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## Defence-related industrial sectors

Jean-Paul Hébert, Jacques Fontanel

Report Research  
Dual-use company in Europe

Economic Impact of Dual-Use Industries in France.  
[Research Report] Eurostrategies, Brussels. 1991.

French defence statistics identify six main industrial sectors within the armament industry, aerospace, electronics, shipyards and arsenals, mechanics and metallurgy, nuclear and others. There are new activities in aerospace and electronics, traditional activities with mechanics and metallurgy, and nuclear technology. They are interesting exporters, but with offsets contracts. In order to export, France is often compelled to buy back some foreign products, often low tech for third world suppliers. What is the relative importance of defence within each industrial sector? There are good correlations for aerospace, electronics, shipbuilding and nuclear. There are bad correlations for ammunition and small arms and motor vehicles, and no correlation for machines and engineering.

Les statistiques de défense françaises identifient six secteurs industriels principaux au sein de l'industrie de l'armement, l'aérospatiale, l'électronique, les chantiers navals et les arsenaux, la mécanique et la métallurgie, le nucléaire et autres. Il y a de nouvelles activités dans l'aérospatiale et l'électronique, des activités traditionnelles avec la mécanique et la métallurgie, et la technologie nucléaire. Ce sont des exportateurs intéressants, mais avec des contrats compensatoires. Pour exporter, la France est souvent obligée de racheter certains produits étrangers, souvent de basse technologie pour des fournisseurs du tiers monde. Quelle est l'importance relative de la défense dans chaque secteur industriel ? Il existe de bonnes corrélations pour l'aérospatiale, l'électronique, la construction navale et le nucléaire. Il y a de faibles corrélations pour les munitions et les armes légères et les véhicules à moteur, et aucune corrélation pour les machines et l'ingénierie.

Industrial military sectors, France, armaments, military industries

French defence statistics identify 6 main industrial sectors within the armament industry, as follows (with their relative share of the equipment budget) :

- aerospace	30%
- electronics	30%
- shipyards and arsenals	14%
- mechanics and metallurgy	9%
- nuclear	6%
- others (jointly)	11%
	100%

This situation is the result of a long evolution, probably still to be completed, originate in the conversion of the French armed forces to a nuclear-based defence in the 1960s. This resulted in a shift of their equipment from heavy ships and land-based weapons to sophisticated aircraft and missiles, with an important share of electronics. The corresponding progress in electronics was then applied to ships and land-based weapons. This general evolution towards high-tech products is enhanced as a result of offsets. Indeed in order to export military equipment, France is often compelled to buy back some foreign products, and these are necessarily low-tech in the case of third-world suppliers.

The general scope of the industrial sectors thus appears as follows :

- a traditional activity in mechanics and metallurgy (including shipbuilding) and munitions, mostly held in state arsenals (or former ones), and of decreasing volume;
- a new activity in aerospace and electronics, mostly held in industry;
- a nuclear technology which is essential in the whole concept, but whose industrial share is relatively low.

The interest of this breakdown is to measure the relative importance of each industrial sector within defence, whereas the object of the present report is to measure the relative importance of defence within each industrial sector. The two approaches could merge if the definition of the sectors coincided. Unfortunately, this is not always the case. Indeed, as shown in table 5.1, crossing the sectors above (except for "others") versus the defence content of the sectors adopted in the present report leads to :

- good correlations for "aerospace", "electronics", "shipbuilding" and "nuclear";
- bad correlations for ammunition and small arms (due to the specificity of the term "small arms") and for "motor vehicles";
- no correlation at all for "machines and engineering", a sector which is not identified such in French civil statistics.

CORRELATION BETWEEN CIVIL AND DEFENCE SECTORS					
CIVIL/DEFENCE	Aerospace	Electronics	Shipyards & Arsenals	Mechanics & metallurgy	Nuclear
Aerospace					
Electronics					
Shipbuilding					
Ammo. & s. arms					
Motor vehicles					
Machines/eng.					
Nuclear					

Table 5.1  
Source: CEPS compilation



Even in the favourable cases above, going into details raised problems due to the difficulty of defining the precise outline of the "sectors". After an unsuccessful attempt to use official statistics, it was found that the only way of obtaining relevant information was to address the professional unions, especially :

- GIFAS (Groupement des Industries Françaises Aéronautiques et Spatiales) for Aerospace,
- GIEL (Groupement des Industries Electroniques) and SPER (Syndicat des industries de matériel Professionnel Electronique et Radioélectrique) for Electronics,
- CSCN (Chambre Syndicale des Constructeurs de Navires) for shipbuilding,
- CCFA (Comité des Constructeurs Français d'Automobiles) for motor vehicles.

But even this choice can be argued, because the CCFA excludes military vehicles and conversely, all professions incorporate a share of electronics, hence a certain overlapping especially with aerospace. Indeed, the aerospace/electronics intersection constitutes an important subsector of "avionics" (i.e. airborne electronics), which is taken into account in the statistics of both sectors.

All this makes it difficult to obtain the data requested by a macroscopic approach, i.e. aggregated figures. Hence the obligation, in some cases, to resort to a microscopic approach, i.e. studying sectors as the sum of their components. But this raises other problems :

- some companies work on several sectors (e.g. Thomson on missiles - i.e. aerospace and munitions, and obviously on electronics), and their financial breakdown does not coincide with that of sectors;
- adding the turnover of all companies in a given sector results in neglecting the smallest ones, but also counting twice or more the transfers between the major ones

For all these reasons, the quantitative aspects of the sectorial analysis hereafter - as compiled in table 5.2 and detailed in the subsequent ones - are subject to some doubt

## Aerospace

The aerospace sector covers 30% of the total defence industry. It is dominated by four systems integrators (see tables 5.3, 5.4 and 5.5), among them the first three companies in terms of defence turnover. These systems integrators are :

- Aérospatiale, which covers the whole range aircraft + missiles and satellites,
- Dassault Aviation for aircraft,
- Matra for missiles and satellites,
- Thomson-CSF for missiles.

Country: France				
SECTORS				
	TOTAL TURNOVER	DEFENCE TURNOVER	TOTAL EMPLOYEES	DEFENCE EMPLOYEES
Aerospace	13.300	6.500	120.000	63.600
Motor Vehicles		1.000		
Shipbuilding	2.900	1.900	13.000	8.200
Electronics	27.200	3.000	213.000	53.500
Machines/ Engineering				
Ammunition/ Small Arms	1.100	1.100	12.000	
Nuclear	8.000	1.440	44.000	10.400

TABLE 5.2

Sources: compilation of subsequent tables

MAIN COMPANIES IN AEROSPACE

MAIN AEROSPACE COMPANIES	AIRCRAFT		MISSILES		SPACE		PROPULSION		AVIONICS
	civil	mil. hel.	land	air sea	launches	sat.	turbine	rocket	
Aérospatiale	X	X	X	X	X				
Dassault Av.	X	X				X			
Matra			X	X					
Thomson-CSF			X					X	
SNECMA								X	
Labinal									
SNPE + SEP									X
Sextant Av.									X

TABLE 5.3

Source: CEPS



Country: France					
AEROSPACE					
Main Aerospace Companies *	Total Turnover	Defence Turnover	% Defence	Total Employees	Total Defence Employees
Aérospatiale	4,510	1,985	44%	33,220	14,100
Thomson CSF**	2,590	2,465	95%	20,400	19,000
Dassault Av.	2,470	1,930	78%	13,380	10,500
Matra D.E.	1,200	780	60%	9,330	6,400
Sextant ***	860	320	37%	3,900	3,900
Total Aerospace *	(10,200)			(80,000)	(48,600)

TABLE 5.4

\* excluding propulsion (see table 5.5) and transfers between companies

\*\* aerospace activity only (for turnovers, and evaluated for employees)

\*\*\* also listed in electronics

Sources:

- for company turnovers and employees: annual reports, and interviews for internal breakdowns
- for total employees and total turnover (tables 5.5 + 5.6): GIFAS
- for total defence employees (tables 5.4 + 5.5): French Ministry of Defence

Country: France					
PROPULSION					
Main Propulsion Companies	Total Turnover	Defence Turnover	% Defence	Total Employees	Total Defence Employees
SNECMA	1,920	766	40%	13,730	6,500
SEP	600	164	26%	4,000	1,100
Labinal*	490	251	25%	16,320	4,000
SNPE**	150	258	49%	6,700	3,500
Total Propulsion	(3,000)	(1,400)		(40,000)	(15,000)

TABLE 5.5

\* Turbomeca + Microturbo only

\*\* division "Defence & Space" (49.4% of total)

Sources:

- for company turnovers and employees: annual reports, and interviews for internal breakdowns
- for total employees and total turnover (tables 5.5 +5.6): GIFAS
- for total defence employees (tables 5.4 +5.5) : French Ministry of Defence

These top companies induce a considerable number of subcontractors, especially in propulsion and avionics :

- SNECMA and the aerospace sector of Labinal for turbine engines,
- SNPE for rocket propellants, and the joint SNPE/SNECMA/Aérospatiale subsidiary SEP (Société Européenne de Propulsion) for rocket motors,
- Sextant (a joint subsidiary of Thomson and Aérospatiale) for avionics, a subsector shared between the aerospace and electronic sectors.

Adding up the turnovers of these companies and all the others involved in this sector (see tables 5.4 and 5.5 for the main ones) gives a total figure of 15,792 Million ECU for 1989. This must be reduced by the amount of transfers between these companies, which gives a more realistic consolidated total of 13,273 Million ECU (see table 5.6).

The strongest increase between 1988 and 1989 is due to national civil orders, and the lowest one to national government orders (i.e. mainly military). But even so, the military activity remains very important in this sector :

- 53% of the employees (i.e. 63,600 out of 120,000) and approximately the same share of turnover when export is taken into account;
- 33.5% of the turnover (i.e. 4,430 out of 13,273 Million ECU) and approximately the same share of employees for the French national forces.

The total percentage of export (i.e. military + civil) is very high (59%, i.e. 15% more than in 1988), but this value must be handled with care since most of the aerospace equipment is manufactured in international cooperation, as previously indicated, so the figures for exports should be reduced by the amount of import. According to customs statistics, the data for 1989 were exports = 6,539 Million ECU versus imports = 3,946 Million ECU, i.e. a positive trade balance of 2,593 Million ECU.

GIFAS has a different approach to the problem (see table 5.7), because its statistics (which include avionics) subtract the foreign participation in those end products manufactured in international cooperation, in order to obtain directly the trade balance : this amounts to 3,535 Million ECU. The difference between this value and that given by the customs statistics above ( $3,535 - 2,593 = 942$  Million ECU) corresponds to :

- exports of avionics equipment when this is labelled "electronics" in customs statistics;
- real imports of aerospace end products.

As far international cooperation is concerned, GIFAS statistics show that :

- the French share of foreign sales amounted to 37.97% in 1988 and 42.55% in 1989;
- the French share of foreign orders amounted to 52.76% in 1988 and 64% in 1989.



Consolidated turnover of the French aerospace industry

CONSOLIDATED TURNOVER	1988	1989	var.88/89
National govt. orders	4 037	4 430 = 33.5%	+ 9.71%
National civil orders	794	997 = 7.5%	+ 25.26%
Export	7 020	7 836 = 59.0%	+ 11.39%
Total	11 852	13273 = 100.0%	+ 11.75%
* in current MECUS (in constant Francs, the increase is only 7.97%)			

Table 5.6

Source: GIFAS

Export of the French aerospace industry in 1989

CATEGORY	SALES		ORDERS	
	TOTAL	FRENCH	TOTAL	FRENCH
Airframes and planes	2 960	1 267	6 285	5 053
Helicopters	690	118	845	1
Engines	1 892	1 335	1 471	1 174
Missiles	775	138	578	129
Space	281	281	383	210
Equipments	1 238	296	1 277	367
Total	7 836	3 535	10 839	6 634
*Total* = including the foreign participation in international cooperations *French* = French share of international cooperations				

Table 5.7

Source: GIFAS

Since the 1989 orders mean future sales, this shows that the contribution of international cooperation in the French aerospace exports (and in the French aerospace production in general) is more and more important. This may result from the fact that the French aerospace industry, although partly nationalized in 1936, was never constituted in government agencies such as the arsenals or shipyards, which makes it less national-minded.

Anyhow, the total exports place the aerospace sector second to the agriculture and food sector in terms of economic balance. These exports include sales to the USA, mainly helicopters for police use (as a follow-on to previous helicopters and to Falcon patrol aircraft ordered by the US coast guards), and naturally European Airbus liners for civil uses. They also incorporate the French share of CFM 56 turbine engines, jointly manufactured by SNECMA and General Electric.

This situation is the proof of an efficiency which should soon be increased by the achievement of Europe's largest aeronautical complex, near Toulouse, for the assembly of widebody Airbus liners.

Airbus sales have raised a strong argument between the US and Europe about "undue" aids to civil industry. In fact, comparing the percentage of turnover of the whole aerospace industry (civil and military) generated by government contracts in various OECD countries gives the following results (previously commented) :

- USA : 70%
- Europe (as a whole) : 37%
- France (alone) : 31%

Subsidies are only one of the elements which may distort competitiveness. Another important one is the currency rate : maintaining the dollar at a rate of approximately 0.7 ECU (instead of approximately 1 ECU, as calculated by the OECD as a "normal" value) also constitutes a subsidy. French industrialists in this sector are unanimous : the managers of Aérospatiale protest, and those of Dassault Aviation appeal for a new "Bretton-Woods" agreement, considering that customs fees would be a totally inadequate answer if they were limited to 5%, as compared to the 25% or 30% shift of the dollar.

All this makes it very difficult to establish a valuable assessment of the competitiveness and profitability of this sector. The situation is clearer in terms of capability, since the French aerospace industry covers the whole range of technologies required :

- advanced materials for airframes and space launchers;
- CAD-CAM systems (Dassault's CATIA computer code was adopted by Boeing in 1985);
- rocket propulsion (SNPE and SEP);
- turbine engines, though partly by means of a cooperation with General Electric.

As previously indicated, the Ministry of Defence is the "tutor" of the whole aerospace industry, and the R&D expenses in this sector amount to 33% of the overall defence R&D budget (18% for aircraft, and 15% for missiles). Even upstream of real developments, an important effort is devoted to research, with the government agency ONERA, with a number of relatively small companies working on technology per se, and with participation in various European research programmes, either at community level or in more restricted groups (especially the GARTEur and the European wind tunnel, with the UK, Germany and the Netherlands). In spite of this particular position of the Ministry of Defence, technological spinoff is less and less military-to-civil, and often tends to be reversed, as will be seen in the chapter "conversion".

### Electronics

The defence activity in this sector (30% of the total defence industry) was dominated until 1989 by :

- Thomson-CSF (largest company in terms of defence turnover, but not exclusively working on electronics, since its activity also includes systems integration and even munition manufacturing).
- Dassault Electronique (9th largest)
- SAGEM (13th largest)

The existence of these top companies also induces a very high number of subcontractors which can go down to extremely small sizes for software companies. Software activity is dominated by CAP-SESA Defense. This is only one among other technological activities per se, which are covered by small companies or subsidiaries.



To these traditional defence companies, a newcomer must be added : Alcatel, a European group but a subsidiary of the French CGE (Compagnie Générale d'Electricité), which will change its name in 1991 to "Alcatel-Alsthom".

An agreement had been passed in 1983 between CGE and Thomson-CSF, which led to sharing activities (and swapping several subsidiaries and divisions) : civil activities to CGE and defence activities to Thomson-CSF. But this agreement was only valid in France and up to the end of 1989, and even before that deadline, Alcatel had already started to work in the defence field through its European "Radio Space and Defence Group". This group achieved a turnover of approximately 1,400 Million ECU in 1989, half of it in France on space applications which happened to be partly military (communications satellites Syracuse).

In 1990, for the first time, Alcatel presented itself officially as a competitor to Thomson-CSF in the defence field (a fact which does not appear in table 5.8, derived from annual reports for 1989), while it also progressed in space activities thanks to the acquisition (jointly with Aérospatiale and Selenia) of 45% of Loral Space Systems, in the USA. Conversely, Thomson-CSF tries to diversify its activity towards space systems, as indicated in the company strategy.

Country: France					
ELECTRONICS					
Main Electronics Companies	Total Turnover	Defence Turnover	% Defence	Total Employees	Total Defence Employees
Thomson CSF*	2,210	1,300	64%	17,400	10,000
Dassault El.	590	451	78%	9,335	7,000
Sextant Av.**	860	317	37%	9,850	3,200
SAGEM	520	253	36%	7,690	2,900
TRT	410	190	46%	4,100	2,000
SAT	410	128	31%	4,670	1,600
SFIM	130	65	50%	1,460	800
CSEE	180	54	30%	2,160	650
Total Electronics	27,220			213,500	53,500

TABLE 5.8

\* electronics only (for turnovers, and evaluated for employees)

\*\* also listed in aerospace

Sources:

- for company turnovers and employees: annual reports, and interviews for internal breakdowns
- for total employees and total turnover: GIEL
- for total defence employees: French Ministry of Defence

This shows the difficulty of defining a precise boundary between civil and military activities in electronics, and also between the electronics sector and the aerospace sector both working on satellites and on aircraft (hence the overlapping already mentioned of "avionics", i.e. airborne electronics).

Similar overlappings occur with other sectors : as an example, 50% of the cost of the Leclerc battleship is constituted by electronics.

According to the French Ministry of Defence, 53 000 employees worked for defence in the sector in 1988, i.e. 25% of the total employment in the sector (213,500 in 1989, according



to the professional union GIEL). In proportion, this would mean 25% of the turnover (27,220 Million ECU in 1989, according to the GIEL), i.e. 6,800 Million ECU, of which 4,000 (i.e. 30% of the defence equipment budget) for the French armed forces. All this makes a series of approximations, but the overlappings and the difficulty of breakdowns make it difficult to produce more precise figures.

The GIEL subdivides this sector as follows :

- "electronics" (213,500 employees and a turnover of 27,220 Million ECU in 1989) contains "equipment goods", among others;
- "equipment goods" (159,680 employees, 22,470 Million ECU) contains "professional goods", among others;
- "professional goods" (52,070 employees, 6,430 Million ECU) contains "detection", among others.

The sub-sub-subsector "detection" (i.e. mostly radars) accounted for over 57% of the turnover of "professional goods" in 1989, and the percentage of export exceeded 61%. This is higher than the same percentage for "professional goods" in general (48.5%) and incorporates a low percentage of induced imports, since the national added value amounts to 85%. In addition, the military activity in this sub-sub-subsector should be less affected than that of others by the CFE treaty, due to the predictable increase of orders for detection systems.

The sub-subsector "professional goods" (corresponding to the statistics of the other professional union SPER) is the only one where the military activity is explicitly identified : this was 28% of the turnover excluding exports and 32% including exports, i.e. respectively 1,800 Million ECU and 2,060 Million ECU. This is less than the defence turnover of Thomson-CSF alone, even when restricted to the electronics sector alone (see table 5.8), i.e. exclusive of its activity in missiles (see table 5.4). This shows that other defence applications appear under other headings, but generally scattered.

In this sub-subsector of professional goods, the export-to-import ratio is very high : close to 500%. But it falls down to 102% in the subsector "equipment goods", and the situation is much less favourable in other subsectors, where this ratio falls down to :

- 71% in "passive components" (while it was 103% in 1985),
- 65% in "computers",
- 40% in "expression goods" (i.e. HiFi, TV, etc...).

This last ratio results more from commercial options than from technology gaps, but the other two actually denote a certain technological dependence, in spite of the important effort made in R&D in the whole electronics sector. It is worth noticing that 3 electronics



companies appear in the first 13 innovative companies in France : Thomson (n° 2), Philips France (n° 12) whose defence activity was acquired by Thomson-CSF in 1990, and Dassault Electronique (also n° 12) .

This effort partly results from an important public funding (since R&D in electronic represents 25% of the whole defence R&D), but relatively lower than in other OECD countries : as previously indicated, the total public funding (civil and military) amounts to 40% of the turnover in France, versus 49% in the UK, 67% in the FRG and 90% in the US.

The overall situation of the electronics sector in France is summarized in table 5.9. As opposed to the aerospace sector, the economic balance in this sector has become negative since 1987 : the deficit amounted to 1,770 Million ECU in 1988, and 2,130 Million ECU in 1989. In addition, as indicated above, the orders in hand for further years are decreasing. The French electronics sector in general is in a difficult situation, like the whole European electronics industry.

GENERAL SITUATION OF THE ELECTRONICS SECTOR IN FRANCE			
	General	Equipment Goods	Professional Goods
Turnover 1989 (Million ECU)	27.220	22.470	6.430
Variation 88-89	+8.9	+8.8%	+8.8%
Exports	12.920	9.030	3.120
Imports	15.050	8.820	630
Export/Import Ratio	86%	102%	493%
Manual Workers	63.256	32.740	11.230
Other Employees	150.250	126.942	40.844
Total Manpower	213.506	159.682	52.070
Variation 88/89	- 1%	- 0.5%	- 1%

Table 5.9

Source : GIEL

## Shipbuilding

As indicated in the general introduction, France has many overseas interests, many of them islands. In addition to mainland coasts, France possesses 11 million square kilometres of maritime sovereignty. Moreover, 80% of France's nuclear power is submarine-borne. For all these reasons, France maintains a strong Navy (the only military service not to suffer from budget cuts in 1991), and military shipbuilding is a strong component of her industrial activity.

The total military turnover of shipbuilding (civil and military) is difficult to calculate, since the unit adopted by the professional union CSCN is not the turnover but the CGT (compensated gross tonnage). It can be evaluated around 2,900 Million ECU, with a 65% military share.

This share appears surprisingly low in consideration of the imbalance between the number of employees :

- in the Navy shipyards DCN (4th largest "company" in terms of defence turnover) : 30,400, with a 100% military activity,
- and in the whole of the civil shipyards : 6,500.

In fact, these two numbers cannot be directly compared : the DCN manufactures naval systems and some specific naval weapons in addition to ships, but it also has a number of tasks which, in other sectors, are considered government tasks. Thus, among its 30 400 employees, only 8,200 actually build ships, and 6,200 more work on repairs and maintenance (which is an industrial type of work, but considered a navy task throughout the world). Within its total turnover for 1989 (2,900 Million ECU), only 1,810 Million ECU correspond to shipbuilding.

In spite of this correction, a considerable imbalance remains between these two subsectors when their recent evolution is taken into account : the manpower in the DCN has remained approximately stable for many years, whereas that in the civil shipyards has dropped drastically from 23 000 to 6 500 between 1983 and 1990 :

years	1983	1984	1985	1986	1987	1988	1989
employees	23 000	21 700	19 000	13 500	9 000	7 000	6 500



Several civil shipyards have already been closed (there is virtually no shipbuilding left in the Mediterranean), and this evolution has raised a number of social conflicts, some of them still pending. This is why there has been strong pressure in the recent years aiming at a transfer of orders for the French Navy from the DCN to the remaining civil shipyards. This resulted in a decision, taken in 1988, to order 6 frigates from the "Chantiers de l'Atlantique" (a subsidiary of Alstom) for a total price of 40 Million ECU (of which 8 were paid by the Ministry of Industry). This workload does not appear in table 5.10 because the figures it contains are those for 1989, but it should appear in 1990.

Country: France					
SHIPBUILDING					
Main Shipbuilding Companies	Total Turnover	Defence Turnover	% Defence	Total Employees	Total Defence Employees
DCN*	1,180	1,180	100%	8,200	8,200
DCN**			100%	(6,200)	(6,200)
Alstom Atl.	700	0	0%	6,500	0
A&C du Havre	170	0	0%		0
CMN	90	55	60%		400
SFCN	20	10	50%		100
Total Shipbuilding	(2,900)	(1,900)		(13,000)	(8,700)

TABLE 5.10

\* shipbuilding only

\*\* maintenance and repair

Sources:

- for DCN: budgetary documents

- for others: professional union (CSCN) and annual reports (if any)

Civil shipyards did in fact build military ships before this, but only for export. Conversely, the DCN does some civil high-tech work (although negligible in its whole turnover), e.g. building a scientific submarine for deep underwater exploration, and giving civil companies access to some of its research facilities.

But the DCN, due to its military status, does not manufacture ships especially for export: it only tries to sell (indirectly, because the French government is not supposed to export by itself) those types of ships it manufactures for the French Navy. This being an oceanic one (as opposed to the German Navy, for instance), it orders such ships as nuclear missile-launcher submarines and a nuclear aircraft carrier, which are not the exportable type, as opposed to coastal ships. For this reason, the DCN only sold one ship in the last 10 years, and its export turnover in 1989 (66 Million ECU) represents only 2.3% of its total turnover.

Thus, while civil shipyards request a share of the orders for the French Navy, the DCN tries to get some industrial freedom which might allow it to work for export. This might draw the game, unless the DCN takes a different sector of export - namely high-tech ships - as it intends to. More details are given in the analysis of the DCN as such (company profile, strategy and "conversion").

The overall export share was about 70% in 1989, but it varies considerably from one year to another. This is due to the fact the number of items sold for a given turnover is much lower than in other sectors, so selling a ship in December one year or January the next year induces strong variations.

### **Ammunition and small arms**

Like all Western countries, France followed the change of the NATO calibre for small arms and developed the FAMAS model. This won the 1978 NATO contest, but its rather high cost reduced its export perspectives. The total orders for the French armed forces amounted to 360 000, but the Gendarmerie cancelled an order for 34 000 in late 1990 (i.e. 200 000 hours of work). Since all others had already been delivered, this means the end of the production, and there are not many prospects for the future.



Restricting the scope of this sector to "small" arms forbids quantitative statistics, since there is no particular identification for them. Extending the scope to all "arms", i.e. to artillery and land-based weapons (except for armoured vehicles) allows for the identification of specialized sectors in two companies, as done in table 5.11 :

- the "artillery and weapons" branch of GIAT
- and part of TBA (Thomson Brandt Armement), a 100% subsidiary of Thomson, identified as such in 1989, but aggregated into Thomson-CSF in 1990.

The qualitative conclusions for small arms can be extended to this broader subsector, in particular the budget cuts (68 artillery guns were cancelled in the 1991 budget).

Country: France					
AMMUNITION AND LAND WEAPONS					
Main ammo & land weapons companies	Total Turnover	Defence Turnover	% Defence	Total Employees	Total Defence Employees
GIAT*	533	533	100%	8,300	8,300
SNPE**	261	108	41%	3,600	1,480
TBA***	171	171	100%	1,300	130
Matra-Manushin	102	102	100%	970	970
Luchoire	263	93	35%	2,350	580
Total		1,100			12,000

TABLE 5.11

\* Divisions 'Munitions and pyrotechnics' and 'Artillery and Weapons' only (55% of total)

\*\* Division 'Defence & Space' (49.4% of total)

\*\*\* Including 'Forges de Zeebrugge' (Belgium)

Sources: annual reports (or accounts, for GIAT) and interviews for internal breakdowns

In the ammunition subsector, the position of France is very particular in Europe because of its strong evolution after the war of Algeria (following that of Indochina), which ended in 1963. At that time, the force of the Army was 665 000 men, and the individual consumption of training munitions very high. This provided activity to a number of specialized companies, some of them very small.

But the army force continually decreased ever since : 665 000 in 1963, 333 000 in 1965, 312 000 in 1980, 297 000 in 1988, and 260 000 as forecast in 1995. At the same time, the individual consumption of training munitions was strongly decreased, in small-arms for economy reasons (all orders for 12.7 mm munitions have been cancelled in the 1991 budget), and in artillery and air-support for technological reasons, i.e. a double evolution :

- from real firing to an extensive use of simulators;
- from unprecise saturation munitions to very precise or even "smart" ones (up to guided missiles), much less numerous.

Of course, these new munitions are individually expensive, and simulators too. But this means a transfer of activity from the munitions sector to the electronics sector, and also to the aerospace sector for guided missiles. In addition, although France is a major manufacturer and exporter of guided missiles, its warhead industry does not benefit by the production of the Franco-German Milan, HOT and Roland, whose warhead is produced by MBB in Germany.

It ensues from all these factors that the total activity of the munitions sector suffered a drastic drop since the early 1960s. But in spite of this, most of the specialized companies still remain in existence (although some of the individual arsenals disappeared in the 1960s), which results in a scattering of productions and a lack of profitability in low-tech munitions.

This situation has just led to a merger (not taken into account in table 5.11, since it occurred only in 1990): the main manufacturer GIAT (6th largest company in terms of defence turnover), on occasion of its conversion from army arsenals into an industrial company (GIAT-Industries), acquired all the munitions activities of Luchaire and Matra-Manurhin Défense in France, and those of PRB (in Belgium). This should result in a better organization of production in the medium term, especially in high-tech warheads, where only two companies remain : GIAT Industries and Thomson Brandt Armements.



Now, for the time being, none of the existing production plants of GIAT Industries have been closed (for social reasons), so the profitability will remain low in the years to come. In addition, the production of such items as igniters, artifacts, hand grenades, etc. remains scattered among half a dozen companies.

Conversely, there is no need for a merger as far as propellants and explosives are concerned, since these were initially produced under a state monopoly. This official monopoly disappeared in 1971 as a consequence of the Rome Treaty, which gave rise to the state-owned company SNPE (11th largest), but a monopoly of fact still remains within the French industry.

The profitability of this subsector is also low, in low-tech productions, versus third-world industries, which hold two important assets : low wages and - still more - very reduced safety regulations, whereas the French ones lead to very costly modes of production. The solution might be the construction of highly automated facilities, but the volume of the national orders does not justify this type of investment, so the solution could only apply at the European scale.

On the contrary, the high-tech activity of SNPE holds a dominant position in Europe, but most of it is devoted to rocket propulsion, i.e. out of the munitions sector. More generally, the situation of the French industry is satisfactory in high-tech munitions (with an important share of electronics) and missile warheads, which benefit to a certain extent by those assets initially developed for nuclear warheads (research, high explosives, computer codes). And even in small arms munitions, GIAT Industries possesses an interesting asset: it is the only Western manufacturer of steel sleeves (instead of brass sleeves), a technology which should potentially result in strong economies.

### Motor vehicles

The outlines of the military "motor vehicles" sector are difficult to define, since defence orders range from common-use civil cars to main battle tanks.

The only national statistics available deal with common-use cars and trucks. In the civil-oriented sector, the state-owned group Renault (and its subsidiary RVI : Renault Véhicules Industriels) and the private group PSA (Peugeot + Citroën) come respectively n° 1 and 2 in the list of French companies, and they have a number of agreements with smaller French companies (Matra, Heuliez) and still more with European ones.

France as a whole comes second to Germany in Europe for the number of cars produced (3.4 million in 1989, of which 55.7% exported), and first in Europe for trucks (.5 million

in 1989, of which 41.7% exported). This civil sector employed 346 000 people in 1989, and the total induced employment added 485 000 more.

All this well-known to the EC, and military orders in this sector are not considered part of the "defence industry".

At the other end of the span - i.e. heavy and medium battletanks - the only French manufacturer is the GIAT (now "GIAT Industries") which developed the whole AMX series in the past years, and which has just finished the development of the Leclerc main battletank. Speaking of world market shares for such products is very difficult because, so far, each of the main industrialized countries has developed its own tanks, and all attempts for international cooperations have failed.

In between (i.e. light armoured vehicles, specialized trailers, special four-wheelers, etc.), other companies appear, from general-purpose (such as RVI) to military-oriented (especially Pankard, a former car manufacturer now working only for defence).

Country: France					
MOTOR VEHICLES					
Main Motor Vehicles Companies	Total Turnover	Defence Turnover	% Defence	Total Employees	Total Defence Employees
GIAT*	436	436	100%	6.000	6.000
RVI	4.885	364	7%	32.500	2.300
Pankard	97	97	100%	450	450
Creusot Loire	320	62	19%	2.845	745
SAMM	45	17	39%	575	225
Total Motor Vehicles		1.000			10.000

TABLE 5.12

\* Division "Armoured vehicles and turrets" (45% of total)

Sources: annual reports (or accounts, for GIAT) and interviews for internal breakdowns



The joint existence of lightweight and heavy armoured vehicles partly results from the existence of two different missions for the French Army (and Air Force) : in Europe in front of the Warsaw Pact, and overseas. The recent political changes and the outburst of the Gulf crisis result in a certain re-consideration of the priorities, and in a strong decrease in the orders for Leclerc MBT'S : probably 800 left in total, instead of the 1 400 initial forecast.

But the GIAT has acquired a considerable experience as the system integrator of the Leclerc, and the company wishes to apply its experience to lighter vehicles. Hence the announcement of the creation (in 1991) of a joint subsidiary between GIAT and RVI, as also Creusot Loire Industries (for armour).

In terms of financial links, this sector can be characterized as follows :

- GIAT Industries, former state arsenals converted into a state-owned company in July 1990;
- the Renault group represented by its subsidiary RVI (Renault Véhicules Industriels);
- the PSA group represented by its subsidiaries Pankard and SAMM;
- Creusot-Loire Industrie, a metallurgist which provides the armour plates;
- a few independent companies, such as Lohr.

In addition to these manufacturers of end products and armour, several companies produce ancillary equipments, which take more and more importance in the whole turnover of the sector : half the cost of the Leclerc MBT is electronics, electro-optics and computers.

### **Nuclear energy**

France was a pioneer in nuclear energy, and the depletion of its coal mines led her early to study the possibility of building nuclear reactors. World War II interrupted this effort, but immediately afterwards, a state agency was created in order to resume and coordinate the work - the CEA (Commissariat à l'Energie Atomique).

Another consequence of World War II was the US-UK assistance agreement on nuclear weapons, which excluded France. Thus, when France decided to build up a nuclear industry in the late 1950s, it had to face a US embargo on enriched uranium and on high-capacity computers. This, in turn, caused France to develop capabilities of its own in the whole field of nuclear energy and its applications, primarily military, but also civil. For this reason France now masters the whole industrial process :

- of nuclear fuels, from the uranium ore to the re-treatment of nuclear waste (for own use and for that of many civil clients, including Japan);
- of nuclear plants, both of the first generation and of the "breeder" type (Phenix and Superphenix reactors);
- and of associated technologies, especially in computer software.

The existence of uranium mines in mainland France also results in a total national independence in the nuclear sector, even though much of the uranium ore is imported from Niger and though the French process for first-generation reactors was replaced by the US Westinghouse process. Because of this technological independence, France could reduce its energy dependence on oil producers by building a number of nuclear plants, so 75% of electric power was of nuclear origin in 1989.

All this makes France an exporter of ready-to-operate nuclear plants, of re-treated fuels and even of electric power, so 31% of the turnover of this sector resulted from foreign sales in 1989.

In 1983, a reorganization took place within the CEA, which led to the creation of two entities :

- a "public establishment" CEA, which holds all the scientific and technological assets, and also the military applications division (DAM)
- and a holding "CEA Industries", which joins the remaining CEA assets with external industrial participation, in order to carry out the whole industrial activity in this sector, and also a few non-nuclear activities derived from its specific environment.

The main components of this holding are as follows :

- GOGEMA (a 100% CEA subsidiary, but also an international group with foreign participation, in particular in Eurodif for the enrichment of uranium) covers the whole cycle of the nuclear fuel : ore extraction, enrichment and processing, waste re-treatment;
- Framatome (35% CEA), the first manufacturer of nuclear reactors in the world, and Technicatome (90% CEA), specialized in medium and low-energy reactors;
- Intercontrôle (61.3% CEA) for engineering studies, and STMI (40% CEA) for decontamination and protection.

In addition, CEA Industries commercializes some of the technologies developed for the sake of nuclear energy :

- CISI (64% CEA) for computer science;
- ORIS (100% CEA) for biology and radio-isotopes.





The whole group remains under a strong government control. Only Framatome might have escaped this control in 1990 when the main shareholder CGE (40%) tried to acquire the share of Dumez (12%), according to an agreement between the two firms. But the French government refused, and these 12% were acquired by a state-owned holding CEA + EDF (Electricité de France, the electric power supplier), so the majority of the group is now state-owned :

- CEA + EDF = 46% and Crédit Lyonnais (nationalized bank) = 5% ;
- Framatome personnel = 5% ;
- CGE = 44%.

(Note that the CGE, whose main other subsidiary is the European group Alcatel, will change its name to Alcatel-Alsthom in 1991).

Table 5.13 lists the turnover and employees for all the companies involved in this sector. A total 10,400 employees work for defence in this sector, of which 7,000 directly on weapons within the DAM (Direction des Applications Militaires). Since the defence turnover of the CEA incorporates all sales from other companies (uranium, etc.), the percentage of defence turnover of these other companies was equivalent to zero.

Another possible breakdown is as follows (employees and turnover in 1989) :

- military division of CEA (DAM) : approximately 7,000 employees and 1,440 Million ECU (as from the defence budget);
- CEA (public establishment + CEA industries + 100% subsidiaries) : 20,000 employees and 3,560 Million ECU;
- CEA consolidated (i.e. with share of partial subsidiaries) : 36,280 employees and 4,770 Million ECU
- total sector : approximately 44,000 employees, and sum of turnovers equal to 8,770 Million ECU (but this incorporates the transfers between companies).

In the consolidated CEA turnover, foreign sales accounted for 1,470 Million ECU (i.e. 31%). In the CEA budget, the defence funding was 1,440 Million ECU, and there was an additional public funding of ECU 934 Million ECU (essentially basic science and technology).

The military funding covers the nuclear materials and two types of applications :

- weapons,
- and reactors for nuclear-powered submarines and for the nuclear-powered aircraft carrier now under development.



Weapons are strictly for a national use, but the non-proliferation treaty does not forbid export of nuclear-powered ships. However, no request of this type has even been accepted by the French government so far (although some talks have taken place with Canada), so the defence funding is purely national.

In the civil side of this sector, in addition to exports, the CEA is involved in several international cooperations :

- on basic science, especially the CERN, the JET and several EC projects;
- on nuclear generators, especially with Germany : in addition to a long-lived agreement on the breeder technology (extended to the UK in 1989), a joint Framatome/Siemens-KWU subsidiary "Nuclear Power International" was created in 1989 for the development and commercialization of pressurized-water reactors.

Country: France					
NUCLEAR					
Main Nuclear Companies	Total Turnover	Defence Turnover	% Defence	Total Employees	Total Defence Employees
CEA	3,560	1,440	40%	20,000	10,400
COGEMA (100%)	2,670			14,000	
Framatome (35%)	2,220			5,950	
CISI (64%)	164			2,620	
ORIS (100%)	92			630	
Intercontrôle (61.3%)	39			330	
STMI (40%)	26			550	
Total Nuclear	1,440			4,080	10,400

TABLE 5.13

Sources: CEA annual report

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