Activity report of the French Team

For Ikinet, March 2006

1. General statistical description of the region[1]

1.1 General characteristics

The Greater Paris Region (or Ile de France) comprises eight *départements* that cover over 12000 km². The region can be divided into three main areas: The Paris *arrondissements* (or districts), the Little Crown (comprising the *départements* of Seine-Saint-Denis, Val de Marne and Hauts-de-Seine) and the Big Crown (comprising the *départements* of Yvelines, Val-d'Oise, Essonne and Seine-et-Marne).

Table 1: The "Kernels" in Paris

	Smallest (comparable to the "Administrative City" of other large cities)	Medium (in comparison with London for instance)	Largest
Paris	A (20 "arrondissements"): 2.1 million inhabitants. 1 x NUTS* 3 regions	K ("Little Crown"): 6.2 million inhabitants 4 x NUTS 3 regions	LUZ ("Big Crown"): 11 million inhabitants 1 x NUTS 2 regions

Source: Urban audit, Eurostat 2004
**NUTS: Nomenclature of Statistical Territorial Units*

With its 20 *arrondissements* and 2 million inhabitants, Paris is the smallest (105 km^2) but most densely populated *départements* in France. Then come the *départements* of Hauts-de-Seine (1.42 million inhabitants on 176 km^2), and Seine-Saint-Denis (1.38 million inhabitants and 236 km^2). The Seine-et-Marne is the largest *département.*

[1] This note is largely based on the IAURIF's work «*Key figures of the Ile de France Region - 2004* ». Most maps and tables included here are borrowed from this study.

Fig 1: The *départements* of Ile de France and their population

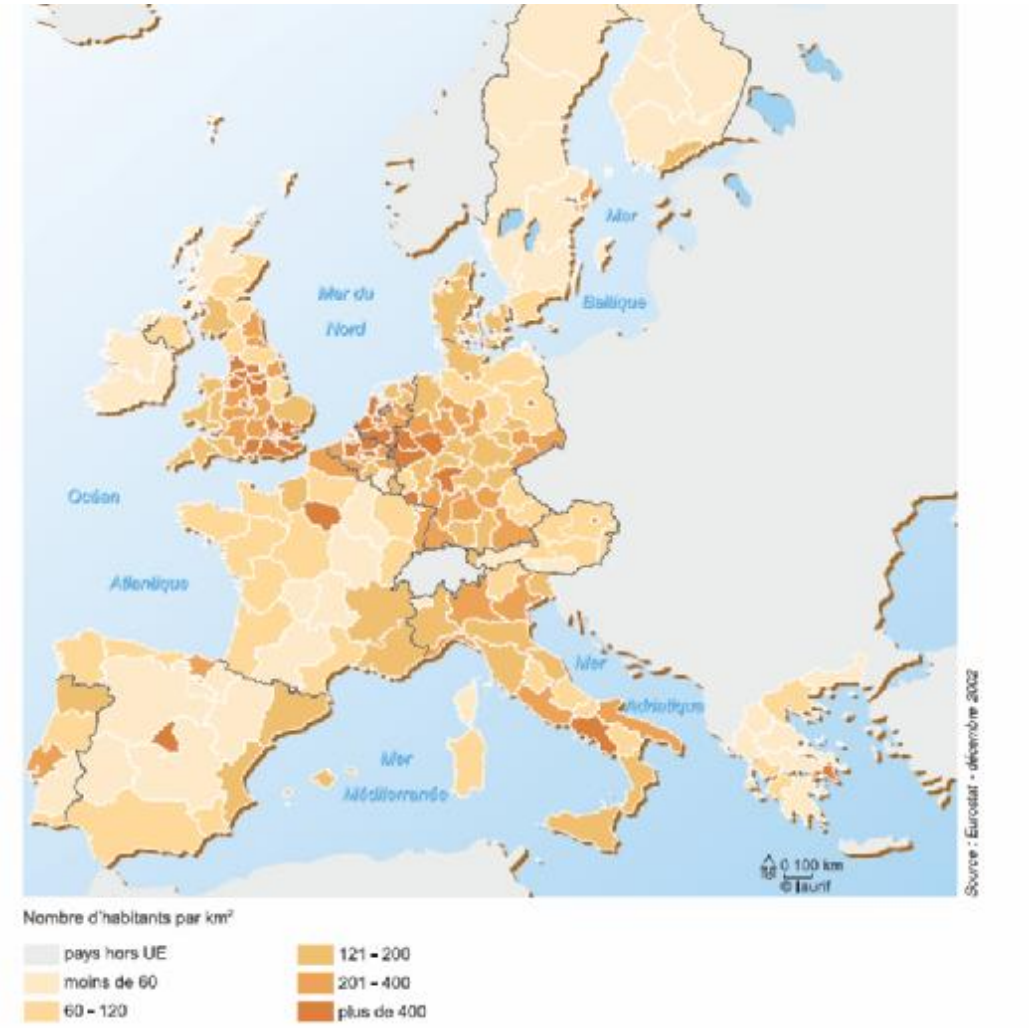
	Superficie (km²)	Population	
		1999	2002
Paris	105	2 125 246	2 145 844
Seine-et-Marne	5 915	1 193 767	1 219 175
Yvelines	2 285	1 354 304	1 364 538
Essonne	1 804	1 134 238	1 145 147
Hauts-de-Seine	176	1 428 881	1 463 107
Seine-Saint-Denis	236	1 382 861	1 389 294
Val-de-Marne	245	1 227 250	1 236 136
Val-d'Oise	1 246	1 105 464	1 115 025
Ile-de-France	**12 012**	**10 952 011**	**11 078 266**

Source: IAURIF, Key Figures-2004

Population:

The demographic weight of the Greater Paris area makes it one of the most important metropolises in Europe and in the world (see fig 2). Indeed, in 2003 the region was home to 19% of the French population, that is 11 million inhabitants and approximately 5 million jobs. What's more, its population is younger than the national average.

Fig 2: Population density in the regions



Source : IAURIF, Chiffres clés 2004

As the largest employment pool in Europe, the Ile-de-France Region has a highly qualified workforce. It is home to over one third of all senior executives, to approximately 40% of the nation's research workforce, and to 30 % of all higher learning institutions (with prestigious international schools in the fields of computer science, mathematics, telecommunications, alternative energy, biotechnologies, management and international commerce…).

Table 2: Ile de France in a few key figures

Population	11,1 million
GDP	430 billion euros
Firms	617 000
Enterprise creations	65 900
Jobs	5,4 million
Unemployment rate	9,5 %
Researchers & grant holders	73 800
Students	563 000

Source: INSEE, Ministry of Research, 2004

Characteristics of the region

The Ile de France region is the nation's political decision-making and administrative centre because of the presence of public administrations. Being home to over 615 000 firms and to a large proportion of the country's industrial and financial firms' headquarters, the region is also the main economic centre of the nation.

The Greater Paris region plays a major part in the country's economy: its value added represents 29% of the national wealth. It is also one of the greatest wealth-producing regions with the highest GDP/capita (36924 million euros in 2000) in Europe. It ranks third behind London and Frankfurt in the European financial markets, and has a strong research capacity.

Furthermore, the region has one of the world's densest transport networks. Roissy Charles de Gaulle is the second largest European airport behind Heathrow (London). It is linked with the TGV high-speed train network, which will in future connect all large capitals of Western Europe. The national highways and roads, the metro (metropolitan railways), the RER (Regional express railroad), the railways as well as the bus routes constitute a dense transport network; however, as all metropolises, the Greater Paris Region is affected by chronic congestion problems.

1.2. Economic structure

The region's economy is dominated by the service sector (administrations, commercial services, international financial establishments) and in particular by business services: approximately 83% of the region's workers are employed in the tertiary sector, against only 12% in the industrial sector, 5% in the building industry, and 0.3% in agriculture. A similar distribution is found at firm level: 82% of firms belong to the tertiary sector against only 8.1% to the industrial sector and 1.4% to the agricultural sector. The developments of centres such as la Defense or Marne la Vallee, areas that are highly specialised in tertiary activities, reflect this evolution.

Nevertheless, Ile de France is still characterised by a strong industrial tradition. It remains the main industrial region in France and employs 15% of the country's industrial work force. Firms such as Renault, Citroën, Thalès, IBM are located in the region. The region's industrial sector has two main distinctive characteristics: a particularly dense network of SMEs, and a wide range of industrial activities. The most represented among the region's industrial activities are:

- Publishing, reproduction
- Electrical and Electronic appliances
- Automobile industry
- Aeronautics and space industry
- Para chemistry and pharmaceuticals

The region also has a strong agricultural tradition, particularly in the Seine-et-Marne. Agricultural land still covers 50% of the region's territory. The region's agri-business is France's number one in terms of turnover and value added. The Ile de France region, and particularly Paris, is one of the world's capitals of trade shows, professional conventions or other exhibitions (the Rungis market, in particular, is the largest wholesale market in the world). Finally, tourism is also a significant activity in the region's economy.

The distribution of industrial activities in the eight ***départements*** of the region is uneven. In terms of work force, the ***départements*** of Hauts de Seine, Paris and Yvelines account for over 60% of industrial jobs. Two organisations out of five are located in Paris. Most activities in the high and medium technology industry, such as computer systems, optics, electronics, instrumentation, the

biomedical sector, are concentrated in the south of the Greater Paris Region, in a crescent stretching from the Hauts de Seine to the new town of Evry.

Table 3: Number and distribution of firms per region and main sectors of activity on december 31st 2002.

	Agriculture		Industrie		Construction		Commerce		Transports		Services aux entreprises		Services aux particuliers		Autres *		TOTAL
	Nombre	%	Nombre	%	Nombre	%	Nombre	%	Nombre	%	Nombre	%	Nombre	%	Nombre	%	Nombre
Paris	625	0,2	24 466	8,1	15 382	5,1	66 923	22,1	7 951	2,6	93 023	30,8	42 459	14,0	51 617	17,1	302 446
Seine-et-Marne	3 921	7,6	4 646	9,1	6 425	12,5	12 385	24,1	2 942	5,7	7 739	15,1	5 316	10,4	7 975	15,5	51 349
Yvelines	1 928	3,1	4 495	7,3	6 025	9,7	14 441	23,3	2 560	4,1	14 086	22,8	6 899	11,2	11 454	18,5	61 888
Essonne	1 442	3,1	3 708	7,9	5 639	12,1	11 455	24,6	2 424	5,2	8 998	19,3	5 067	10,9	7 911	16,9	46 644
Hauts-de-seine	281	0,3	6 567	7,5	5 274	6,0	18 168	20,6	3 641	4,1	27 194	30,9	11 068	12,6	15 818	18,0	88 011
Seine-Saint-Denis	162	0,3	5 778	9,2	7 953	12,6	19 764	31,3	5 113	8,1	9 063	14,4	7 426	11,8	7 770	12,3	63 029
Val-de-Marne	330	0,6	4 362	8,0	6 094	11,1	14 542	26,6	3 321	6,0	10 827	19,8	6 357	11,6	8 933	16,3	54 766
Val-d'Oise	1 059	2,4	3 817	8,7	5 428	12,4	11 257	25,8	3 102	7,1	7 508	17,2	4 556	10,4	6 983	16,0	43 710
Ile-de-France	**9 748**	**1,4**	**57 839**	**8,1**	**58 220**	**8,2**	**168 935**	**23,7**	**31 054**	**4,4**	**178 438**	**25,1**	**89 148**	**12,5**	**118 461**	**16,6**	**711 843**

Source : INSEE, fichier SIRENE
**Activités financières, activités immobilières, éducation, santé, action sociale.*

Source : INSEE, SIRENE file
Financial activities, real estate activities, education, healthcare, social work.
Source: IAURIF, Key figures 2004

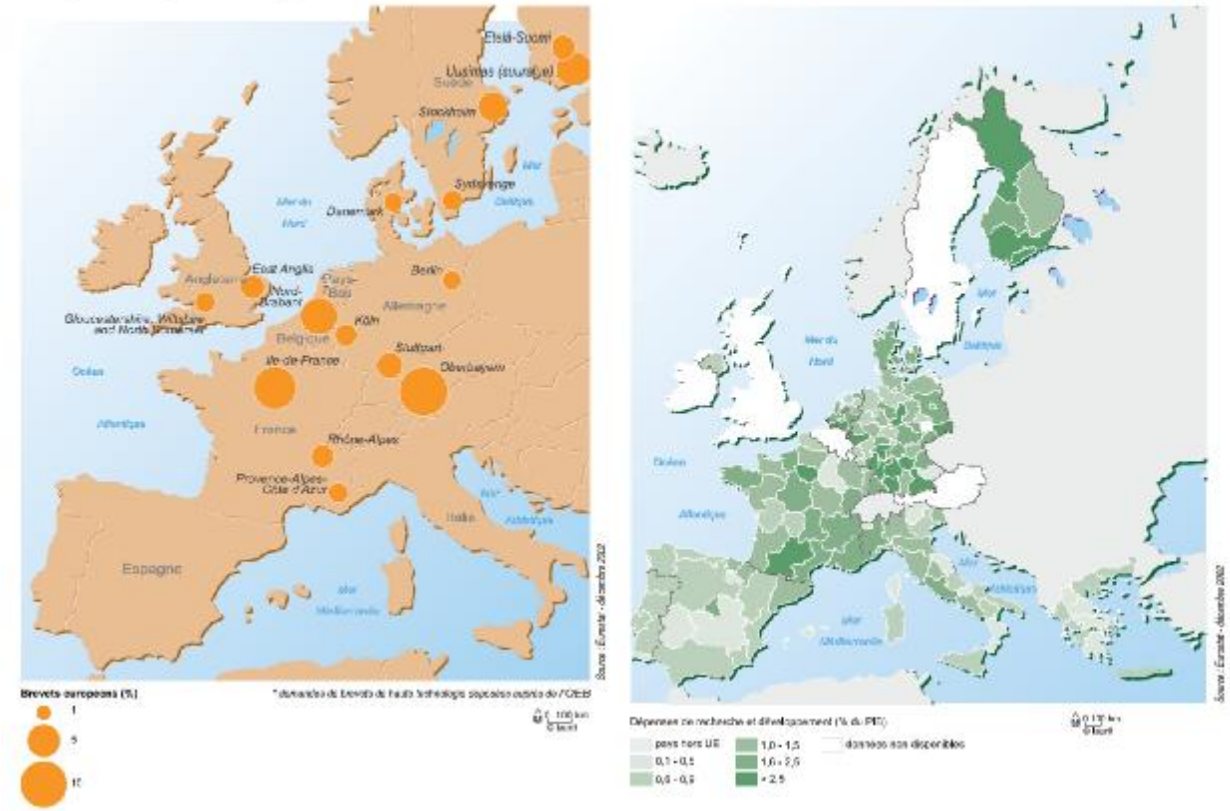
Industrie : Industrial sector
Construction : Building industry
Commerce: Trade
Transports: Transport industry
Services aux entreprises : Business services
Services aux particuliers : Personal services
Autres : Others

1.3. Knowledge structure

Research in the Greater Paris Region and in Europe

In Ile de France, the gross expenditure on Research and Development (GERD) represents 3.4% of the GDP. In 10 other European regions, the percentage of GERD is higher, particularly in Stuttgart (4.8%) and in the Midi-Pyrenean Region (3.7%). The importance of R&D activities in Ile de France, in both the public and private sectors, is reflected in the rate of R&D workers in relation to the total regional work force: 2.5%, that is almost double the national average, far above Midi Pyreneans (2.0%) and Rhone Alpes (1.6%). In the classification of European regions according to this GERD/GDP ratio, Ile de France ranks seventh (behind Stuttgart in Germany). In terms of absolute R&D expenditures, Ile de France ranks first with 13.5 billion euros in 2000, that is twice as much as Bavaria and Stuttgart (in second and third position respectively).

Fig 3: The first 15 technological regions in Europe in 2001 (left); R&D expenditures of regions in the EU (right).



Source: IAURIF, key figures 2004

Public research

With 50 300 employees, among whom 24000 are researchers and teacher-researchers, and a budget of 4.2 billion euros, public research in Ile de France remains an important activity. However, because of a redistribution of research activities in favour of provincial regions, of staff relocations and of a reduction of State investments, the share of Ile de France in the country's public research has declined from 50% to 37.5% in the last ten years.

Public research is organised around several types of institutions: the Public Scientific and Technological Establishments (EPST), the Public Industrial and Commercial Establishments (EPIC), the universities, associations, etc. The main organisations are EPICs such as the CNES (National Centre of Spatial Studies), the CEA (Nuclear Energy Commission), and EPSTs such as the INRA (National Institute of Research in Agronomy) or the CNRS (National Centre of Scientific Research). These public research organisations account for 74% of the region's public expenditures in R&D, against 64% in provincial regions. This difference can be explained by the stronger presence of the CNRS in Ile de France.

Table 4: Gross domestic expenditure on Research and Development (GERD) in 2000

In million euros	France	Ile-de-France	Ile-de-France/France
Public research	10 533	4 238	40,2%
Evolution 1997-2000	*15,5%*	*11,0%*	
Private research	19 348	9 237	47,7%
Evolution 1997-2000	*11,5%*	*8,6%*	
Total	29 882	13 474	45,1%
Evolution 1997-2000	*12,9%*	*9,3%*	

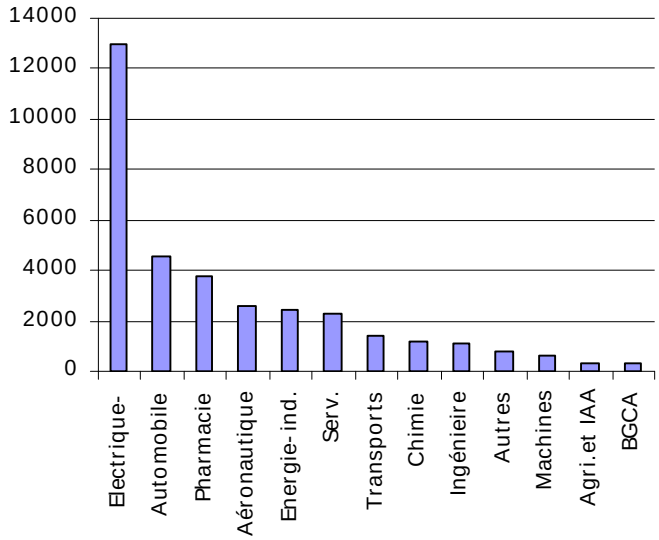
Source: MEN - DPD C3

The private research sector

The private research sector of the Greater Paris Region employs approximately 37000 researchers and engineers in full time equivalent, that is 8.5% of the total European R&D work force. Almost 9.2 billion euros were spent on private research in 2000. In Ile de France, the weight of the private research sector in terms of manpower is superior to that of public research. The Private researchers/total population ratio is over twice as high as the national average.

According to the national Observatory of Sciences and Technologies [2], large firms employ most of the region's R&D workers (61% of all private researchers work in firms employing over 2000 employees). R&D activities are performed by large international groups. Moreover, the region's research activities are concentrated in a small number of sectors (see graph below).

Fig 4: Private research in the Greater Paris Region: the main sectors



Source: INPE/OEP data, processed by OST and IAURIF, 2001

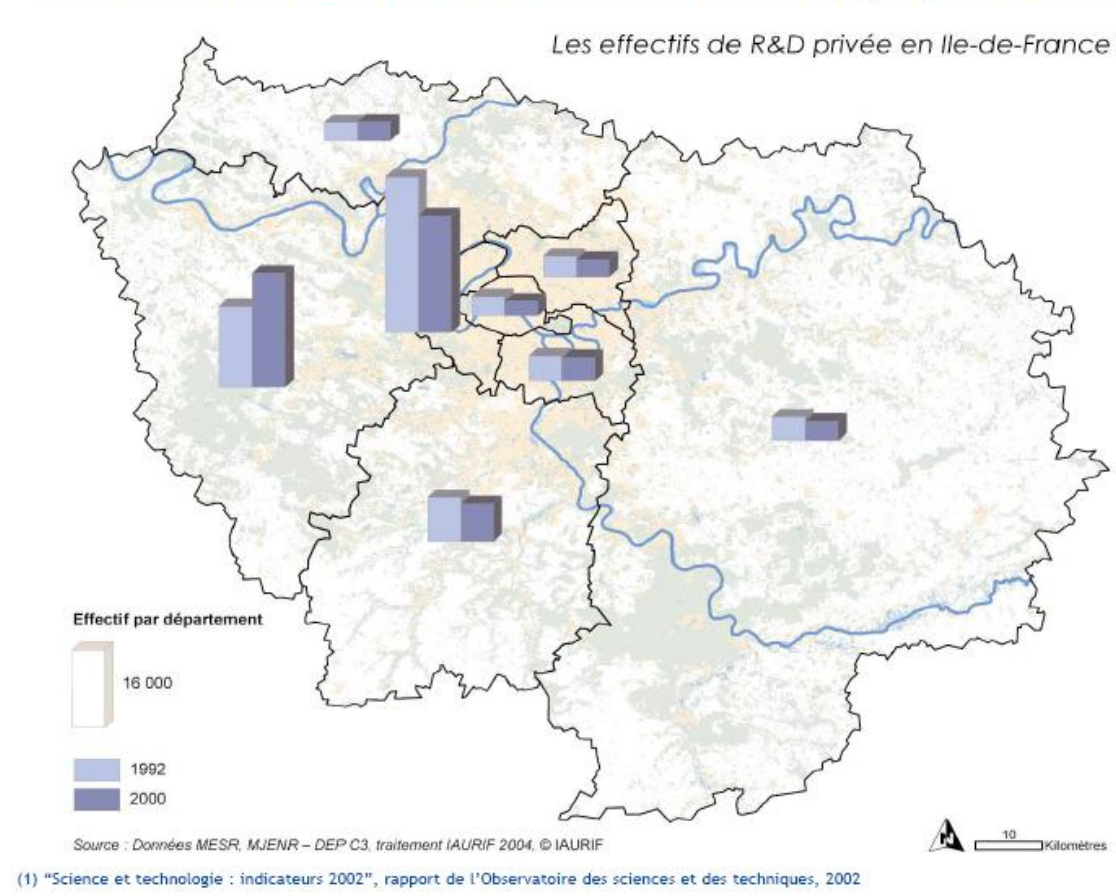
Electronique: Electronics
Automobile: Automobile industry
Pharmacie: Pharmaceuticals
Energie-Ind: Energy Industry
Serv: Services
Transports: Transport
Chimie: Chemistry
Ingenieurie: Engineering
Autres: Others
Machines: Machinery
Agri et IAA: Agriculture and agribusiness
BGCA: Construction

Private research activities are concentrated in certain areas of the region. Most of the private sector's staff are concentrated in Hauts de Seine and Yvelines whereas in the public sector the staff

[2] "Science and Technology: Indicators 2002", OST Report, 2002.

work essentially in Paris and in the Orsay area. The private sector's research work force has decreased in the Little Crown in favour of the Yvelines.

Fig 5: Location of R&D workers in the region's firms in 2000 (full time equivalent)



(1) "Science et technologie : indicateurs 2002", rapport de l'Observatoire des sciences et des techniques, 2002

Effectif par département : manpower per departement
Sources : MESR MJENR-DEPC data. Processed by IAURIF 2004)
(1) Science and technology; indicators 2002, report by the Observatory of sciences and technologies, 2002.

Finally, the private sector rests on and is organised around several poles of excellence: Electrical and Electronic equipment (over one third of the total), the automobile industry, pharmaceuticals, aeronautics, energy and IT services.

The output of research in Ile de France

The researchers of the Greater Paris Region signed 38% of all French scientific publications in 1998, 5.8% of all works published in the 15 countries of the European Union, and 2% of all works published in the world. Ile de France ranks below the economic region of London, but above the Randstad Holland, Rhin-Rhur, Munich, Madrid or Berlin regions. However, its position is weakening. The region is particularly strong in the fields of mathematics (3.3% of all world publications), physics (2.2%) or fundamental biology (2.2%), but is less strong in chemistry (1.5%), engineering (1.4%) and above all in applied biology-ecology (1.1%).

In 2001, Ile de France was the European region that submitted the largest number of patent applications to the European Patent Office (3 423). Ile de France has filed 6% of all patents at European level. It is followed by Bavaria. Both Bavaria and Ile de France rank well ahead of the other European regions, while London ranks far behind. Nevertheless, in terms of number of applications per inhabitant, the Greater Paris Region – with its 312 applications per million inhabitants - ranks behind 15 other European Regions, particularly German regions (such as Bavaria with 824 applications) or Stockholm (610). However, it ranks well ahead of other French regions such as Rhones-Alpes (244) and Paca (114).

The great diversity of fields for which European Patents are applied reflects the multidisciplinarity of the region's research activities. Thus, Ile de France is particularly renown for its research in electronics, fine chemistry-pharmaceuticals and instrumentation. It is in a lower position in the fields of Construction, basic-chemistry-metallurgy and machinery-mechanics-transport. Its main competitors in Europe are German (Munich, Stuttgart, Rhin-Rhur, Rhin-Main), followed by London, Rhones-Alpes, Milan, Randstad or Stockholm.

Tertiary education

Ile de France is home to several poles of excellence including 17 universities (La Sorbonne, Jussieu, Dauphine, Orsay, Nanterre, etc) and several internationally renown engineering and commercial/management schools (Ecole Centrale de Paris, Ecole Nationale des Ponts et Chaussées, Ecole Nationale Supérieure des Télécommunications, Ecole Polytechnique, Ecole Supérieure de Physique et de Chimie Industrielles, Institut d'Etudes Politiques de Paris, Ecole des Hautes Etudes Commerciales, Ecole Nationale Supérieure des Mines de Paris, Ecole Normale Supérieure, Ecole Supérieure d'Electricité, Ecole Supérieure de Commerce de Paris, INSEAD, etc.,) ; one fourth of all French engineering students are trained in the region. Furthermore, these training institutions have developed partnerships with firms and research institutes located in the region.

The weaknesses of the regions' research sector

- The population of researchers is ageing (the average age of researchers in Ile de France is higher than in other French regions: 48.5 years old against 47 on average in France);
- General weaknesses in the R&D sector in France and in the Greater Paris Region. France (just as Germany) is a country of medium-high technology (automobile for example) rather than high technology. The rate of R&D Expenditures in relation to the GDP (2.2%) is lower in France than in Sweden (3.8%), Finland (3.1%), Germany (2.4%), Japan (3%) or the United States (2.6%). Moreover, in France, the number of patent applications in relation to expenditures is relatively low. In 2001, Ile de France accounted for 6.2% of all European patent filings, against 8% in 1993.
- The relations within the regional innovation system: the public laboratories in Ile de France work essentially with large firms and have little relations with small and medium enterprises. However, measures are being taken to develop relations with SMEs, through support to technology transfer, the creation of incubators or of centres such as the Evry Genopole.

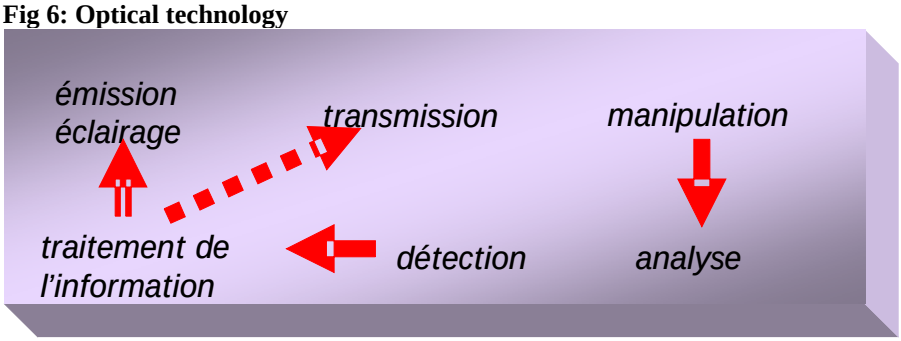
2. Description of the sector/cluster chosen: manufacturing of optical instruments for the transport industry[2]

2.1. At national level [3]

2.1.1. Optics and its markets

Optics is defined as the field of science that observes and models the phenomena associated with the generation, manipulation, transmission and detection of light.

Fig 6: Optical technology



Source: BIPE, 2003

Emision/Eclairage: Emission/lighting Traitement de l'information: Information processing Transmission: Transmission Detection: Detection Manipulation: Manipulation Analyse: Analysis

From an economic point of view, the ***optics industry encompasses all organisations that design, produce or distribute intermediate optical goods*** (source of light or components). Also included in the optics sector, are the ***service providers***, who have strong commercial (sales) or technological (common knowledge base and skills) relationships with the optics industry such as it is defined above. These intermediate goods are then used in production processes or as components of finished products for end consumers in various sectors such as:

- Transport (automobile, train, aeroplanes…)
- ICT (telephones, computers…)
- Health care (medical imagery, various medical instruments…)
- Defence (vision devices…)
- Industry (industrial control devices…)

This definition of the optics industry according to the sectors of applications can be refined by classifying the firms according to the types of technologies they develop. Indeed, optical products vary in nature and require different skills and knowledge despite their being related to the same knowledge base. The optics industry can therefore be divided into sub-technological sectors. Thus, we have:

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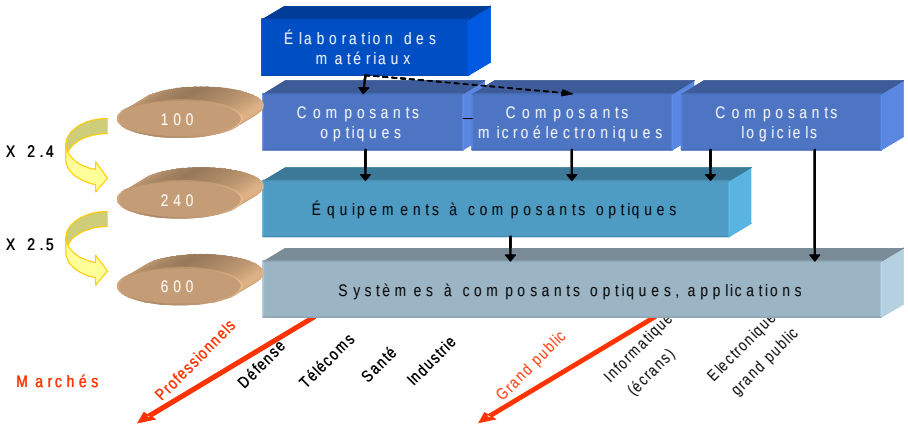
[2] This note is largely based on the work entitled " *An overview of the strengths and weaknesses of the Optics sector in France, 2004*". Most maps and tables included here are borrowed from this study.

[3] Name of the sector belonging to the machinery sector: manufacture of optical instruments dedicated to transport. Code in NACE classification (cf. Annexe 2).

- Physical optics (Physics of lasers, holography, crystallography, crystal optics, polarization, active optics, spectrometry…)
- Optomechanics (quantum physics, nonlinear optics…)
- Optoelectronics (micro-electronics)
- Computer science (imagery, digitising of signals and of visual data…)

The firms in these various technological sub-sectors operate with different industrial, technological, and technical problematics. These sub-sectors have different trajectories of technological evolution. The latter depends greatly on the state of development and competition on the different application markets (Transport, IT, Health care, etc) and on the level of demand from clients of the optics industry (the level of demand[4] is higher in the defence industry than in the automobile industry for example)

Fig 7: The markets of the optics sector



Source: BIPE, 2003

Marches: Markets
Professionnels: Pofessional
Defense: Defence
Telecoms : Telecommunications
Sante : Health care
Grand public: Mass consumption
Informatique (ecrans) : Computer (screens)
Electronique grand public : Mass consumtion electronics.

Elaboration des materiaux : Elaboration of materials
Composants optiques: Optical components
Composants microelectroniques : Micro electronic components
Composants logiciels : Software components
Equipements a composants optiques : Equipment with optical components
Systemes a composants optiques, applications : Systems with optical components, applications

A distinction can also be made between the so-called **mass consumption markets** and the **professional markets**.

[4] The Mean Time before Failure (the average time it takes for a failure to occur) must be very high in demanding environments (high speed, extreme temperatures), as in optical devices installed on fighter aircrafts for example.

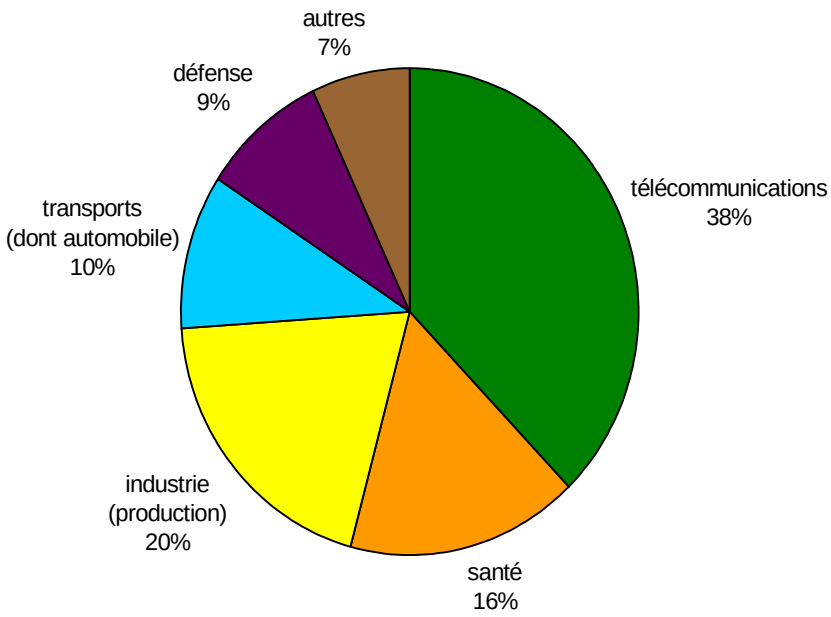
With regard mass consumption products, the eye care market represents today 36% of the optical component markets. This should drop to 26% in 2008 (according to the BIPE's forecast). However, this relative drop in terms of market shares does not imply that the market will decrease in absolute value. On the contrary, it will increase from 21 billion dollars in 2003 to 25 billion dollars in 2008.

Fig 8: The mass consumption markets in the optics industry (2003)

Source: BIPE, 2003

The healthcare industry accounts for approximately 16% of the professional markets of optical components; this share should remain the same between 2003 and 2008, but it will increase in absolute value from 2.6 to 3.5 billion dollars per year (that is an increase of 34% over the 2003-2008 period).

Fig 9: The professional markets in the optics sector in 2003



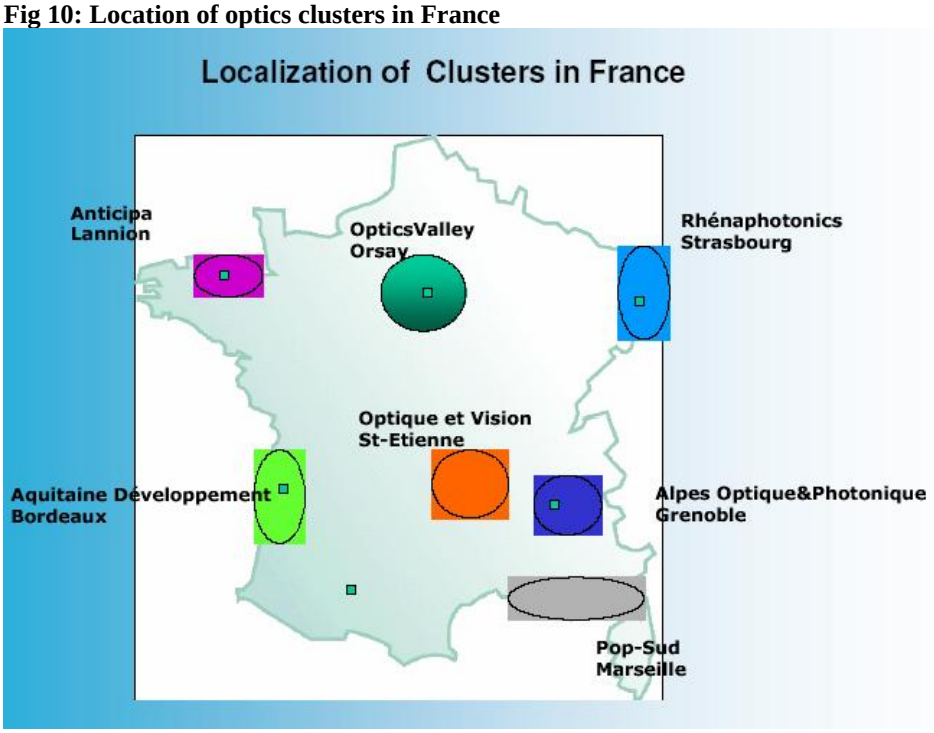
Source: BIPE study on the optics industry, 2003

Autres: Others
Defense: Defence
Transports (dont automobile): Transports (incl. automobile)
Industrie (production) : Industry (production)
Sante : Health care
Telecommunications: Telecommunications

2.1.2. The optics industry in France

The Greater Paris region has the largest concentration of actors in the optics industry. Indeed, approximately half of the industry and research in the field of optics is located in Ile de France. This high concentration of actors of the optics sector in the region is reflected by the creation in 1999 of an organisation whose mission is to energize and promote the optics industry in the Greater Paris region (Opticsvalley[5]). The Rhone Alpes region also has a large optics sector represented in the "Pole Optique Vision" situated in Saint Etienne. The "pole optique et Photonique Sud" (POP sud, Optics and Photonics Cluster in the South, Marseille), which covers Marseille, Nice and Toulon was founded in 2002. It is also an important pole for the French optics industry. Several clusters have been created in order to structure the optics industry of the Aquitaine region and particularly the laser technology sector: among them: the PALA (Aquitaine Platform for lasers and their applications), the CELIA (Centre for intense lasers and their applications), the ADI (Aquitaine Agency for Industrial development), the CEA and the Laser Megajoule. Finally, as shown in the map below, other poles developing optical technologies exist in France but they are less developed and less concentrated (public research, training, industry).

Fig 10: Location of optics clusters in France



France has important research potential in the field of optics. There are over 260 teams[6], laboratories or units listed in the different universities, public organisations and private firms; they specialise in optics, optoelectronics, imagery and visionics. However, the number of researchers effectively participating in

[5] Opticsvalley is also a stakeholder in the competitiveness pole SYSTEM@TIC PARIS REGION and acts as the permanent secretariat of this pole.

[6] The evaluation of the number of researchers working in the field of optics is approximate given the difficulty of determining precise boundaries between the different knowledge bases involved in the R&D activities. For example, A researcher working in the field of chemistry may be involved in the development of materials for optical technologies. This is often the case in private research where researchers are assigned to certain projects defined over time and are subsequently assigned to different types of studies in other fields of research. Thus, a researcher in optics may be a physicist, a chemist or a biologist.

the evolution of knowledge in optical technologies should probably be much higher given the "diffusing" nature of optical technologies.

In France several types of optical technologies are developed by industrial firms:

- The Ophthalmic optics and eye care sector is one of the strong points of the French optics industry (ESSILOR is the world leader on this market).
- Opto-electronics is also an important and highly strategic sector of activity (the defence industry) with industrial firms such as Thalès, Sagem, EADS, Sofradir, Astrium, Dassault…
- Optics plays an important role in the Aeronautics (Eurocopter, Dassault, Airbus…) and space industry (Astrium, Alcatel Space, Seso, Sagem, Sodern).
- Despite the crisis that has affected the optical telecommunications sector since 2001, this sector remains important with the growth of related services and capacities; the traffic has never ceased to increase during this period. The main firms in this industry are Alcatel, Alcatel Space, Nexans, Avanex, ATI, Compagnie Deutsch, France Telecom.
- Other important markets exist in France: the market of optical components (lenses, mirrors, prisms (Fichou, Alcatel), and that of complex optical systems (Thalès, Angenieux, Sodern, Sagem, Seso).
- Laser technology is also an important sector in France; it has a diversity of applications, in particular in industrial processes, instrumentation, metrology and controls, the medical industry and research. However, French firms are under-represented in relation to the size of the world market (Cilas, Sopra, Quantel, Thalès laser, Thalès Laser Diode, Laser Cheval, Amplitude Systemes, Fastlight, Nettest, Highwave, Keopsys, Nanolase). It is an industry for which Germany is the main supplier.
- In the field of **control and measurement instrumentation,** the industrial sector is not as developed as the research sector (Jobin Yvon, Newport, Micromodule, Sopra, Bertin, Techlab, Cotec, Imagine Optic)
- The production of passive materials is under-developed in France (Saint Gobain)

2.2 At regional level

2.2.1. The optics industry in the Greater Paris region

Half of France's optics research and industry is concentrated in the Greater Paris area. In terms of applications, the optics industry in the Greater Paris region is oriented towards IT, the defence/spatial sector, health care, life sciences and the markets of industrial production (see graph below)

Fig 11: Direct employment per application sector

Thus, 85% of the jobs in the optics industry are concentrated in firms whose markets are:

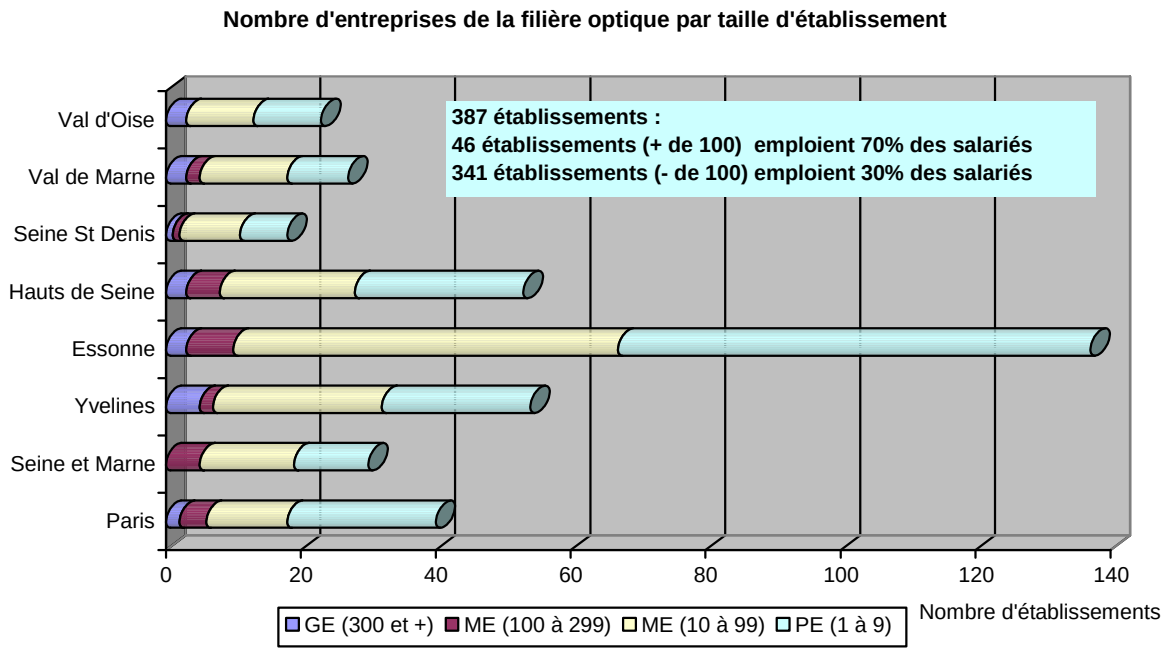
- *Health care and life sciences: Diagnosis and medical treatment (Ophthalmology, eyesight correction, endoscopy, medical imaging, cosmetics…)*
- *Information and communication technologies: data storage and reproduction (printing, image recording and reproducing, screen (display), projection…) and data transmission (fibres, components)*
- *Defence and aerospace applications: Detection, surveillance, target tracking, floodlighting, navigation, destruction…)*
- *Industrial production: Transformation of materials (metals, machining, surface treatment…silicon, lithography, marking, prototype, simulation, cleaning) and industrial measurement and controls systems (industrial vision, particle sensing and measurement, metrology, alignment, non destructive testing, automatic identification)*

The main organisations are essentially concentrated in four départements in the south West of the Greater Paris Region (Essone, Yvelines, Hauts de Seine and Paris). Thus, we note the presence of a tight network of start-up firms, SMEs and large international firms, an important number of public and private laboratories, incubators, and structures promoting the optics industry in the Greater Paris area.

The geographical concentration of optics activities in the region does not in itself indicate whether or not there are strong and dense interactions between these different actors in the region.

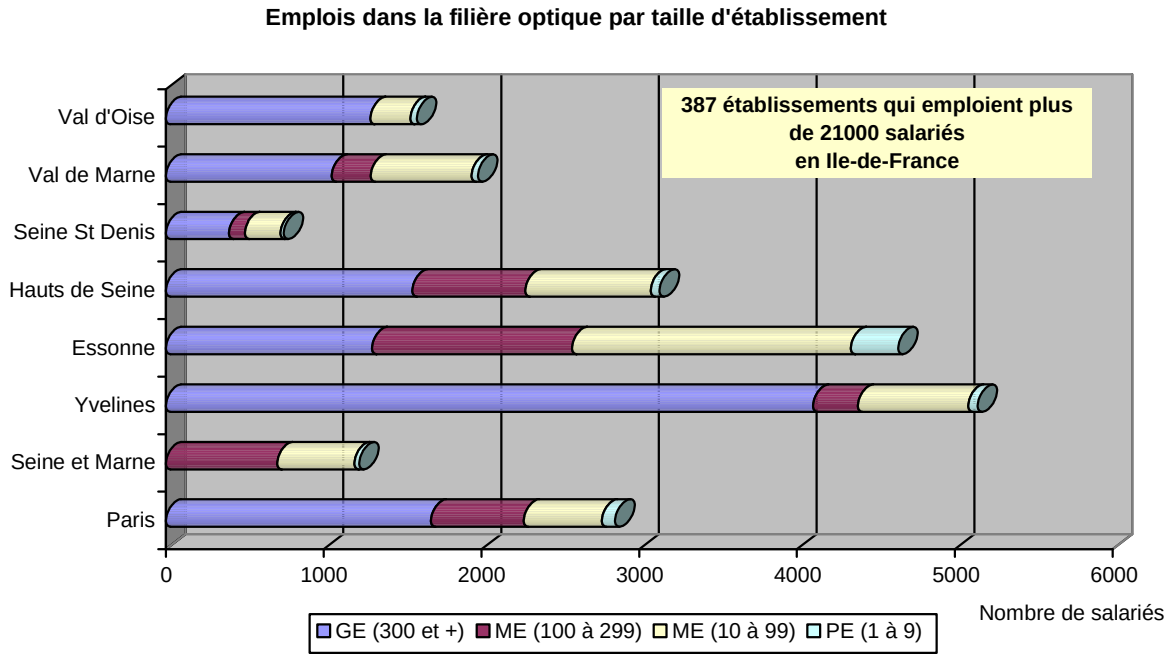
The Greater Paris Region is home to 387 optics firms and to over 6200 public and private researchers; it accounts for over 21000 non-research jobs (figures 2005) half of which in large firms (Alcatel, Thalès, Agilent, Avanex, Essilor…). 46 establishments (of over 100 employees) employ 70% of the optics work force, and the other 341 (less than 100 employees) employ 30% of the work force.

Fig 12: Number of firms of the optics sector per size category in Ile de France in 2005



Source : SL pour **Optics**valley, 2005

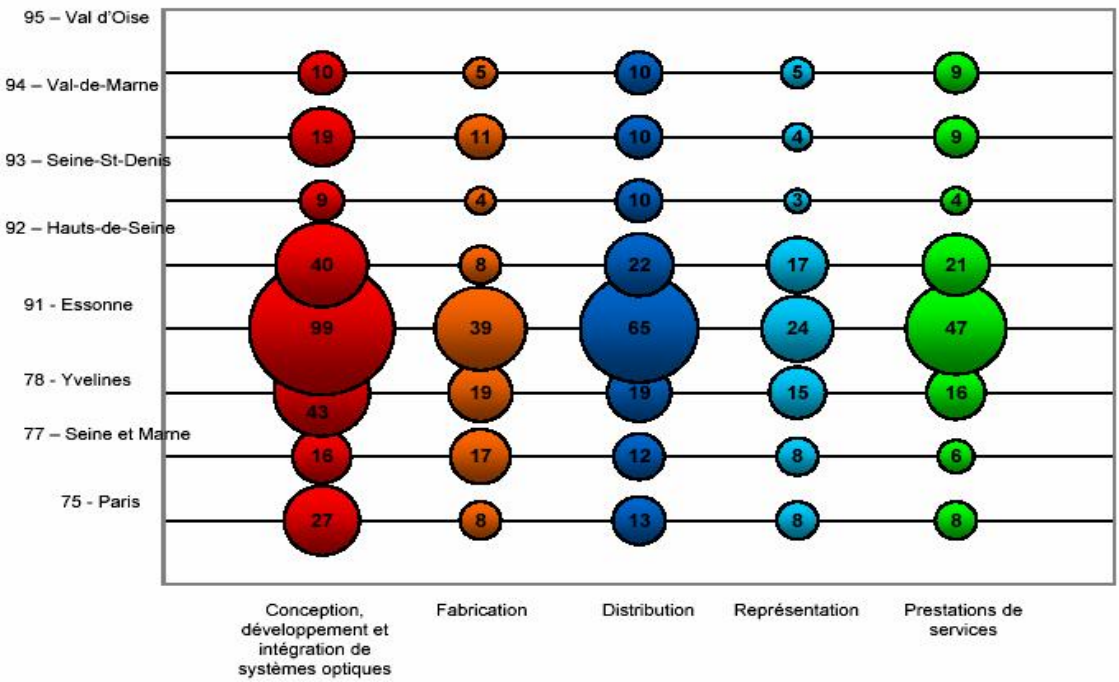
Fig 13: Employment in the optics industry per size category in Ile de France in 2005



Source : SL pour **Optics**valley, 2005

1.
Approximately two thirds of the jobs in the industry are concentrated in the South West of the region. The graph above also shows the importance of large firms in terms of employment in the optics sector, in particular in the Yvelines. Finally, the Essone *département* has the most even distribution of small and large firms (this also applies in terms of employment).

Fig 14: Positioning within the optics sector



Source: SL for Opticsvalley, 2005-10-13

Conception, developpement et integration de systemes optiques: Design, development and integration of optical systems
Fabrication: Manufacturing
Distribution: Distribution
Representation: Representation
Prestations de Services: Service providing

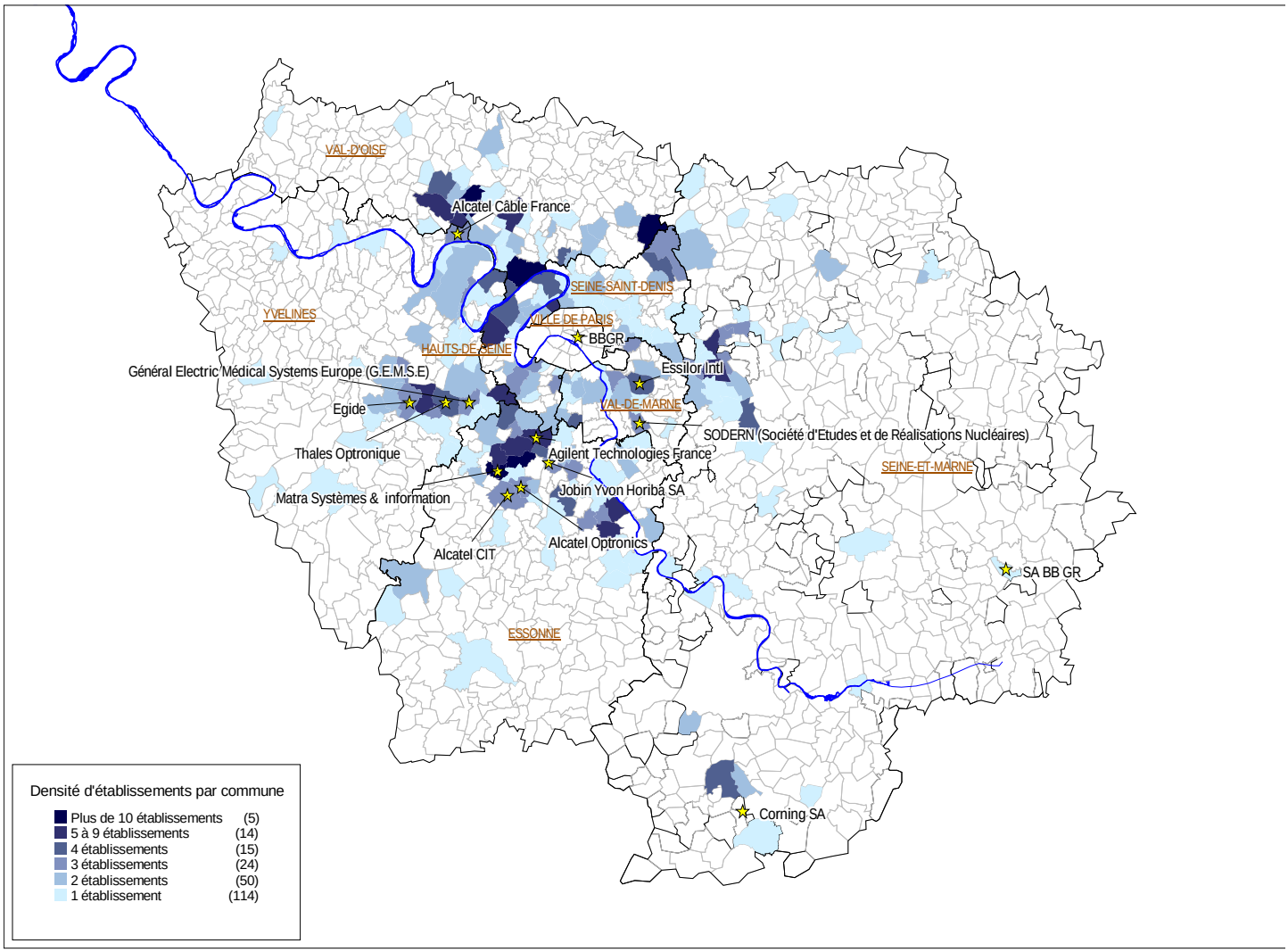
A large part of research activities is located within a relatively small geographical area, in the south west of the region (Paris, Essonne, Hauts de Seine and Yvelines). Indeed:

- Over three quarters (80%) of the firms that design, develop and integrate systems are located in the « greater south west area of the region » (Paris, Yvelines, Essonne and Hauts de Seine)
- Over half of the optics firms (65%) that manufacture products are also located in the Southwest area of the region (Paris, Yvelines, Essonne, and Hauts de Seine).

The optics firms with their own R&D and / or production capacities are mainly: Alcatel, Thalès, Sagem, EADS, Snecma, Essilor and Avanex.

Source: Opticsvalley, 2003

Fig 15: Location of the firms belonging to the structuring optics sector in Ile de France



2.2.2. Academic research in optics in the Greater Paris Area

Just as the industrial sector, a large part of the country's academic research in optics is also concentrated in the Ile de France region (Saclay plateau for example). The region's research sector comprises:

- Universities that account for over 50% of France's public research in optics, and associated research organisations (the Institute of Optics, Polytechnique, Ecole Centrale, Supelec, IEF..)
- 103 teams dedicated to optics and related disciplines (electronics, computer science, physics, mathematics).

The directory of optics-photonics of Ile de France (2005 edition) lists 95 public research laboratories. These laboratories employ over 2600 researchers (excl.doctorate students and research engineers)[7]

Fig 16: Laboratories of optics and photonics in the Greater Paris Region

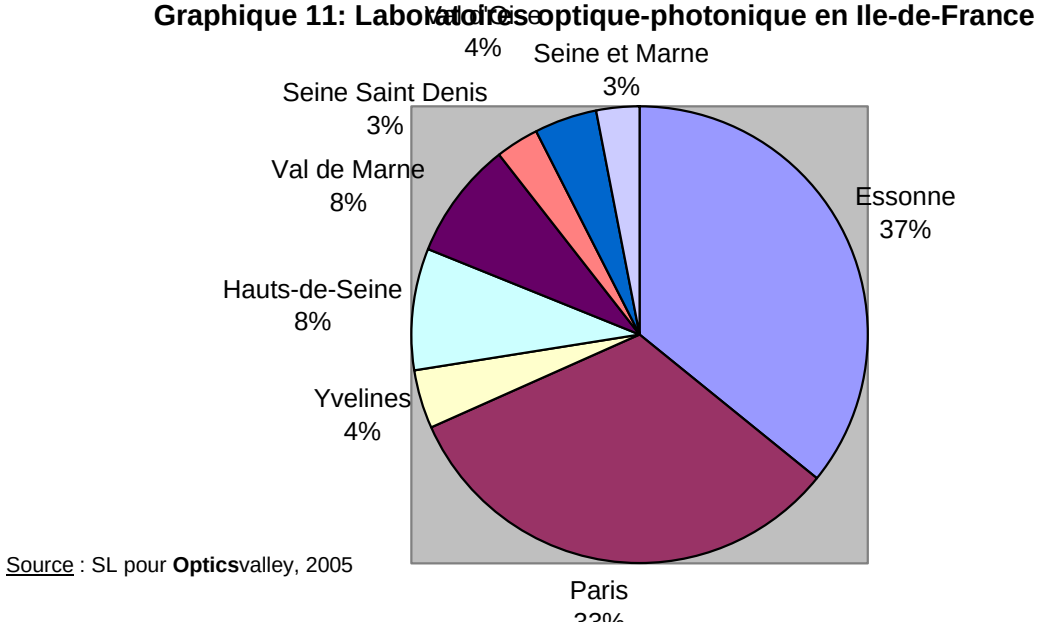
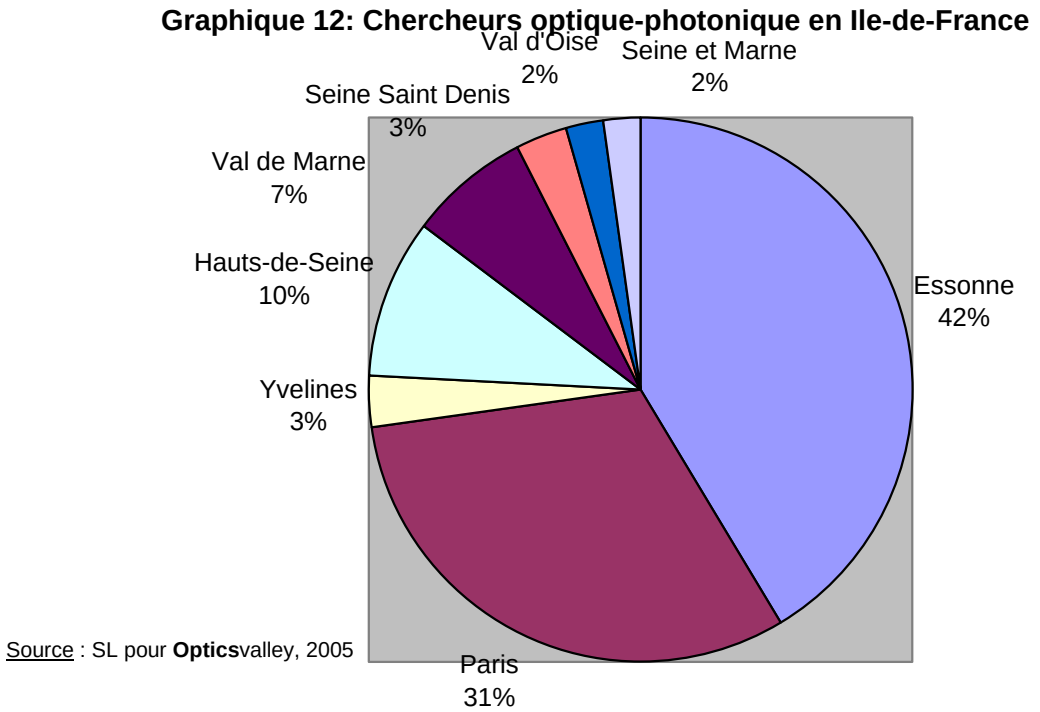


Fig 17: Researchers in optics and photonics in the Greater Paris Region

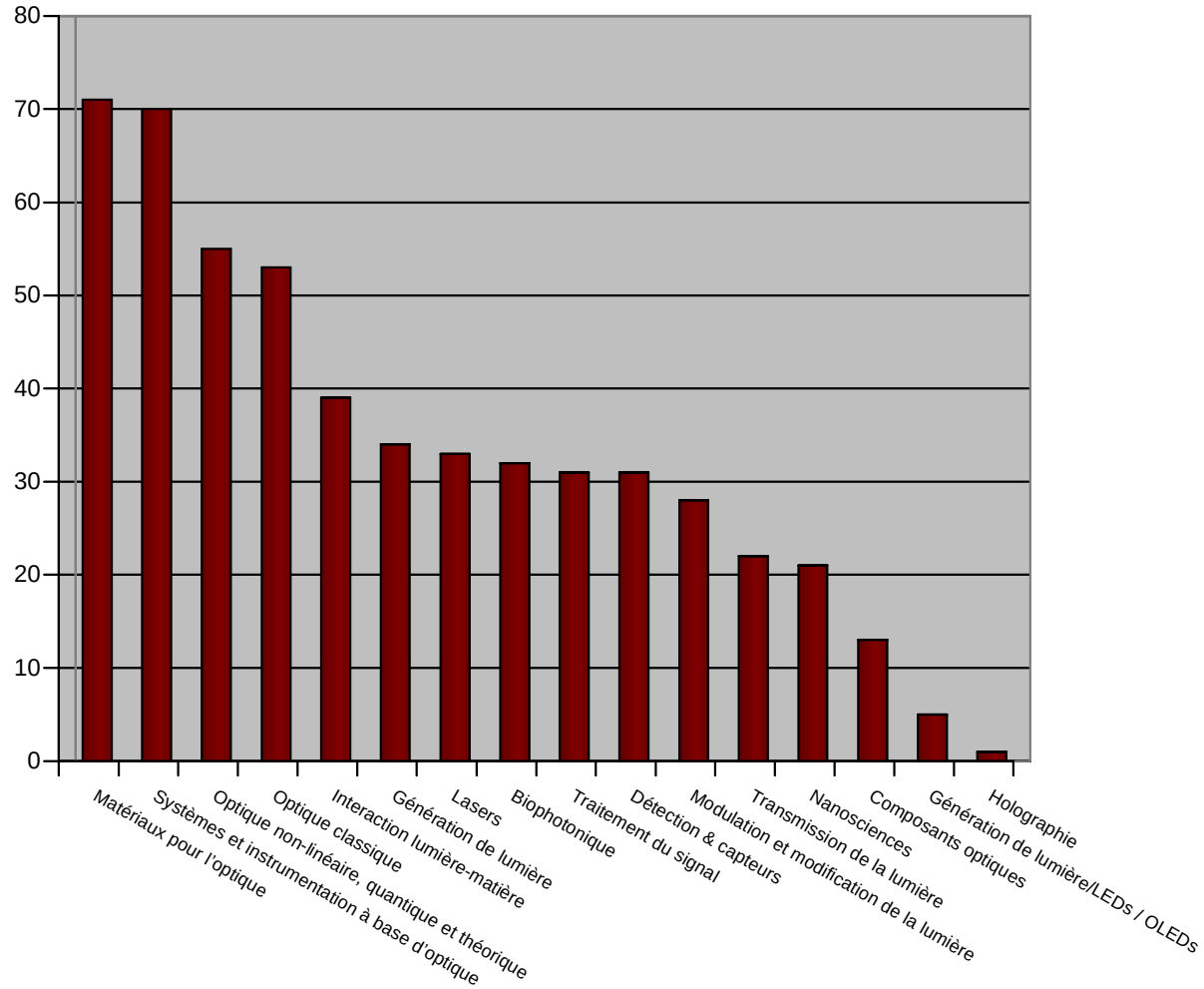


[7] Methodological notes : Research laboratories may have several teams working on different themes.

Three quarters of the region's research in optics is concentrated in Paris and in Essonne. Let us also note that the research centres located in Essonne, particularly on the Saclay Plateau, are situated in close proximity of a large number of optics firms located in Yvelines.

Fig 18: Number of laboratories per theme of research

Figure 18: Nombre de laboratoires par thèmes de recherche



Source : SL pour **Optics**valley, 2005

Source : SL for Opticsvalley, 2005-10-14

Materiaux pour l'optique : Materials for optics Systemes et instrumentation a base d'optique: Optics based systems and instrumentation Optique non-lineaire, quantique et theorique: Nonlinear, quantum, theoretical optics Optique classique: Classical optics Interaction lumiere-matiere : Light-matter interaction Generation de lumiere : Light generation Lasers : Lasers Biophotonique : Bio-photonics Traitement du signal: Signal processing Detection et capteurs : Dectection and sensors Modulation et modification de la lumiere : Light modulation and modification Transmission de la lumiere : Light transmission Nanosciences : Nanoscience Composants optiques : Optical components

Generation de lumiere/LEDs/OLEDs : Light generation/ LEDs/OLEDs
Holographie: Holography

2.3.3. The Optics Cluster in Ile de France

2.2.3.1. The technological and productive interactions between the actors of the optics industry.

Few studies have been carried out to determine the degree of interactions between the actors of the optics industry in Ile de France. However, based on our knowledge of this industry, we can safely say that interactions are neither dense nor systematic, particularly between academic research and industrial research. This characteristic is not exclusive to the optics industry, or to the Greater Paris region, but applies to all industrial sectors in France, and possibly Europe.

Several factors explain this relatively low level of interactions in Ile de France: Firstly, there is, in the region, a strong concentration of important actors of both the industrial and research sectors. This strong presence does not allow for the emergence of a "natural leader" (as is the case in Grenoble for example with STMicroelectronics and LETI) around which projects could crystallize. The second main reason is the recent realisation by the local authorities of the necessity to promote, dynamize and organise the industries present in the region (Optics, biotechnology, electronics, software, for example).

Nevertheless, policies for the promotion of the Greater Paris Region are being revamped, with for example, the implementation of public policies promoting cooperation and collaboration between the different actors (large enterprises, small and medium enterprises, public research) in a number of defined areas. It is the policy of poles of competitiveness (see annex 1).

2.2.3.2. The implementation of the SYSTEM@TIC PARIS REGION pole

The SYSTEM@TIC PARIS REGION pole is aimed to support the development of and expertise in complex systems' key technologies. These key technologies are:

- Technologies for the design and development of complex systems, with problematics related to architecture, technological heterogeneity, the incomplete knowledge of user environments, acceptability and use.
- Generic and enabling software technology
- Material technology of electronics and opto-electronics.

The main application markets of these technologies are the automobile/transport industry, telecommunications, security/defence and system design and development.

This strategy rests on the strong presence of industries and, in terms of research, on the technological domains of the SYSTEM@TIC PARIS REGION pole (see table below)

	Effectifs R&D en IDF	Effectifs R&D en France	Part IDF/France	Effectifs R&D (SYSTEM@TIC) IDF	Effectifs R&D (SYSTEM@TIC) France	Part IDF/France	Part (SYSTEM@TIC) dans le secteur en IDF
Automobile	18 500	32 000	58%	3 100	4 800	65%	17%
Outils numériques	5 000	5 600	89%	5 000	5 600	89%	100%
Sécurité/ Défense	56 000	120 000	47%	16 000	22 000	73%	29%
Télécoms	25 200	61 600	41%	18 000	36 000	50%	71%
Totaux	104 700	219 200	48%	42 100	68 400	62%	40%

Automobile : Automobile industry
Outils numeriques : Digital tools
Securite/defense : Security/defence
Telecoms : Telecommunications
Effectifs R&D in IDF : R&D manpower in Ile de France
Part IDF/France: Ile de France/ France Ratio
Effectifs R&D (system@tic) IDF : R&D manpower (system@tic) Ile de France
Effectifs R&D (system@tic) France : R&D manpower (system@tic) France
Part IDF / France: Ile de France / France Ratio
Part (system@tic) dans le secteur en IDF : Share of system@tic in the region's industry

Thus, the Greater Paris Region's automobile industry, for example, employs over 18000 researchers, that is over half of France's research potential. 17% of these researchers - that is 3000 people - are directly or indirectly involved in collaboration projects that have resulted from the implementation of the pole of competitiveness.

Finally, the geographic perimeter of the SYSTEM@TIC PARIS REGION pole forms an ellipse situated mainly in the South West of the Greater Paris region. 70% of the region's capacity in complex systems is concentrated in Essonne, Hauts de Seine and Yvelines. Two other territories are part of the pole: Paris because of its academic potential and the areas around Argenteuil and Cergy Pontoise in the Val d'Oise.

2.2. Characteristics of the region's industrial firms specialising in optics for the transport industry

A number of firms located in Ile de France are world leaders in their respective market segments (Thalès, Alcatel, Safran, Sagem…); they develop and manufacture optical technologies, but also other related technologies (electronics, software in particular). These large firms therefore operate in a globalised market, but an important regional market exists in parallel with this global market.

Beside these large firms, there are smaller enterprises representing the region's network of SMEs. Although these SMEs belong to the same industry as the large firms mentioned above, their territorial integration and positioning on the market are different. Indeed, although they also operate in a global market, the resources of the region in which they are located (the Ile de France region) can play an important role in helping them maintain their competitiveness (generation of quality, infrastructure, proximity with big clients in particular). However, the main difference between large firms and these small and medium enterprises is related to their positioning on the market: Small firms are often positioned in market niches and are often sub-contractors or suppliers of optical products for larger groups or research institutes. Let us note here that, just as large firms, SMEs possess a diversity of skills in related technological fields, which enables them to develop optical technologies and products (electronics, software, optics).

The firms selected for this study have direct commercial relations with the transport industry including the aeronautics, naval, automobile and railway sectors. Their products are either intermediate components of finished products (beacons, LCD screen for GPS in the automotive industry, various sensors etc) or machines used in the production processes of the transport industries (machines used for dimensional checks, lasers, sensors…). The products

developed by these firms (small and large) are essentially "medium high technologies" according to the classification developed by the OECD.[8]

3. The list of the firms and organizations analyzed

Firms :
A.T.I Electronique SA
CEDIP Infrared Systems
Hexagon Metrology
HGH Systèmes Infrarouges
Laselec SA
Ateliers Laumonier
Le contrôle industriel (LCI)
Satimage
Vannier-Photelec SA

Organizations :
Agence Régionale de Développement de l'Ile de France
Caisse des Dépôts et Consignations PME
Chambre de Commerce et d'Industrie du Val de Marne
Communauté d'Agglomération du Plateau de Saclay
Conseil Général 78
Conseil Général de l'Essonne
Conseil Régional d'Ile-de-France
CRITT Méca
Ecole Polytechnique
Incuballiance incubateur
Laboratoire ADIS
Laboratoire de Physique Théorique de la Matière Condensée
Office National d'Etudes et de Recherches Aéronautiques
Optics Valley

4. The main results of the case studies

4.1. The process of restructuring in the cluster and the performance of the firms

The "Ile-de-France" optics cluster is experiencing three major evolutions that affect the local firms strategies. First, the growing competition of new producers mainly located in Asia (China and India), secondly, the important evolution of the French industrial policy (decrease of military procurement and the creation of the "pôles de compétitivité") and third, the important impact on local cluster players of the 2001 major telecom crisis.

The **cluster is still recovering from the telecom crisis in 2001.** This world crisis has strongly affected some large firms localised in the optics cluster and subsequently the local

[8] See annex 4 for more details on the OECD classification

sme's that supply them in products linked to the telecom industry. We also have a relatively slow local growth rate of optics markets.

There seems to be a slow but steady spatial reorganization of the production activities towards more price competitive countries (mainly localised in Asia, and more specifically China). The cluster is slowly evolving towards non material products (software engineering), but still has an important industrial base (strong automotive industry, aeronautics industry, defense and security industry, space industry…). The trend of production delocalisation is reinforced by these main factors :

- The Asian market has a much stronger growth, and more attractive factor conditions (lower wages with increasingly quality competencies in China for example) than the European market (natural attraction for production, and necessity for large firms, to implement production units in Asia). Will the R&D and all immaterial production follow this trend ?
- This "delocalization" (relocalization) requires also that these firms create "technical studies units" near their new production units (preliminary to R&D delocalisation?) and near their foreign clients.

An important part of the interviewed sme's has important historical and actual links with the military industry. They are spin offs mainly from firms and sometimes from public research laboratories or even from public institutions (Ministry of defence) and have been created during the last 30 years.

Their markets were based till the 90's on public military procurement. This procurement is in a very sharp decrease (mainly during the 90's) and the sme's connected to the military industry had to diversify their markets (Telecom, aeronautics, space, automotive, medical...).

The firms of the cluster are very exposed to international competition. Even local sme's that sell their products to local large firms have to be internationally competitive because their products are in competition with those of other international suppliers. So some sme's explained to us that 80 % of their products are integrated in final products that are then exported.

We can distinguish the firms according to their innovative strategy and capacity :
- large firms have very strong R&D units in the "Ile-de-France" region. **These firms drive the cluster's economic development and its technological evolution. They are the main local clients (probably the only clients) of the local sme's.**
- local sme's are very heterogeneous. Most of the sme's are technological integrators and do not create new technologies, but make new more productive associations of new technologies and knowledge produced in other firms or research laboratories. We also have some firms that invest in R&D and create knowledge in order to improve their products.

The evolution and the development of the sme's depend on :

- **their market specialisation** (automotive, aeronautics, telecom, defense, security, medical, transport...). Each market has its own logic of development, its own growth rate;

- **their dependence on local clients** (mostly large firms, but also large public laboratories), or their insertion in the global competition;
- **the level of global competition on there products** (rarely local competition);
- **the personal history of the sme's creators** (firm created by a public researcher, by a person that worked in a large industrial firm);
- **their ability to export their products and to be less dependent on a few local clients.**

The ability to export seems to be reinforced when sme's are much specialised in niche type products and are identified as one of the quality and price competitive suppliers of that product. This ability is weakened by the size of sme's which makes it more difficult for them to have international distribution network and gives them a limited capacity to promote internationally its several niche type products.

A second factor that affects export capacity is that some sme's are specialised in products that have mainly military application. That might be a strengh because it put important entry barriers to new potential competitive firms, but it can also be a brake to the firms need to export because of the nature of the products (risk of military technology transfer for example). Let us also specify that this need for local sme's to export in order to survive also leads them to open distribution and technical units near their new important clients (Mostly in Asia).

The optics cluster is totally connected to the global market and is rapidly affected by the worldwide business evolution. Even when sme's do not sell directly to foreign clients, their products are integrated in final products which are mainly sold to foreign clients. They have to be internationally competitive.
So, **innovation in the optics cluster is completely driven by the clients needs** (local or global) and these clients are in a very large part big international firms.

4.2. The process of innovation in the firms

The sme's of the Ile-de-France optics cluster are all evolving in a fierce global competition. They need to constantly innovate and create new products in order to remain competitive and to survive. **Their size often does not allow the sme's of the Ile-de-France optics cluster to invest in R&D in order to create new knowledge and new products with new in-house produced technology, but they rather have a reinforced technological watch, and a capacity to absorb knowledge and to create new products out of it**. Their clients are the key element that influences the shaping of new products adpated to the needs of the industry.

For all the sme's we met, **constant innovation is vital for their short-term survival (3-5 years).**

Even though the sme's are all different, **we can still categorize them in two types of strategies:**
- the sme's that mostly sell "niche type products": they are quite small (mostly less than 30 persons).
- the sme's that mostly sell "standardized products" : they are larger (between 30 and 150 employees).

The innovative strategies and the implication of these two types of strategies in the local networks are different. One of the main difference between these two types of sme's is that in the "niche type products" sme, the innovation strategy is more informal whereas in the "standardized products" sme, the innovation strategy is written (with a certified knowledge management).

A large part of the sme's define themselves as technological integrators. That means that they do not invest in R&D in order to make radical innovation or to create new knowledge in order to make new products.

Their strategy is to have an active technological watch on the market and on the new technologies that are available in order to keep there products technologicaly and economicaly competitive. It is therefore very important for sme's to keep informed on the new technologies, new kowledge that is developed and that they can integrate in their products.

The relation with clients is vital in the innovation process of the sme's. There is a constant technological and market need for feedback between the sme's and their clients. The client specifies its needs (it might be a general idea of what it need to a more precise specification of the product needed), then validates the production of the sme's.

The reactivity of the sme's with there environment is the main key to its success, because there is in the optical industry a fierce competition between firms, and also because one technical problems, or innovation needs can be solved by other technologies (substitution technologies).

The sme's are in a constant process of improvement of their products (incremental innovation for better performance and liability of their products).

All innovations in sme's are market oriented. They depend on the needs of the clients of the sme's. There is no place and no time for sme's to invest on risky radical or major innovation. The innovation takes place only when the market exists. These market oriented innovations are mostly based on pre-existing knowledge or technologies. **In fact the innovations in most sme's are based on a new combination of existing technologies**.

The cooperation is important between sme's and there clients (mostly big firms, and state programs also), but there is not a systematic cooperation between sme's in order to innovate.

Failure factors of the sme's innovation :

- The **client is not sure of what type of product he needs**, so their is a bad definition of the technical specifications of the product, of its use. This is a major factor of innovation failure.

- **Lack of reactivity of sme's** because of small workforce resources. The development of a product has taken too much time, the market turned over to alternative solutions.

- **Lack of trust of the sme's in the large firms**. In one case, a large firm asked a sme to develop a product in order to improve a

production process, once the product developed, the large firm turns over to cheaper producers in order to have the product at optimal price.

4.3. The process of knowledge creation within firms

The size of the firm determines the process of knowledge creation within the firm. The smaller the firm is, the less codified knowledge it possess and the less explicit is the knowledge management within the firm.

There is a **strong culture of secrecy within the optics industry** due to the competition on the world markets, to the lack of trust between players within the cluster, to the military influence of many innovative project.

The knowledge management within local sme's depends strongly on the size of the firm :

- **Tacit knowledge firms** (some employees are the core of the firms knowledge stock) mainly employ less than 20 persons. They **mainly have an informal management of knowledge which makes it very dependent on the people that possess the knowledge**. They are more flexible and seem to be able to change their knowledge structure and there strategy more rapidly than larger firms that have identifed, codified kowledge.

- **Larger sme's** (More than 20 employees) **possess a more codified knowledge structure.** The larger number of employees makes it compulsory for them to have an explicit knowledge management method. This explicit knowledge management method is growingly certified ISO.

The technological watch is a key element of the knowledge creation process within sme's because of there market positioning as technological integrators (Receptivity and creativity). The consequence of this strategy is that sme's need to employ people who are able to understand the implications for the firm's competitiveness of all worlwide technological evolution.

The firm needs to have a very strong ability to constantly introduce the new knowledge produced worldwide in their products within minimum time in order to remain competitive. This strategy is also possible because of the niche type specialisation and the very good knowledge of their business (world competitors, market evolution, technological and scientific evolution) of the firms.

T**he process of knowledge creation within sme's ends rarely with a patent**. This can be explained by two main factors :

- Small firms (and mainly firms that have less than 20 employees) make a very important use of secrecy to protect their knowledge.

- The rate of innovation is too important to make it affordable and useful for small firms to use patents in order to protect their knowledge.

The process of knowledge creation does not always result from an explicit decision of the sme's owners, but depends in fact on business opportunities and the knowledge needed in order to answer to these opportunities. The smaller the firm is, and the most uncertain is the direction and the type of knoweldge created within the firm. These small firms often tell us that they had to integrate new fields of knowledge in order to satisfy the demand of their clients.

4.4. Relationships of the firms with the local actors

The **networks** considered in the empirical research led on the Paris Region represent a **more general form** of organization of firm linkages than the **traditional local clusters analysis. Especially, they involve not only firms of various sizes, but also institutions (both local and national ones).** That is the reason why **we prefer to consider the Ile de France system of production and innovation as an "institutional cluster",** a form of cluster including not only firms or intermediation organisms but local and state institutions as well

Sme's have **two types of local relations** :

- local relations where geographical proximity is not the crucial factor. Indeed, the Paris Region concentrates many large firms that are world leaders in there respective markets, so sme's have a natural local market for their products. Geographical proximity is not the main element in the relations between these local players. One must add that the optics sector is linked with an international market.

- local relations where geographical proximity has a role and an impact on the sme's activity. The relations concerned are mostly between sme's and local institutions (financial, public, business services) and also between sme's and training centers. The relations between sme's and public laboratories, or university research are more difficult to analyse, but a large majority of the relations of sme's with public labs or universities are local (in the "Ile-de-France" region).

It is obvious, as said in the general report, that the success of the SMEs highly depends on the complex capability of the entrepreneur to **master the complex personal relationships** with other business partners, the key technical workers in the firm and the actual and potential **clients** in the local economy, the capability to identify potential **partners** or **key workers** and to avoid conflicts of interests and to promote **flexible forms of cooperation** in specific common fields.

In the case of **the Paris region**, the equation is rather complex, mostly for two main reasons:

- **the size of the region and the lack of accessibility**. As quoted before, Ile de France area is rather large but, most of all, it involves a complex network of roads, highways, train lines… which are still quite obstructed and lead to a quasi permanent crowding effect. The times to access from a place to another may be quite long;

- because of **the accumulation of wealth and centres of decision** in the Region (All the Public Ministries and most of the central administrations, most of the largest firms, the most part of the private and public French laboratories) the number of firms located in the area is extremely large, even in the same field of production or innovation. Concerning the Smes they are most of the times competitors (even though the sme's told us there was a very weak local competition, but a very strong global competition) and not co-operators. **So at a local level, there are nor competitors, neither co-operators. The links are in a very large part client-supplier links.**

The Smes we have interviewed are seldom linked together by means of economic or technical relations. Unlike the italian industrial district model, **Ile de France Sme's most vital relation are with their clients; inter-Sme's relations are rather weak**. Even if they belong to the same production sector, Smes only maintain relations with large firms.

The local inter-Smes relations are not very developed in the Region, except for some local technical networks (RMVO...) and international networks of sme's (The French-German network Visiolaser). The sme's seldom cooperate in order to innovate or in the production process. They are not exchanging experiences or human resources mainly because of a rigid labour market . Most of sme's interviewed don't even have local competitors.

This result may be linked with the specificity of the optics industry and of its various applicative markets. Indeed, the firms in the optics industry have a common knowledge base, but this knowledge is used to develop products to different applicative markets (automotive, aeronautics, space, defense, medical, industrial production...). A large part of the sme's are strongly specialised in technologies that only have "niche type markets". **Nevertheless, some sme's also has suppliers for certain parts of their final product, and depending on the availability and quality local offer (quality of local sme's) they can be clients of other local sme's**.

Some of these firms have strong relations with smallest providers, mainly subcontractors. **But these relations** usually do not deserve a lot of confidence; they **can be brutally interrupted**, because there stand other subcontractors and capabilities within the local network, or because the relations concern only a specific temporary demand of the client (large firm or public laboratory)

These subcontracting interactions are Asymmetric ones: the subcontractors are rather weak in terms of power and they must follow the indications and the orders of the main contractors. The interactions are strongly depending from market opportunities and business life.

Our firms strongly ask the subcontractors to improve the flexibility of production, to shorten the supply time or to speed up their reactivity. They never make reference to an exchange of knowledge or skills through this channel.

Smes are mainly providers of the local large firms and this relation is vital for them. The clients of the sme's studied are mostly large firms (along with big public research laboratories). **All product innovations are made with a large influence of the needs of large firms in their production process.**

The relations with the largest firms imply a lot of confidence, because the small firms have to engage into the production or small series of products or into the elaboration of prototypes. They invest a lot of money and human resource into this process. So, they need to be confident in order to work on an anticipated basis.

The Smes are looking for large firms in order to enlarge their panel of clients and to reduce the risk of a change in the conjuncture. Personal relationships are rather important in this respect.

The labour relationships are quite stable and the turnover is very low, mainly because of rigid labour market condition and also because of a low local optics industry growth and subsenquently a low hiring rate from the local firms (so the employees that find a job are not very incitated to move to another firm). The loyalty to the firms is quite high, maybe because the local market is not so much open and because there is a huge labour supply: the local labour market is very large, in relation with the great number of Schools of engineers and technological Universities in the Paris region.

On the main, **the local production system seems to be rather asymmetric and hierarchical: 1) the subcontractors are strongly dependant from our Smes 2) but the Smes are strongly linked with large firms or groups.** They are mainly depending from their orders.

This hierarchical character of the local production system may be the reason why most of our firms do not feel to be part of a local network. When we ask them about this so-called local network of local firms they say that they do not beneficiate from its positive effects and most of the times that they do not feel its presence.

These firms appreciate to be located in the Paris Region but they do not share the idea to be part of a local network. They do not have the feeling that there exists a local network. **They take advantage of the geographical proximity with local institutions**

It is crucial to notice that a large part of the firms interviewed do not work with local firms, even with clients. When we ask why do they prefer to stay in the region, they say that it is because they are located not too far from decision centres their research departments. It is obvious that these firms also find a better human resource locally, with more skills, and that they also take advantages to be located near the main public authorities.

The relations of Sme's with institutions are crucial. The links between Smes and institutions (Universities, Local schools of engineers, various types of local institutions… intermediation or technical centres…) **is at the core of the functioning of the institutional cluster**.

Local firms have many links and many relations with local institutions:

- **Universities, especially technical departments.** They sometimes share grants subsidies for PHD or post-doc students. These relationships are mainly related to the education function of universities. The relationships with universities in the elaboration of fundamental research are rare;
- **Local schools of engineers** (aerospace, optics, mechanical engineering…). Sometimes the engineers and the managers of the firms belong to informal networks of engineers or of past scholars. They can beneficiate from the advices of their colleagues located in other firms or within public or private laboratories. They also call this network in order to recruit new employees;
- **Technical centres.** They ask them in order to get technical advices, to improve their techniques, or to have information about recent technical progresses or innovations;
- **Chambers of commerce**. In order to have information about the local economic system, and to buy data on the market and its evolution;
- **The cluster type institutions** (Opticvalley for the "Ile-de-France" optic/photonics industry) **are quite new institutions** (created in 1999). Other cluster type institutions are cited, but not often in the vital relations for the sme's.

In fact, Sme's are aware of the existence of many local institutions, but because of insufficient time, they are often not able to understand what each institution can offer them (subsidies, a network, international visibility...).

With regards to the typology of institutions underlined in the Ikinet project, **the relations are as follows:**
Public institutions: Rather important relations.
Financial institutions: Very weak (except of course with local banks!).
Business services institutions: Quite developed (subsidies).

The local institutional relations of sme's are mainly done with institutions that **have subsidies or financial opportunities** to help develop local economic activity.

Some of the firms interviewed are against the system of subsidies granted by public bodies. They think that it is too complicated and that it does not help firms in the end. Some of them view it as a distortion to competition in favour of the firms which own the funds. In a word, they find it unfair.

4.5. Relationships of the firms with national and international actors

National and international relations are often essential for the firms we have interviewed. Most of the Smes interviewed claim that more that 2/3 of there sales are made out of France.

As we said earlier, the relations with the clients are by far the most important one for local Sme's. **Several firms of our panel have only relations with national clients, and some of them only with international ones…**

It is worth to notice that **the optics market is an international market and that the main technical competencies are spread all around the world**, with some peculiar traditions and skills located in Germany. The situation is slightly different in the defence and mechanical sectors.

The place of Germany and the role played by German firms can be rather strategic for several Smes of the optics sector. They are mainly providers of equipment. But the firms from the Paris Regions do not seem to share the same values with these enterprises. We have found several contracts or agreements between French and German firms. The relations are traditional demand and supply exchanges, or sometimes involve informal links with long term commercial or production partners.

The search for good subcontractors seems to be worldwide. Our firms are looking worldwide for the best subcontractors and do not hesitate to quickly shift them, disregarding the fact that they are located in various countries.

Most of sme's interviewed operate in "niche markets" where there are only few competitors (less than 10). So they know each other, the local dimension is, at first sight, not

the appropriate level of analysis. In fact, the impact of geographical proximity is more complex that we could think.

As an example**, the competition is worldwide in the defence sector.** Our firms only face a few competitors, and they are located in foreign countries. They usually do not have any local competitors.

The Sme's are deeply implicated in international networks that represent them and where they can find all the useful information.

When our firms are in contact with firms located in distant countries, they assume that **the lack of geographical proximity can be compensated by the use of Tics** (vide conferences, e-mail…).

The participation to international affairs is not systematic and does not prove to be a major source of new contracts. Contacts are better established with the help of local institutions such as chambers of commerce.

Smes entrepreneurs mainly focus on the production and technological organization. **Smes do not have enough time and enough human resource to organize their commercial relationships in foreign markets.**

They mainly consider that there is a lack of support for firms on the international market. The persons we met often wish a greater help from the institutions, in order to have information about foreign markets, access to the markets and distribution.

Main references

Eurostat, 2003, « Les demandes de brevets déposées auprès de l'OEB toujours en hausse – 1990 à 2001 », Statistiques en bref, janvier.
Eurostat, 2003, « Dépenses et personnels de R&D dans les régions européennes 1997-1999 », Statistiques en bref, janvier.
Gollain V., 2003, « L'Ile-de-France, pôle mondial de recherche », ARD.
IAURIF (Institute for Urban Planning and Development of the Paris Ile-de-France), 2005, *Key Figures of the Ile-de-France Region.*
Lourimi S., 2005, « La caractérisation de l'industrie optique : note méthodologique », mimeo ADIS, Faculté Jean Monnet, Univ. Paris Sud.
Ministère de la jeunesse, de l'éducation et de la recherche : « Dépenses de recherche et développement en France en 2000 », Note d'information, novembre 2003.
Ministère délégué à la Recherche, Direction de la Technologie, 2004, *Bilan des forces et faiblesses de l'optique en France*, Livre blanc, Rapport effectué pour le compte du Ministère de la Jeunesse, de l'Education Nationale et de la Recherche.
OST, 2002, *Science et Technologie : indicateurs 2002.*