the wage rates of graduating scientists and engineers in the short run, even though the supply of graduates is much more elastic in the long run. In France, State R&D personnel are sometimes public servants ; so that, if higher wage rates are perhaps on incentive, it is not always possible to raise them, because of public servant status. To increase operations and maintenance, procurement and construction is easier than to increase salaries, except for indirect and non-cumulative payments such as bounties or special subsidies. The crowding out effects may

occur when very specialized engineers are requisitioned by military sectors, thus provoking bottlenecks for civil production or when limited financial resources are allocated directly to arms production. In France, these effects certainly exist, but it is not obvious that they are very important, taking account of the high degree of complementarity between military and civilian R&D in the present structure of defence in France.

- **The spillovers of military R&D** generate knowledge which can be cheaply or costlessly exploited by civilian R&D and which increase the productivity of the civil sector. The larger the stock of knowledge-capital, the smaller the quantity of civil R&D needed to produce marginal improvements in products and processes. But, it is possible that in some instances the value of the spillover is negative, when the applications of military technologies, such as Concorde for example, have been a financial disaster for public utilities, their customers and the citizens. For five or six years, French governments have been trying to develop spillovers. The study of Schankermman and Pakes on the value of patent rights in the U.K., France and FRG during the post-1950 period indicates that there is a dense concentration of patent rights with very little value... The general picture of a sharply skewed distribution of the value of patent rights emerges clearly in all three countries. Basic research certainly offers the greatest prospects for generating beneficial knwledge. Because of secrecy and the highly classified nature of much public-supported activity, the special development of hardware and the differences between military and civil types of thinking, there is very little potential for the commercialization of military R&D.

The demand-pull effects can result in the demand for technology producing innovation. Military R&D stresses the role of market and production opportunity in innovation. It is often difficult to know if there really is a demand-pull effect (short run theory) or a **technology-push effect** (long run theory, which insists on the role of supply factors in explaining variation in research activity). Because of the "military-industrial complex", it seems that in France the technology-push effect in military R&D is predominant.

Table 24 - Outlays of military R&D in million current francs (by the Ministry of Defence)

Year	Outlays	% Public Budget R&D
1976	5,05	28,3
1977	5,95	29,2
1978	7,55	32,4
1979	9,35	34,3
1980	11,35	35,7
1981	17,67	39,0
1982	17,86	35,5
1983	20,31	33,7
1984	22,98	33,2
1985	23,62	31,5
1986	25,78	34,7
1987	30,75	38,3

Table 25 - Main categories of outlays of military R&D in constant francs 1981 (Ministry of Defence)

Outlays	1981	1982	1983	1984	1985	1986
Basic (Capital)	3.4	3.6	3.4	3.9	4.3	4.3
- Conventional	1.8	1.9	1.8	2.1	2.4	2.4
- Nuclear	1.6	1.7	1.6	1.8	1.9	2.0
Basic (Personnel)	0.3	0.3	0.3	0.3	0.3	0.3
Developments						
- Conventional	3.6	3.8	3.1	3.6	3.8	3.9
- Nuclear	6.0	6.2	5.7	5.6	4.8	4.7
Total R&D	13.3	13.9	12.5	13.4	13.1	13.3

Table 26 - Main sectorial outlays of military R&D in 1985 (percentage of total)

Nuclear	21
Electronic	28
Land Vehicules	3
Shipbuilding	5
Aircraft	17
Engines	15
Ammunitions and others	11

The main characteristics are :

- For the computer sector, the leadership of the military area is declining and often civil products are more complex than military products. Military computer R&D is sometimes important for development, but not for fundamental research.

- Without military purchases, naval shipyards would be in a deep economic crisis. The civil spin-off of military naval R&D is very small except for composite materials and very rarely in electronic equipment.

- The relations between military and civil aeronautic products are very ambiguous, because of the dual applications of these products. But it is very difficult for a country to build an aerospace sector without military purchases.

- There is no spin-off from nuclear weapons programmes which could profit the civilian nuclear industry and results are so extremely secret that access is not permitted for civilians.

- Military R&D represents more than 12 per cent of the military budget, a third of the R&D State budget and more than a fith of the national effort on R&D. In 1988, more than 24 billion francs went to private or public industrial enterprises for military R&D. In 1989, DGA will entrust 60 per cent of its military R&D to enterprises, 15 per cent to the universities and 25 per cent to itself. For Aerospatiale, R&D outlays represent 23 % of turn over and the military programme, entirely financed by public funds, financed 75 per cent of the total R&D. More than 20,000 highly skilled workers are employed in military R&D, but this figure seemsvery low in comparison with international data.

- Military products are very voracious of R&D and especially of electronics (40 per cent of the new Leclerc tank is devoted to electronics). Actually, R&D represents 30 per cent of the price of military products and this percentage is clearly growing.

Table 27 - Total French R&D manpower (thousands)

Countries	1965	1979	1984
USSR	541	1298	1560
USA	494	620	675
Japan	118	282	350
FRG	61	122	160
UK	50	88	100
France	43	73	80

26000 persons are assigned to R&D activities within the Ministry of Defence, the Commissariat à l'Energie Atomique (6000) and the State-controlled establishments. This represents 30 to 35 per cent of total R&D personnel (engineers and searchers). By wider definition, more than 270000 persons work for French R&D.

Tableau n° 28 - Personnel of R&D administrations or departments in France in 1987.

Organisations	Scientists and engineers	Others	Total
Administrations and public systems	29450	57690	87130
University	25780	14410	40190
Non profit associations	1460	3260	4720
Enterprises	41520	96330	137850
Total	**98210**	**171680**	**269890**

Indices of R&D prices indicate that R&D is clearly cause an subject to inflation. It is interesting to note, that notwithstanding the differences between countries general index prices, it appears that countries with substantial military R&D had more inflation in their index of R&D prices. We can therefore consider that military R&D, because of the urgency and importance of its objectives, is not very influenced by economic constraints and becomes a clear source of inflation.

Table 29 - Index of R&D prices (from Eurostat)

Years	FRG	France	Italy	the United Kingdom
1980	100	100	100	100
1981	105.4	113.7	120.6	112.3
1982	109.9	128.2	141.0	121.7
1983	113.7	141.1	162.3	130.0
1984	117.0	151.6	180.3	136.8
1985	120.1	161.3	197.5	146.3

Proponents of military programmes maintain first, that there have been substantial technological spin-offs (for example, on jet engines, computers and nuclear power) and second that State funding on R&D would not have been available for civilian R&D (so the military programme must be seen as net additions to the civilian effort rather than substitutes).

C) Military technology vs civil technology

The defence and civil research organisations are independent of each other, but there exists a lot of links between them. For example, the "Office National d'Etudes et de Recherches Aérospatiales (ONERA) which is under the control of the Ministry of Defence works with civil aeronautics as well as military aeronautics ; thus basic research is applicable to all types of helicopters or aircraft. It is the same with the "Bassin d'Essais des Carènes", the civil part of CEA and with the "Centre National d'Etudes Spatiales" which are respectively the only naval hydrodynamics, nuclear and space authority establishments in France. There are some agreements between military R&D Centers and "Centre National de la Recherche Scientifique" (CNRS) or "Centre National d'Etudes des Télécommunications" (CNET) which are respectively the most important fundamental and telecommunications research agencies in France.

More than 60 per cent of R&D expenditures are incurred in the industry, and thus technology transfers from the military sector to civil activities is easily feasible. In 1984, DRET created an "Mission Industrie" to inform small and medium-sized enterprises of defence research results and to ensure that these results are applied in both civil and military sectors, trying at the same time to detect new technologies, originating in this kind of enterprise, which could be

integrated into future weapons systems. This Mission bas been in touch with 1200 enterprises and 15 per cent of these contacts produced effective exchange of technologies. There is now a lot of wide variety of initiatives from the Ministry of Defence to enlarge the base of innovation.

Now France needs :
- An adequate level of scientifically and technologically skilled management, aware of the economic, social and cultural issues involved,
- a market large enough to provide an adequate return on investment in R&D and production,
- international cooperation and restructuring.

But the concrete conditions do not match these requirements and european programmes are not able to bring long term solutions to the latent crisis. Eureka and the Common Research Programme adopted in 1987 strengthen the integration apparatus. These programmes are specifically civilian, but in practice, they give priority to work on dual technology, both civilian and military. Military applications are clearly, for the European Commission, a desirable objective which will develop the common interests of EEC countries. Some French people think that these programmes encourage a specialization on civilian and industrial technologies for the FRG and on basic research and military technologies for France. Some developments such as the decision of CGE and CEA to concentrate their investments on military lasers to the detriment of civilan applications, on which Siemens will concentrate, could confirm this hypothesis. There is concern for naval shipyards and engineering.

Military spending is mainly unproductive in terms of opportunity costs. The conversion of resources to civilian sector is seen as likely to improve the performance of national economy. The countries with the highest military burdens compete less well in world markets. Correlation does not establish causality. It depends on the nature of R&D, on the will to seek civil applications, on the secrecy of military R&D, etc. Civilian spin-off effects of military R&D have been considerably exaggerated and the civilian spin-off effects on military R&D are not often analysed. There is considerable evidence that many new technologies now being sought in the military-security sphere were initially generated in the commercial sphere.

Table 30 - Spin-offs military vs civil

Military R&D	Civil R&D
Nuclear energy	Nuclear reactor
	Nuclear propulsion of oil tankers
Propulsion	Urban bus
	Helicopters
Aerospace	Knowhow
	Engines
Electronic	Air traffic
	Landing systems
Optronic	Laser
	Sprectroscopy
Information	Computers
Miscellaneous	Meteorology

Some analysts argue that military R&D has significant spin-offs for the civilian sector, that research in the military field yields civilian applications as a by-product (radar, computers, electronics for example). Spin-offs are also used as an argument for European participation in the Strategic Defence Initiative (SDI) developed by the government of the The United States. In this version, SDI would produce goods directly useful to the civilian sector and would be the occasion to get insight into modern U.S. technology. The other school of thought considers that spin-offs are very low and become lower and lower. For example, integrated circuit or silicon ships were developed by commercial firms without any military funding. If early development such as radar, jet engine or transport aircraft or more recently semiconductors, fiber optics, lasers, nuclear power, satellite communications, composites materials are presented as successful technology transfers, these efforts to stimulate development and expand markets, represent quite limited contributions, taking account the importance of civil transfers to military products. The growing importance of new materials, lasers, sensors, advanced energy devices, computers inevitably will lead to a growing overlap of defence and non-defence technologies.

- Moreover, non defence firms exploit technology and achieve economies of scale. Often, large arms enterprises tend to be risk minimizers rather than innovators. The problems of measuring the contributions of military R&D is very difficult, because of the unavailability of direct and relevant measures of the output of the R&D process and the need to use indirect measures such as aggregate productivity growth which reflect imperfectly the contribution of R&D investments.

- Technology transfer between military and civilian sectors involves adapting technological information from a technical priority to an economic priority. There is a widening gap between defence and commercial planning processes, due largely to increased emphasis on short term returns for enterprises. The distinction between military and civilian technologies is fairly clear for nuclear missiles and submarines but less obvious for helicopters or computers. These military products are distinguished from their civilian products by greater ruggedness, higher costs and specialized components. When there is a dual-use technology, then the government must take account of the COCOM list which forbids free trade with the USSR. Military secrecy, special military requirements which are not relevant to civilian applications, emphasis in military programmes on product innovation over process innovation, the **"megalomania" of military products** (which produces "baroque" civil technology), the businesses' segregation of military work, pricing practices are very important barriers to the diffusion of technology from the military to the civilian sector. While there are some applications where the results are not so good in commercial terms, such as Concorde, applications such as liquid crystals, portable satellite communication links, night vision equipment and carbon fibres are successful examples of civil spin-offs. The underlying military technologies have separated into civilian and military streams ; production for military products does not result in the development of cost-effective production practices or highly competitive processes. Sometimes, military R&D has clearly clearly negative effects on economic development, for example, in France, when military choices stopped the development of the transistor and small computer industries. While the military sector systematically surveys civilian programmes with respect of the take-over of potential technologies, the reverse process rarely occurs because of secrecy. Although civilian R&D priorities rarely influence military R&D programmes, the reverse is frequently the case.

- On the positive side, military interest in a new technology improves its development and it is possible to think that its incorporation into final civilian products is quickened. Government assume the risks of

introducing the new technology by a guaranteed and high priced market. But secrecy and specialization in defence firms reduce this positive effect. The loss of the scientific and engineering resources devoted to military sectors is only partially offset by the possible civilian applications of some new technology. Incentives to improve productivity are weak within the defence sector. The long-run consequence for the economy is to encourage growth along technological lines that have their origins in military priorities. Military spending for research and development has dominated the national R&D programme and thereby influenced the direction of technological changes.

- Kurt Rothschild suggested that the receptiveness of spin-offs from the military to the civilian sector is dependent on the state of the economy ; it is very low during an economic depression and high during a boom phase. This analysis may. be interesting for the USA, but for France it seems inadequate. During recession phases, civilian R&D tends to be reduced because of the lacks of opportunities and of financing. Military R&D maintains a sufficiently high level of expenditures, in order to allow the scientific teams or centers to follow their tasks. During the boom phase, there are some substitution effects which are not often in favour of civilian R&D. In this case, spin-off is widely considered as a non-planned, accidental product, because military R&D is not geared towards civilian industries or towards the military products departments involved or in tight connection with civilian departments.

- The problem of confidentiality occurs from the first start-up phase and is most important in the R&D process. The process itself of dividing the R&D process into phases is possibly a way of reducing the effects of uncertainty. By putting at risk the smallest levels of resource expenditure in the earlier and more uncertain phases, managers aim to avoid catastrophe. Now, military R&D reduces the importance of uncertainty for private firms, even if the division between Civil and Military R&D is far more marked than in the past.

III. EXPORTING and IMPORTING ARMS

France decided to have an aggressive export policy in order to facilitate its independent military technological base and arms design was a compromise between national defence needs and the profiles of exportable arms systems. Even if there is a severe slump in sales in the1980s, French arms industry ranks third for arms exports.

A) Main arguments

The question is whether national arms production is still justified. Several economic arguments are generally put forward :

- the importance of military research is fundamental to the competitiveness of national R&D ;
- national industries need military orders in high-technology sectors (like computers and aeronautics) ;
- imports are subject to price fluctuations stemming in particular from erratic exchange rate variations (at a time when the value of the dollar was continally increasing, Sweden had to increase her defence budget, by a multiplier coefficient mainly determined by the exchange rate of the dollar, to satisfy her military planning) ;
- national production saves foreign currency and improves the balance of payments and
- the arms manufactured exactly meet the nation's defence requirements.

Technological success is dependent upon educational systems, the volume and distribution of research and development investment and innovative orientations. Despite the emergence of new arms supliers, the technological hierarchy of defence production remains in place. A reduction in R&D effort could have two additionnal effects : first, the French arms industry would loose its military competitiveness in the quality of weapons and so would abandon its markets ; second, military R&D would not be replaced by civil R&D and so there would be a major crisis for innovation and high technology in the country.

These arguments are difficult to evaluate from a strictly economic point of view, especially as the French industry has definite handicaps - such as the limited domestic market which leads it to look for outside outlets on which it becomes dependent ; the inadequate productivity of French aerospace compared with the American industry

; and the dissipation of industrial efforts among all types of arms. If the domestic market is not adequate in a depressed conditions, the risks of selling at a loss abroad and of paying the research and development costs and part of the fixed costs for one's customers are considerable ; in this case, it is the desire for independence and security leads to the additional costs. **Some exports impoverish a country, although not the enterprises concerned.** It is not obvious that, over the long run, France'a arms exports do not fall into this category.

Given the size and volatility of the international market, the poor demand and the entry of many new competitors the likely return from arms exports is not great, particularly in terms of opportunity costs.

B) Domestic production versus imports

France imports few arms, about 1 per cent of the equipment bought each year according to US Arms Control and Disarmament Agency (USACDA) estimates. However these figures are misleading because they do not take into account equipment manufactured collaboratively, of arms manufactured under licence or imported components necessary for the manufacture or assembly of arms. In fact, much of France's production is dependent of imports. For instance, armaments exported induce 30 per cent of components imports. There is some ambiguity about what distinguishes an import : whether the crucial characteristic is that it is made in France, made by French-owned firm or made with French technology. In several sectors of manufacturing, the products of foreign-owned companies are more French than the products of French-owned companies.

For the Rafale programme there are some questions which are not resolved yet, particularly for the naval version. France will have a transition problem between 1994 and 2000. The renting of U.S. F18 aircrafts was studied, but that solution was rejected on technical grounds (weight, radar signature, modernisation needs), economic grounds (costly adaptation, large operating costs, costs duplication), industrial grounds (with large investment for a temporary solution, temptations will appear to maintain F18 against the naval version of Rafale and to replace Super-Etendard for the years 2000-2005), export grounds (sales arguments for US competitors of franch military aircraft). Even if there are some industrial compensations for a foreign solution for the transition period, on the long run, this choice was rejected by a parliamentary report.

Compared with foreign countries, France, apparently, does not have high production costs. In particular, French military R & D costs seem far lower than those in the The United States, Italy or thethe United Kingdom. Moreover, an armaments industry that exports is normally able to supply products at satisfactory prices for its own domestic market, if it does not allow itself to be tempted by dumping or by-selling at a price which only covers fixed costs. If a weapon is imported the buyer may gain part of the advantage accruing from the seller's longer production run. For short production runs there is little return in investing heavily in cost-reducing equipment and process innovation. Thus, the cost of a weapon is often less important by imports, but the exceptionnal quality of the weapons, the absence of competition for technical or political reasons or the importance of the international military supply may be more appeciated characteristics. Conversely, the foreign buyer sometimes pays for part of the research expenditure, particularly when the product concerned is much in demand, when the arms market is not too saturated by competitive tenders or when the export contract is awarded even before the product concerned has been developed.

A further uncertainty is added to the costing when the equipment is imported : fluctuations in the exchange rate, even if commercial firms have a wide variety of methods of hedging longer-term contracts againts exchange rate risk. Arms import contracts tend to be complicated, involving offset deals, credit terms, counter-trade and various elements of a complete package. As a result the real price is difficult to estimate. The bargaining power of buyer and sellers will depend on the extent of the competition. If the equipment supplied by various firms is very similar, if not identical, the buyer has scope to substitute and the price will be forced down. If the supplyer is in a monopoly situation and the equipment is essential to the potential importer, then the price may be high. Currently, the arms export market is very competitive and many governments have subsidised the development of indigeneous national industries for political and sometimes economic reasons. This creates strong pressure to export, with cheap credit for importers, and sometimes prices get forced down towards marginal production cost which is much less than average cost. In the past, arms exporting countries tried to obtain political advantages, now importing countries want low prices, without political implications.

C) Exporting arms

It is difficult to distinguish whether some particular transactions, such as aircraft or electronics components which have a dual use, should be classified as civil and military. In the arms market the transaction price is rarely well defined. The transfer takes place as a part of a package involving the equipment itself, spares, training, access to technology, export credits, insurance for payment, offset agreements and counter-trade arrangements. Hence, the national exports figures are very difficult to resolve. The net costs or revenues to the countries concerned may be different from the nominal prices.

Developing countries comprise the major source of demand for internationally traded weapons. In the 1970s and 1960s weapons transactions became more commercial, as OPEC oil revenues provided an alternative source of finance for purchase. Alongside these quantitative changes, there were important qualitative changes in demand. Initially, the weapons transferred to the Third World had largely been obsolete, outdated or second-hand. During the 1970s the most modern weapons systems produced by industrialised countries were being sold. This change is a consequence of the agressive commercial policy of French private military enterprises. The international sales of arms and technology was progressively detached from foreign policy and strategic objectives. The economic reasons invoked for exporting arms tend as a result to become the usual rule on the market and the buyers are able to obtain the highest technology products for conventional armament. The French government wanted to maintain an national arms industry, mainly to ensure national independence of supply and access to latest military technologies. In these conditions, exports sales at prices above short-run marginal cost made some contribution to investment costs. In political terms, by supplying arms, France had the potential to influence directly or indirectly the behaviour of customers and to assist its friends. The 1980s have seen the beginning of a trend towards appropriate technology weapons, cheaper and better tailored to Third World needs, sometimes supplied by Newly Industrialised Countries.

In 1987, although it was a good year for the weapons trade, the exports of the French arms industry were reduced by 18,6 per cent in comparison with 1986, with reductions of 14 per cent in the developing countries and 50 per cent in the industrialized countries' markets. From 1984 to 1986, French arms exports orders were respectively of 61.8, 44.5, and 25.3 billion francs, because of the impoverishment of French customers, the drop of the dollar exchange

rate and international competition. During this time, FRG and U.K. arms exports were growing. The main reason for this crisis is certainly the betting of French arms enterprises on the development of the US market just when the State deficit obliged the US government to reduce the growth of military expenditure. It is interesting to note that the arms exports of French industry are not really in crisis yet, because the deliveries lag behind orders, but present orders are very low. If we have in mind, that usually, orders are higher than deliveries, the arms industry will be in a bad way in the near future.

A supplier with an effective monopoly of a desired weapon system is able to extract a high political price. This is rarely the case for France which produces arms in competition with many alternative sources of supply. Thus its exporting position is not so powerful, because of the new competition, characterised by the absence of political conditions, between arms enterprises. During the 1970s, France made skillful use of her special status and relative independence from the two superpowers, and of the weakness of political conditions to French arms sales, to obtain a shaw at the international weapons market. During the 1980s this advantage has been substantially reduced by the "demonstration effect" involving both new arms producers, like West Germany, Japan and Brazil, and even the two superpowers. Thus, the competitive position of the French arms industry is declining.

Table 31- French exports arms deliveries (billion current and constant francs)

Year	DELIVERIES current francs	1986 francs	1983 dollars	Percentage exports/ Arms production
1970	2. 7	11. 3		19
1971	3	11. 9		20
1972	4	15		24
1973	5. 2	18. 4		26
1974	6. 7	22. 1		30
1975	8. 3	24. 1	2. 89	32
1976	11. 6	30. 2	2. 22	37
1977	14. 7	34. 8	2. 58	41
1978	17. 3	37. 5	2. 78	40
1979	20. 5	40. 8	2. 94	40
1980	23. 4	41. 9	2. 98	40
1981	28. 5	45. 0	3. 21	41
1982	28. 9	40. 2	2. 91	38
1983	33. 1	41. 3	3. 04	38
1984	41. 9	47. 8	3. 59	42
1985	43. 9	46. 5	3. 56	42
1986	43. 1	43. 1		40

Table 32 - Distribution of French exports deliveries (in percentage)

Countries	1974	1976	1979	1982	1983	1984	1985	1986
North Africa and Middle East	57	58	52	66	56	77	39	38
North America & Europe	25	23	11	9	14	10	42	42
South America	3	6	14	16	7	9	5	nc
Far-East	5	2	4	4	4	2	5	nc
Black Africa	2	2	4	1	1	1	2	nc
Others	8	8	4	1	1	1	2	nc

Table 33 - Trend of French enregistered military exports (billions francs)

Year	Orders (current francs)	Orders (1986 francs)
1974	18. 3	60. 4
1975	16. 5	47. 9
1976	18. 9	49. 1
1977	27. 4	64. 9
1978	21. 7	47
1979	25. 1	50
1980	37. 4	67
1981	33. 8	53. 4
1982	41. 6	57. 8
1983	29. 1	36. 4
1984	61. 8	70. 5
1985	44. 5	47. 1
1986	25. 3	25. 3

Table 34 - Geographical structure of arms export orders for France (1985 and 1986) in billion francs

Regions	1985	1986
Europe and North America	18.5	10.1
North Africa and Middle East	17.5	9.3
South America and Caribbean countries	3.3	0.4
The Far East	2.4	3.6
Black Africa	2	1.6
Others	0.8	0.3

Table 35 - Geographical structure of French arms exports deliveries in billion francs (1985 and 1986)

Regions	1985	1986
Europe and North America	6.2	7.2
North Africa and Middle East	26.4	23.1
South America and Caribbean countries	2.1	4.6
The Far East	7.0	5.6
Black Africa	1.6	2.2
Others	0.6	0.4
Total	43.9	43.9

Arms production is characterised by high overhead costs for research and development, learning curves (costs decline with experience) and economies of scale. Large producers can produce more cheaply. Thus, arms exports became an economic condition for an efficient national armament industry. French companies would not undertake the deals if they did not expect them to be profitable, and profitability often depends on subsidies from the supplier government, especially on R&D, credits and official aid and approval for exports. The benefits of arms exports appear directly and accrue to particular interests. The costs are less directly obvious and depend on the alternative use of funds. Therefore there is powerful economic pressure for exports. Military development is a voracious user of scarce scientific and technical resources, depriving the civilian economy of skills useful for improving productivity and competitiveness. In this case, the economic interest of arms must be computed and compared with a civil use of the additional resources involved in exports. It is certainly false to think that, for France, the promotion of arms exports is a profitable proposition. The growing dependence of particular interests on arms exports has created a powerful economic lobby, with enterprises, unions, parliementarians, regional councillors, despite the lack of any estabished economic or commercial logics.

It is interesting that econometric models can suggest that a country's military expenditure has conflicting positive and negative effects on arms exports. For France, if total military expenditure seems to have rather a positive effect on arms exports, the annual increase of military expenditure produces a negative effect. These results indicate that when arms exports forecasts suggest the emergence of a crisis, military expenditure are increased in order to compensate the arms industry for the lack of demand. The present attempt at modernization of French armaments and the exceptionnal increase of equipment as against operational costs must be partially explained by the pressure of the French arms lobby, with blackmail on employment, exports problems and the argument about the destruction of the competitiveness of this industry. Usually, arms exports are analysed as a complement to national defence equipment needs, in order to reduce the collective costs of armaments. In the1980s, additional military equipment sales to the French government have compensated the losses of the French arms industry on international markets.

Table 36 - Strengths and weaknesses of the French arms industry

Strengths	Feablenesses
Men	
- High competence on R&D - Experience in military weapons requirements - Innovative spirit - Cooperative spirit in R&D	- Functional over-employment - Some competitive domestic markets - Insufficient employment turn-over - Operational under-employment - Weak regional mobility
Products	
- High technology - Product quality - Safety - Reputation	- High prices - Imperfect aftersales service - New competitors - Technical and military adaptatbility of armsexport - Proliferation of weapons technologies
Industrial structures	
- International competitiveness of enterprises - Dual investments - Experience in industrial R&D	- Insufficient sales organization - Absence of communication - Rigidities - Localisation
Demand structures	
- Captive national market - Implantation in foreign countries	- National arms industries from LDCs - Limitation of arms demand from OPEC - Political will for disarmament - Excess supply - International agreements for arms exports
Organisational structures	
- Decisive influence of DGA - Army support - government support	- Import substitution policy by foreign governments - International agreements on arms transfers - Arms transfer controls by Alliance agreements.

Desire for weapons does not constitute an effective demand unless finance is also available, and thus in a world crisis, it is difficult to maintain arms transfers in the long run without any financial security of effective payment. But, for the French arms industry, it is vital to export and the parliementary report pleads for a new products policy better defined for international uses, quality research, a wider geographical market, commercial attempt at direct foreign implantation, improvement of risk insurance for the military sector and amelioration of French and European industrial collaborations. This is a political, not an economic decision.

D) Armament cooperation

With weapons collaboration, the typical pattern is that development costs are shared between the partners, cutting the costs to each, if and only if the defence organisations need exactly the same weapons. The arguments for the French military industry are based on the idea that French weapons are superior, tailored exactly to the needs of French forces and that a domestic defence industrial base is essential for strategic independence and that "unfair trade" arguments justify protection. On the economic side, it is argued that domestic procurement creates employment, boosts tax revenue, improves the balance of payments and produces technological spin-off for civilian production. If cooperating countries do not want exactly the same weapon, new costs occur in meeting the needs of each partner, and then the advantages of large scale production can be insufficient to compensate for the increase in costs. Production takes place on a national basis and there are losses if compromise designs are more expensive to produce. Collaboration itself adds a cost penalty arising from co-ordination expenses and transport needs. There are always complicated, politically and rather than economically negociated, work sharing and compensation arrangements.

National self-sufficiency and independence in arms is a policy which can prove both expensive and dangerous. That is why, for cost reasons, it will be necessary for France to call for cooperation or specialization with her European partners, unless she wishes to increase her defence spending to achieve the same level of security, with the consequent risk of burdening the national economy with inadequate industrial productivity which, in the long run, would reduce growth opportunities and national security itself. In a democratic country, good defence is never built on an economy in crisis or recession. The Délégation Générale pour L'Armement is directing France's military policy towards the twin goals of independence and

solidarity. Independence implies autonomy as regards decision-making, in spite of the great complexity of current weapons systems ; it is therefore striving to harness national energies and skills with a view to providing the foundations of her defence from the nation's own resources. Solidarity implies that once a large measure of autonomy as regards decision-making has been obtained, France should collaborate with her allies, at least in the design and introduction of new weapons useful for their mutual security. Under these conditions, the decision to develop an arms industry primarily satisfies the requirements for national independence.

The economic aspects sets the limits to industrial activity, in order to control in the best way the investments committed and also to involve arms firms and sectors in the modernization and industrialization of the French economy. But it is more difficult to support a national arms industrial policy, because of the needs for technical progress in high technology and the risks of investments. Co-production is a way to increase competence in arms production, even if the different strategies imply various kinds of weapons.

European industry has a deteriorating position in high technology, since between 1975 and 1985, the rate of foreign penetration was increased by 8 per cent while exports declined by 2.5 per cent. Thus, there is a need for european cooperation in military research, in order to reduce the technological gap in armaments (especially a strategic computing programme, on design automation, on emerging technologies). The EEC programmes like ESPRIT, BRITE or EUREKA are very advantageous for civil research and military applications will not be negligible. The Groupe Européen Indépendant de programmes (GEIP) is strenghtening cooperation for the structural rationalization of european resources, but the results are not yet sufficient. On specific programmes, French cooperation with individual EC countries countries seems to be more rewarding.

Table 37 - European military programmes involving France over the last ten years.

Programmes	Finance (per cent)	Enterprises	Deliveries	Orders	Technology transfer
Missile Hot	France 50 FRG 50	- Aérospatiale - M.B.B.	1974-1991 and beyond	France 17000 FRG 25000 Export 27000	NO
Missile Milan	France 50 FRG 50	- Aérospatiale - M.B.B.	1974-1991	France 64000 FRG 90000 Export 62000	U.K. Italy India
Missile Roland	France 50 FRG 50	- Aérospatiale - M.B.B.	1977-1988	France 7000 FRG 14000 Export 3500	USA
Minesweepers Tripartite (CMT)	France 33 Netherlands 33 Belgium 33	- D.C.N. - Van der Geissen - Mercantile & Béliard	1983-1989	France 10 Belgium 10 Netherlands 10	NO
Helicopters	France 31 U.K. 69	- Aérospatiale - Turboméca - Westland - Rolls Royce	1978-1984	France 40 U.K. 218 Exports 71	NO
Helicopters S.A. 341-342 Gazelle	France 74 U.K. 26	- Aérospatiale - Turboméca - Westland - Rolls Royce	1973-1990	France 343 U.K. 282 Export 426	NO
Helicopters	France 92 U.K. 8	- Aérospatiale - Turboméca - Westland - Rolls Royce	1969-1989	France 185 U.K. 48 Exports 247	Romania Indonesia
RITA (Communication System)	France 95 Belgium 5	- Thomson - Bell Telephone Manufacturing Co	1981-1985	France 1 Belgium 1 Export USA 1	NO
Jaguar Aircraft	France 50 U.K. 50	- AMD.BA - Turboméca - B.A.E. - Rolls Royce	1972-1982	France 200 U.K. 203 Export 94	NO
Alpha Jet Aircraft	France 50 FRG 50	- AMD.BA - Turboméca - SNECMA - Dornier - Rolls Royce	1976-1984	France 175 FRG 175	NO

New agreements with the FRG on fighting helicopters, with european partners on future antitanks missiles and with Atlantic Alliance partners on multiple "lance-roquette" (MLR) were recently signed. SNECMA and General Electric are to produce C.F.M 56 engines with dual technology and Thomson and G.T.E. are cooperatives on the american version of RITA. There are two military industrial projects with Canada on Drone CL 289 (with the FRG) and an antitank missile (Eryx) for French needs. The success of cooperation projects implies very close common needs on the technical characteristics of materials, well-structured official and industrial organization, serious forecasts of costs in order to measure the interest of cooperation, an improvement or an maintenance of the competitiveness of the national industries involved in the programme and a good possibility of national initiatives on exports.

French trade-union are very suspicious of european military arms cooperation which is accused of being the main cause of the loss of manufacturing activities, to the detriment of regions and workers. For example, the European Space Agency is dependent on co-finance agreements and, as a result, countries call for participation in the production process. There is technolgy transfer without any counterpart being received by French industry. Thus, there is a strong tendency for the ESA to produce inequal relations among European countries to the detriment of France. For the trade unions, arms industry cooperation between the countries of EEC is not very advantageous in terms of employment or the technology gap in the space industry in favour of France's partners.

Conclusion

Arms sales abroad are only a very imperfect indicator of the competitiveness of the arms industry. It is therefore difficult to conclude that the arms industry is a prerequisite for France's economic development or even that it is essential to her immediate security. Indeed, if the prices prevailing in the national economy are significantly higher than those of international competitors, the army will receive fewer arms for the same amount spent. This is the choice that has been made, by Sweden, for example, for her aircraft construction activities. Under these conditions, the country's defence is less well provided for, in the short run, by national production than by imports. However, all aspects of security and industrial development must be taken into consideration, such as embargos, national independence, the development of the national industrial fabric, etc. It is still the case however that France is unable on her own to finance completely electronic warfare weapons and space defence systems.

For developed countries, military contracts and armament industries have created definite advantages which are politically and economically difficult to challenge. Even if the international arms trade is in crisis, the strategic advantages are not negligible and disarmament could bring, in the short run, an increase in underemployment, some painful restructuring and reductions in wages. The conversion of military activities into civilian activities is not always technologically and economically feasible. Conversion is bound to be costly, because if it is certainly possible to transform a tank factory into a factory for cross-country vehicles, the crucial questions are production costs and the size of the solvent markets. Simply knowing how to transform a military aircraft industry into a civilian aircraft factory does not imply a similar ability to expand an already glutted market. Causation is unlikely to be unidirectional. Inefficiency can lead industries to seek protection within military markets and excessive commitments to these markets may cause a deterioration of the domestic industrial base of the whole French economy.

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