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► **To cite this version:**

Jacques Fontanel. French arms industry. The procurement Process. French Arms Industry, CEDSI, Université des Sciences Sociales de Grenoble, 1989. hal-03155566

HAL Id: hal-03155566

<https://hal.univ-grenoble-alpes.fr/hal-03155566>

Submitted on 8 Mar 2021

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French arms industry. The procurement Process

Jacques Fontanel

Université des Sciences Sociales de Grenoble
Cahiers du CEDSI
Grenoble 1989

Summary: French governments have an interventionist philosophy for arms industry. They prefer domestic production versus imports, they organize a military planning for 5 years and they define some institutional steps in the procedure for contracts and cooperation (with a parliamentary control). The determination of prices includes a process of « cost plus and fixes price contracting, with a calculation of profit margin and a real will to support national military R&D. The links between Government, industry, unions and the military staff are oriented for national defence, but the relations between them are sometimes conflicting.

Les gouvernements français ont une philosophie interventionniste pour l'industrie de l'armement. Ils préfèrent la production nationale aux importations, ils organisent une planification militaire sur 5 ans, ils définissent certaines étapes institutionnelles dans la procédure de contrats et de coopération (avec un contrôle parlementaire). La détermination des prix comprend un processus de " cost plus " et de contractualisation à prix fixe, avec un calcul de la marge bénéficiaire et une réelle volonté de soutenir la R&D militaire nationale. Les liens entre le gouvernement, l'industrie, les syndicats et le personnel militaire sont orientés vers la défense nationale, mais les relations entre eux sont parfois conflictuelles.

Mots clés : Arms industry, procurement process, France, weapons prices.
Industrie d'armement, France, Processus public d'achat, prix des armes.

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 is trying to maintain an independent and large size arms industry, even though present and forecasted future exports markets do not encourage the maintenance or development of this activity.

11.1. Domestic production versus imports

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 continually increasing, Sweden had to increase its defense budget, by a multiplier coefficient mainly determined by the exchange rate of the dollar, in order to satisfy its military planning) ;
- national production saves foreign currency and improves the balance of payments and
- the arms manufactured exactly meet the nation's defense 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 suppliers, the technological hierarchy of defense production remains in place. A reduction in R&D effort could have two additional effects : first, the

French arms industry would lose 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. Without a continuous increase of arms components imports, especially certain kinds of sophisticated products which are too expensive for domestic production, there would be repeated upwards revisions of the rate of increasing costs for R&D : higher costs would reduce the competitiveness of French arms in international markets. Reduction of exports has a negative effect on military R&D because of the growing share of self-financing.

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 effort among all types of arms. If the domestic market is not adequate in 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 which 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's arms exports do not fall into this category. From 1975, arms exports were financially very interesting for French enterprises and maybe for French economy, but since 1983 this situation changed. 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.

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 useful for the manufacture or assembly of arms. In fact, much of France's production is dependent on 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 a 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.

As opposed to the British NIMROD programme, which was a severe failure, the purchase of four U.S. AWACS gives an interesting example of a good import, because of a good deal (7,35 billion vs 10 billion originally forecasted) and the difficulty for French industry in producing this kind of product at a competitive price.

The choice between national production and imports is often very difficult to make. For instance, 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, cost duplications), industrial grounds (with large investment for a temporary solution, the temptation will arise 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 French military aircraft). Although there are some long run industrial compensations for a foreign solution for the transition period, this choice was rejected, at least at present.

The components of weapons systems are not always produced by national means. The Pentagon discovered with anxiety that the high-tech electronics needed for its defense was made in Japan (80 %) and for Europe it is certainly worse. Thus, if electronic components are not exactly arms systems, it is undeniable that they might be included in the import of armaments. This analysis must be made not only for industrial components, but also for research, industrial property rights or testing results.

Compared with foreign countries, France does not apparently have high production costs. In particular, French military R & D costs seem far lower than those in the the United States, Italy or United Kingdom. Moreover, an exporting armaments industry 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 reduced by imports, but the exceptional quality of the weapons, the absence of competition for technical or political reasons or the importance of international military supply may be more appreciated 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, although commercial firms have a wide variety of methods of hedging longer-term contracts against 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 buyers and sellers will depend on the extent of the competition. If the equipment supplied by various firms is very similar, or even identical, the buyer has scope to substitute and the price will be forced down. If the supplier 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 subsidized the development of indigeneous national industries for political and sometimes economic reasons. This creates strong pressures 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.

11.2. The "Programmation militaire"

Very few industrially advanced countries are in a position to convert notions of national security into comprehensive programmes 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 defense. It is essential to consider defense costs in relation to the optimum methods of defense 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. The "Lois de Programmation" try to provide prospective answers to those questions.

II.2.1. The contents of French "Lois de Programmation"

The contents of French "Lois de Programmation" have varied. From 1960 to 1977, only the equipment programme (Titre V) was included. Officially, it was not "Lois de Programmation", but "Lois de Programme" inducing the interesting idea that the law was not applicable to defense expenditure on the whole.

Table 43 - The French military "Lois de programmation"

Dates	Registered resource	Number of programmes	Observations
1960-1964	A third of "Programmes authorizations"	16	- Current francs - Nuclear Forces priority - No payment allocations registered
1965-1970	Two third of Programmes authorizations"	25	- Current francs - Nuclear Forces priority - No payment allocations registered
1971-1975	The totality of Programmes authorizations"	31	- Current francs - Nuclear Forces priority - No payment allocations registered
1976	-	-	
1977-1982	Totality of payment allocations	39	- Precise equipment law - Payment allocations for operational costs
1983	-		-
1984-1988	Totality of payment allocations	40	- Global presentation Not year by year - Main financial effort for the end of the period
1987-1991	Payment allocations for equipment only	27	- Revolving plan for 1989 1990, 1992 and 1993. - Constant francs

The Forth "Loi de Programmation" introduced total military

expenditures, in payment allocations ; it gave some resources guarantees with a relation between the budget and the Tradeable Gross Domestic Production and an intermediate Government report on the execution and the immediate future of the Programmation. The Fifth law, incorrectly named "Loi de Programmation", does not include operational costs. There are three levels to the government time schedule : the Plan for the long run (between 15 and 20 years), the "Programme" for the middle run (5 years) and the budget for the short run (one year). The Lois de programmation coordinate the decision-making process from the Plan to the Budget final act.

II.2.2. The new "Programmation militaire"

The last "Programmation Militaire" (military programme for five years) put forward in 1987 seemed to satisfy everyone and defense has ceased, except for the Communist Party, to be a subject of discord. The Socialists have indeed voted the last Loi de Programmation which was adopted by the Parliament during Spring 1987 with a large majority (536 votes for and only 37 against, especially from the Communist Party, at the French Assemblée Nationale). France has not really been marked by a general revision of the objectives of defense policy. Parliamentary debates have been centered on the proportion of GDP that should be devoted to defense, on the application of long-term plans and on long-term credibility of the deterrent forces.

The answers given by the programmation militaire 1987-1991 are not yet very explicit, although 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. The "Loi de Programmation" is very interesting for the military industries, because domestic demand was 65, 73 and 77 billion francs in 1986, 1987 and 1988 respectively and it compensates the reduction in exports.

Table 44 - Payment allocations from "Loi de Programmation (in billion francs 1986)

Years	Payment allocations
1987	84.127
1988	89.100
1988	94.450
1989	100.120
1990	106.200

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. Though 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. Since 1970, changes have occurred slowly and smoothly. If France has given priority to strategic nuclear forces, it should be emphasized that the structure of its 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).

The modernization of France's strategic nuclear strike force can be easily achieved, bearing in mind the relatively small percentage of its GDP devoted to defense and the possibility of temporarily holding conventional forces as they are. In 1986, France spent no more than 21 billion francs (1981 value) on its 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, maybe, that the pursuit of the nuclear strategy will be accompanied by painful financial choices.

II.2.3. The limits and interest of the "Loi de programmation militaire"

There are four main problems : the difficulty of covering the whole of military expenditures, the forecast of inflation rate, the introduction, in the forecasts, of new international events (such as a disarmament process or the emergence of new weapons), and the

achievement of the objectives.

- From 1960 to 1983, five "lois de programmation militaire" were voted by the Parliament, with the aim covering gradually the whole of military expenditure. The inefficiency of military programming was proclaimed by some Members of Parliament. Each new programme was designed to make up for the gaps of the preceding one and to avoid new delays, but this was not usually possible. With the sixth law, this idea appeared too ambitious and it was decided again to programme only equipment expenditures.

- With the US Strategic Defense Initiative and the US-Soviet agreement on Intermediate Missiles Forces (IMF) in Europe, the government will have to face 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 run defense programmes has ever been fully implemented without any political clashes, the new technological challenges in the military sector seem to be particularly dangerous for the consensus on defense 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.

- The main problem faced by the French "Loi de Programmation" was inflation forecasting. For the period 1960-1983 inflation never stopped, at an average rate as high as 7 % par year, with a maximum at 15 % in 1974. "However, although in France it appears that (rigorously defined), military inflation is not superior to general inflation (Aben), such rates are easily able to destroy the purchasing power of any budget. Moreover as public budgets are adapting themselves to inflation and because they are often the instrument of anti-inflation policies... Inflation rates were almost systematically underestimated and the adjustments rarely managed to balance current expenditure with the new growth in prices"¹. Another problem concerns the specific prices of armaments systems, which not only undergo prices increases due to the civilian price indices, but also the additional costs of new sophisticated technical progress. "The history of French military programming is littered with examples of uncompleted armament programmes due to inadequate forecasting of prices : Plateau d'Albion GLBMs, Pluton SRBMs,..."²

¹ SCHMIDT Christian, PILANDON Louis, ABEN Jacques "Defence spending in France : The price of independence". Paris, 1989. Mimeo, pp. 3-4.

² Ibid. p. 5.

- Even though it is a law, the "Loi de Programmation" is not binding for the Government. It is only guideline planning, which decides the main programmes for the five next years. In comparison with the programmed resources decided in 1987, the budgetary allocations are below target.

Table 45 - Loi de Programmation and annual budget allocations (in billions current francs)

Resources	1987	1988	1989
Programmed resources	86.7	92.0	101.7
Budgetary allocations	85.8	90.8	98.0
Realization (in %)	99.1	98.8	96.3

The implementation of the Loi de Programmation militaire is not perfect, but it is not so bad.

11.3. What are the institutional steps in the procedure for contracts

It is interesting to know the key actors and the role of Parliamentary control.

11.3.1. The key actors : Defense Ministry, Armed forces, Agencies, Industries, Research Centres.

The organization of French weapons production 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. There are a lot of Directions, known under their abbreviations :

DPAG : Direction des Personnels et Affaires Générales

DPAI : Direction des Programmes et Affaires Industrielles

DAI : Direction des Affaires Internationales

DRET : Direction des Recherches, études et techniques

DAT : Direction des armements terrestres

DCN : Direction des constructions navales

DCAé : Direction des constructions aéronautiques

DEn : Direction des Engins

DEI : Direction de l'électronique et de l'informatique

GIAT : Groupement industriel des armements terrestres

DCAN : Direction des constructions et armes navales

ECAN : Etablissements des constructions et armes navales

AIA : Ateliers industriels de l'aéronautique.

Table 46 - French Defense Organization

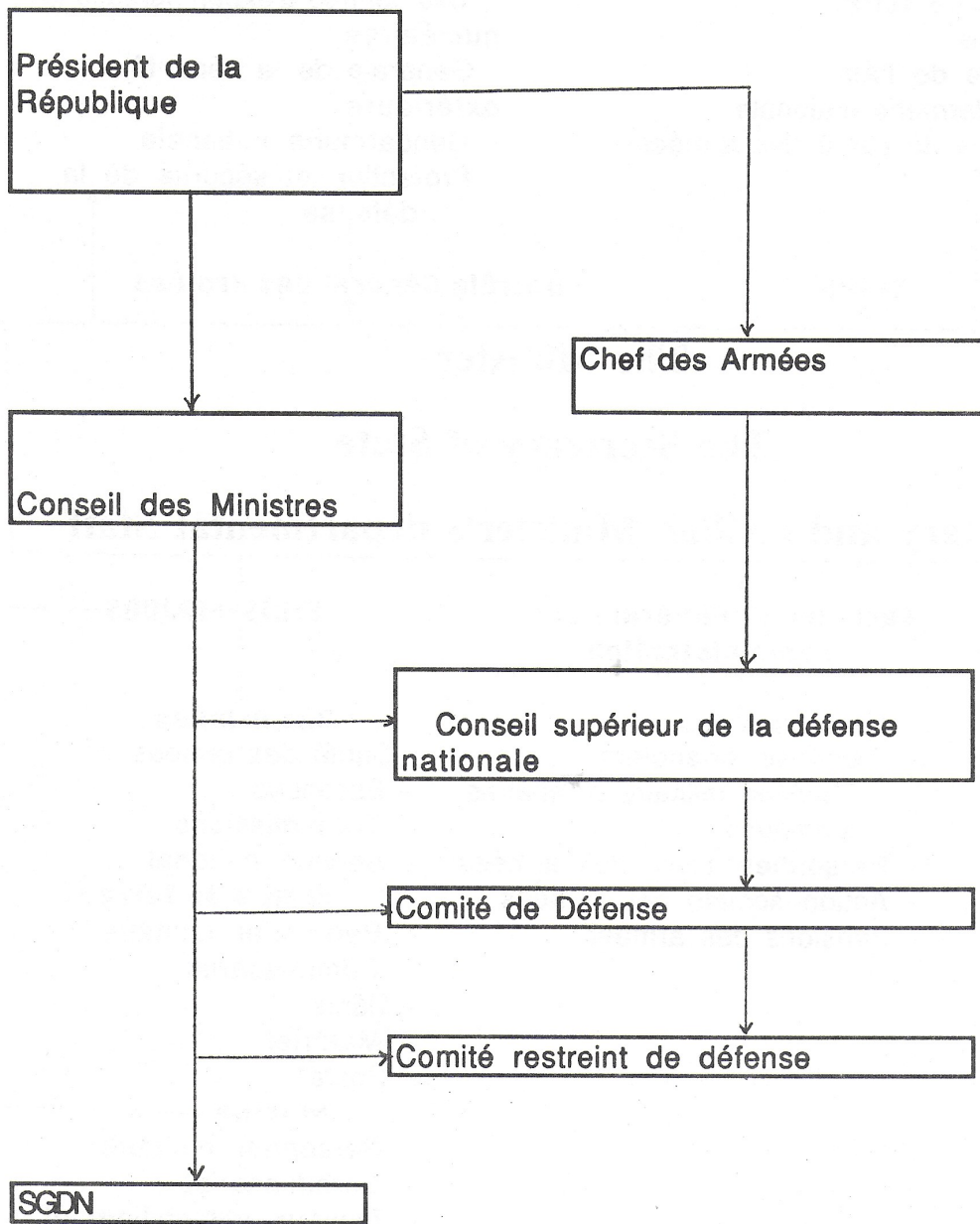
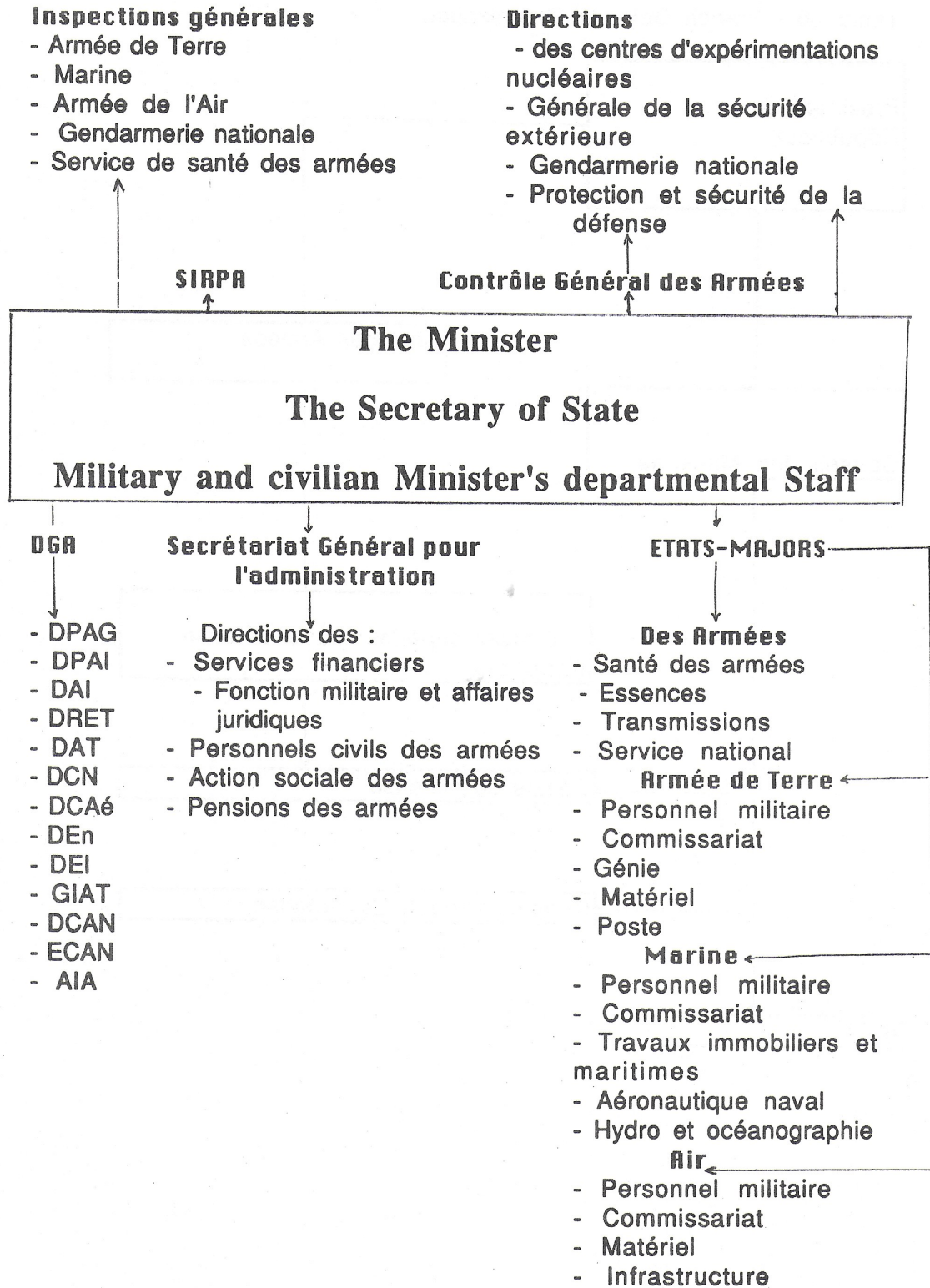


Table 47 - French Defense Ministry Organization



II.3.2. The State decision

With the Budgetary Choice Rationalization (Rationalisation des choix budgétaires ou RCB), the Government specifies the behaviour rules of the documents, which have six components :

- Presentation of the mission and definition of efficiency,
- Operational description of proposed systems,
- Establishment of an efficiency and applications model,
- Establishment of costs and applications models,
- Sensitivity studies and results analysis,
- Conclusions and propositions.

The definition of missions and systems implies the description of the nature of means, the technical characteristics, the materials performances, the personnel needs, the unit organisations and their connections.

The methods evaluation requires an efficiency model with data and hypothesis at the basis of the model and the logical and mathematical relations for simulations. The costs model includes analyses of the total functional cost, the forecast costs, the financial costs and the marginal cost.

The long run Plan tries to define the fundamental objectives of defense. The medium run Plan (5 years) establishes major programmes on Strategic Nuclear Forces, Security Forces, Tactical exercise Forces, External action Forces, Joint Forces, R&D, Personnel support, Equipment support and Central administration.

There exists therefore a rational analysis of military expenditure and the choices between equipment and personnel and between equipments are taken partly with this kind of analysis.

II.3.3. State-armament industry cooperation

The United Nations Charta recognized that the armament sector is essential for the State's security.. There are various industrial markets, inside the general theory of Public Choices. In the classical conception, there are adjudication, purchases with costs and risks and the challenge of competition. Because the conception and industrial implementation of an armament is very long (often more than ten years), it is not possible to introduce these procedures regularly. There are a lot of contracts :

- Research contracts and conventions are not directly connected to a material product but are concerned with basic research.
- The research contracts study a concept with a known end in order to see whether it is potentially applicable to military purposes.
- The study contracts go further into the implementation, such as the fabrication of a "maquette", without involving actual production.
- The prototype contracts involve the construction of one or more prototypes for testing and, if possible, preparing mass production.
- The industrial process contracts ensure the financial statement of investments for the armament production.

The State services supervise the armament industrial contracts inside the factories. The State technical services control the evolution and the progression of the suppliers' work. Manufacturing quality and the checking specifications are important routine procedures, in relation with the users services. There exists a legal possibility for the purchasers to give some service orders to the suppliers, but in armament relations the State and the enterprises prefer the use of an additional judicial act, which allows the continuation of the works, without waiting the final discussion. For study contracts, the relations between suppliers and buyers have the character of an information exchange.

The industrial market involves technical specifications which are part of the contract and there is a guarantee contract which does not exceed six month or one year. This is why the characteristics checking (quality, performances, materials, manufacture process) is so important in order to define the industrial responsibility in case of malfunction. The operational specifications are given by a General Staff document, which lays down the main components. The technical specifications involve the required results, the description of methods in order to obtain the results and these technical specifications applicable to the methods. The State services must be very competent to ensure the observations of the contractual conditions. Some penalties should be applied for delays, but it is often impossible to apply them, because of the close relations between the enterprises and the State. At present, the French government prefers having a regular and specialized supplier, in order to optimize national resources in engineers, research bureau organizations and productive investments. It takes 7 to 10 years for the conception and the production of an aircraft engine. Thus, the

Government must have a long run relation with the enterprise and, because national demand is quite limited, it prefers to create some controlled monopolies in order to give sufficient orders to these enterprises. The State has final control of the armament industry, because it guides R&D and it is the main buyer. In these circumstances, it is not so important for it to be the main owner of the armament firms.

II.3.4. The role of Parliamentary control

Parliament votes both the military budget and the "Loi de Programmation militaire".

Since 1959, the Programmes authorizations constitute the upper limit of expenditures the Ministry are authorized to engage for carrying out investments forecast by the law¹. The capital expenditures of the Ministry of Defense are financially covered by the "Autorisations de Programmes" which are available until the authorized operations end.

- The "Loi de Programmation" law is not really a law, it is a solemn declaration of intention and not a juridical act ; as opposed to a Programme authorization, it does not allow to engage markets or to sign expenses. Some programmes included in the Programmation law were not carried out and sometimes other programmes, which were not foreseen by the law, were developed, as for the Hélios project. However, this law is very important, because it presents future strategy and the economic effort of the State for its security.

Parliament votes the Defense budget, but it is not responsible for the Defense policy ². The Fifth Republic institutionalized the casting role of the Executive on Diplomatic and Defense policies.³ The Parliament usually has to approve the actions of the Président de la République and of the Government. The Parliament is able to have an influence, such as by harassing the government by procedure acts or by using financial power or legal controls. On arms purchases, the Parliament can use financial and control actions, but it is not involved in the

¹ "La limite supérieure des dépenses que les Ministres sont autorisés à engager pour l'exécution des investissements prévus par la loi".

² For Michel Debré, former Prime Minister, "un Parlement est un organe qui soutient ou qui combat, qui approuve ou qui désapprouve, qui suggère, ce qui n'est jamais un organe qui dirige". Journal Officiel de la République Française, Assemblée Nationale, le 17 Juin 1965, p. 2204.

³ Articles 15, 16, 20 and 21 of the Constitution and article 7 of the ordonnance of 1959.

contract procedures themselves.

II.4. The price determination

It is very difficult to find out the exact unit costs of a weapon. The inflation rate for military products, in constant francs, is estimated at 5 % per year, since 1960. The definition of military prices is very wide-ranging.

Table 48 - Price estimates for specific arms:

Military arms	Lower prices	Higher prices	Deviation
Leclerc tank	40	50	25 %
HAC helicopter	65	100	54 %
Mirage 2000	120	150	25 %
Rafale aircraft	220	350	59 %
Light fregate	1000	1200	20 %
Aircrafts carrier	13900	16000	15 %

II.4.1. Cost-plus and fixed-price contracting

There are three broad categories of military products :

- goods destined only for defense market (nuclear warheads) or markets reduced by military secrecy (sonar equipment),
- common products with significant differences between defense and civilian markets (aeroengines) and
- products which are identical or nearly identical (memory chips).

The military yields to civilian innovation increases with the similarity of products and markets. The present trend seems to be to develop completely specialised and sometimes unique goods (without

any economies of scale) and so military conversions to civilian applications are more and more rare, thus reducing the efficiency of the military sector for national economic development. But the components of products are not so different. Since 1980, military products have used more and more civil components, such as electronics. 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 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. The government undertakes to reimburse the contractor for all the costs associated with the project plus an additional amount, fixed either as a percentage mark-up or as a fee irrespective of costs. This first contract is less difficult to sign for the armament enterprises, because the contractor can accept easily a doubling of costs because his mark-up increases accordingly. This method of fixing contracts shows the secondary place of prices in the purchase decision. The measurement of military expenditure price changes presents some special problems : timing of the price decision, long-term contracts, transportation charges, introduction of new technology. Military output without a market price or without adequate market pricing occurs frequently. If there is a price, it may not include all costs.

The Fixed Price Contract has the advantage that once the price agreed the industrial pressure is on the supplier to meet his commitments without raising costs. The armament enterprise is then responsible for its own inefficiencies, poor performance or long delays. The main economic risk is on the industrial firm, but the government will be very involved if the contractor is unable to produce the products. This type of contract is not often used, although it puts pressure on the contractor to limit costs in order to preserve the rate of profit on turnover. It is more valuable when the military goods are standardised or when the estimates of price are reckoned to be rather good. This is the case for fuel, clothing or victuals, but usually the contractors insist on some additional agreement above

fixed prices for inflation or price changes of inputs outside of their control. 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. Control is not so good.

The system of "Price to be Agreed" Contracts which allow work to begin before a complete agreement is interesting because it gives more flexibility on contracts which take time to complete. The preliminary work is started on the basis of a possible price to be set within an agreed time. Then, by an iterative negotiation, depending mainly on the experience in manufacturing the item, prices are settled, usually on a fixed-price arrangement.

Yves Sillard, the Délégué Général pour l'Armement, urged the French industrialists to pay attention to the costs of military products destined for national and foreigner customers.¹

11.4.2. How profit margins are calculated ?

Since it is costs which establish and control prices, performance criteria mainly depend on the efficiency of the industrial sectors 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 overshoot 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 source 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

¹ "Le délégué général pour l'Armement demande aux industriels de serrer leurs prix". Le Monde, 4-5 Juin 1989.

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 narrowly specified 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 by 1500 (9 % of the total), 800 and 2650 (more than 13 % of the total) respectively. In 1987, 94 per cent of the turnover of Thomson-Csf was produced on military products, against 31 per cent in 1982. Alstom obtained orders for military vessels to the detriment of the arsenals.

11.5. The case of military R&D

Military R&D is very significant in the French economy and its actors, contracts and procedures are of a particular kind. Three characteristics of technology developed by military R&D are of particular importance :

- 1) A propensity to the highest and most sophisticated technology not suitable for civilian production,
- 2) An inherent capital-intensiveness, without regard to production costs,
- 3) An excessive secretiveness.

The concept of R&D covers a vast range of diverse 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 comparison 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 weight of military R&D in the total national R&D programme gives rise to continued

debate.

II.5.1. The contracts and procedures

There are four main sources of finance for military R&D : public funds, exports, cooperation and private engagement. For nuclear armaments, public finance is preponderant, and often exclusive.

Before the Second World war, modern weapons were the result of civil technology adapting. 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 defense 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 all under the authority of the omnipotent Minister of Defense. 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.

"Research is mainly conducted within the various directorates which depend on the Délégation Générale pour l'Armement and the Direction Centrale du Service de Santé des Armées, but among these directorates, one of them plays a particular role : the Direction des Recherches Etudes et Techniques (DRET). Its mission is twofold : both functional and operational. As a functional directorate, DRET is entrusted with the co-ordination of upstream studies (programme preparation, stimulation of concerted discussions with the staffs, technical coordination in the fields of common interest, scientific and technical documentation). As an operational directorate, DRET is in charge of conducting research work, in particular basic research, or having it conducted, in its own establishments or those under State control : ONERA (Office National d'Etudes et de Recherches Aérospatiales) and ISL (Institut franco-allemand de recherche de Saint-Louis).

The general policy in terms of studies is examined every year by a "Conseil des Recherches et Etudes de Défense (CRED) which gathers, under the effective chairmanship of the Minister, the Chiefs of Staff, the General Delegate for Armament and, generally speaking, all the high-level executives of the Ministry involved in defense research. In particular, CRED deals with structures, programmes, budgets and

scientific trends... It should be noted that a Conseil Scientifique de la Défense composed of scientific personalities who do not belong to the Ministry, is in charge of advising the Minister on the research work to be undertaken and on the participation of the national scientific community in defense efforts"¹.

There is a link-committee between the executives of the Ministry of Research and the research executives of the Ministry of Defense, because the defense and civil research organizations are independent of each other. The ONERA, which is under the control of the Ministry of Defense, works towards dual applications and a lot of results are applicable to every type of aircrafts. It is the same for the Centre National d'Etudes Spatiales (CNES) and Bassin d'Essais des Carènes (experimental towing tank) which are used respectively for the development of satellites and for naval hydrodynamics. Cooperation (exchange of information, placing of research contracts, granting of young researchers, for example) with public agencies, such as the Centre National de la Recherche Scientifique (CNRS), are often a good way to improve the usefulness of fundamental research.

Small and medium-sized enterprises are not often involved in military R&D contracts, although they are particularly capable of rapid technological innovations. But relations with the Defense sector are usually established through prime contractors of whom they are sub-contractors. In 1984, DRET decided to create an Industry Mission in order to inform the small and medium-sized enterprises of defense research results, to ensure that they are applied in the civil and military sectors and to detect new technologies originating from these enterprises and capable of integration into future weapons systems. The results are rather good, with 1200 firms in touch four years later and some effective exchange of technologies (15 % of cases).

A group of personalities have been asked by the Ministry of Defense to consider the measures needed to develop DGA's relations with small and medium-sized enterprises (SME). The conclusions mention the "creation, around the DRET Industrial Mission, of a real network of innovation inside the DGA, relying on correspondents in each directorate or major establishment ; development of information for the SME and, more generally, of the Defense partners ; setting up of special technological programmes for SME ; reinforcement of the technological potential of SME (financial means, aid to personnel training...)"²

¹ S. BINDEL : "The relationship between defence and civil technologies policy of the French Ministry of Defence".

² S. BINDEL : Op. Cit.

On the nuclear research, La Direction des Centres d'Expérimentations nucléaires (DIRCEN) obtains its budget allocations from CEA (1.375 billion francs in 1989) and Army (2.474 billion francs in 1989).

Cooperation on R&D exists with the Federal Republic of Germany though the Institut franco-allemand de Saint-Louis, created in 1958, on explosives, lasers, noise, software, computers, artificial intelligence.

II.5.2. Economic importance

The French military R&D is the third in the world after the two superpowers.

Table 49 - 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	6.1	
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			

Table 50 - Public R&D Financing by categories of NABS in 1986 (in million ECUs) for France, the FRG, the U.K. and Italy

Categories of R&D	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
- DEFENSE	3312	1236	3782	349
- TOTAL	10649	9942	7329	4140

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 pollution, 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.

On average, R&D budgetary expenditures represent 30 % of the Ministry's equipment expenditure and so 30 % of the cost of French military equipment. The military R&D effort is equal to a third of Governmental R&D and, including expenditures of the arms industry, 18 % of the national R&D effort, for the last ten years.

Table 51 - Total world 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

26,000 people are assigned to R&D activities within the Ministry of Defense, the Commissariat à l'Energie Atomique (6000) and the State-controlled establishments. This represents 30 to 35 per cent of total R&D qualified personnel (according to which engineers and researchers) or by a wider definition, more than 270000 persons work for French R&D and less than 10 % of the total employments in national R&D.

Tableau n° 52 - 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

Estimates of private funding of military R&D, even when available, are not entirely reliable, either with respect to accuracy or coverage. The release of information by private enterprises is determined by a concern for commercial secrecy, to get public contracts or for exports. The economic interest of R&D requires large scale use of this special product ; investments must be made over a long time scale before significant financial returns are achieved and often they are speculative because companies can never be certain that profitable markets will result from the applications. 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 partial explanation of this state 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 53 - French public R&D outlays (Ministry of Finance) in million francs

Public R&D	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
Defense	25780	30750	29150
Civil Aeronautic	2662	2192	4410
CEE with CERN (Nuclear)	800	696	1350
Miscellaneous	2588	2551	4680
Total	75671	78797	85690

For the ACT/ACM (avion du futur), the financing of fixed costs, evaluated at 40 billion francs, by the enterprises will be achieved, partly, by themselves, on their own funds. The enterprises participation to military R&D will be required. 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 54 - French main military R&D expenditures and programmes, operating costs excluded (initial budget)

Programmes	1987	1988	1989
Programme authorizations			
Nuclear forces	10.55	11.82	11.81
Space	1.58	2.39	2.79
Conventional forces	14.59	15.49	19.44
Total	26.73	29.70	34.0
Payment allocations			
Nuclear forces	10.05	11.60	11.55
Space	0.53	1.09	1.78
Conventional forces	10.96	12.95	14.03
Total	21.54	25.63	27.36

It is not very rigorous to compare the productivity of Japan and FRG with French R&D, because the first two countries do not take responsibility for their own defense. 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 scientific progress are also desirable objectives in the long run.

The high technology industries require very heavy investments in R&D and their civilian and military strategic roles are essential for the improvement of products, production method and the modernization of defense equipment. Since 1960, French governments have intervened in high technology sectors, mainly for military objectives. The military authorities financed R&D and ordered new products. There is an interdependence between civilian and military technology in the contemporary economy, but the Defense Ministries lost their decisive role in innovation to the main benefit of commercial activities (electronics, computers...). For electronic components, military orders become marginal (more than 40 % in 1960 against 6 or 7 % in 1989).

Hence the military sector plays a smaller role in technological innovation. The transfers from civilian to military sectors exceed the propagation effect of military investments on economic growth. There is an increased dependence of military technological progress on the civil sector. There is a real effort to conceive dual technology, even in the military sectors. The Pentagon policy on VHSIC or Strategic Computing Initiative is now copied by French Defense sector and there is a desire to improve economic performance in order to ameliorate both the quality of technology and the economic growth, main conditions of long run defense spirit. But for nuclear military R&D there is no spin-off from which the civilian nuclear industry could profit or, results are so extremely secret that civilians are not allowed access.

II.6. Analysis of the link between Government, the Military, Industry and Unions

They are a lot a official and unofficial relations between Government, the military, the arms industry and the Unions. The first characteristic is the homogeneity of the personnel who are educated at the same schools or laboratories.

II.6.1. An homogeneous personnel

There are strong relationships between the military staff, the arms enterprises and the political personnel. Often, the same man can work successively with the National Forces, with the Ministry of Defense or the Secrétariat Général de la Défense Nationale, and with the weapons industry. It is usual for the Chairman or the General Staff of arms enterprises to be a retired General or (more rarely) Colonel. Management of the Arsenals is undertaken by military and civil engineers. Naval engineers have a very old tradition and land armament engineers were educated in the Direction des études et fabrications d'armement (DEFA). Since 1968, there is a unified corps of Armament for which the armament engineers are mainly recruited at the end of the Ecole Polytechnique and the engineers of studies and armaments technicians are recruited by competition. Very high level recruitment is brought about in this way. The personnel selected often have the same kind of education, in the same schools. For this reason, in spite of their competence, they are sometimes accused of creating a militaro-scientific-industrial complex, which is characterised by the "esprit de corps" of the managers and a clear organizational structure.

Because of the extremely specialized nature of defense products,

There is a severe problem of personnel in the arms industry, with the differences between established and non-established employees, the number of engineers and staff personnel compared with the number of workers and the fast evolution of military equipment as against the stability of personnels.

II.6.2. The links between the French arms industry and the Government

The organization of the French arms industry is very centralized. It is composed of Délégation Générale pour l'Armement, of politic personnel from the Executive (Président de la République, Prime Minister, Minister of Defense), of private and public enterprises, of the military forces and of some laboratories specialized mainly on military products.

In France, the military strategy is one of the "domaines réservés" of the Président de la République. The Defense Councils chaired by the Président define the general direction of national defense. The Prime Minister ensures the carrying out of these decisions.

II.6.3. The Unions and Arms Industry

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 of the military industrial complex, is clearly in favour of private or nationalized enterprises. There is a commission to organise technological transfers from the Ministry of Defense 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 defense budget of the operations of the Direction des Armements Terrestres (DAT) and of its establishments. The Arsenals and State 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 Union¹ (CGT des Travailleurs de l'Etat) represents a waste of more than ten billion francs per year. 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 for tanks and some equipment for nuclear and chemical protection. Orders are declining and the GIAT (Groupement Industriel des Armements Terrestres) tried unsuccessfully to close this public enterprise, although 40 per cent of workers became unemployed. The Unions are calling for the production of a new type of gun, even though, in general terms, they are against the arms race.

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