

# 프랑스의 공학교육

우리나라에는 미국이나 일본의 교육제도는 잘 알려져 있다. 반면에, 다른 선진국의 제도는 상대적으로 잘 알려져 있지 않은 실정이다. 선진 각국의 공학교육에 대한 내용을 검토하고 관련된 사항을 알아보는 것은 국제화를 위하여 필요한 일이라고 판단된다. 그러므로, 이번 호부터 선진 각국의 공학교육에 관한 사항을 국내에 진출해 있는 각국 대사관의 협조를 받아 원고를 신기로 한다. 원고는 영어 또는 한글로 작성하도록 부탁할 예정이며, 첫 대상으로 프랑스의 공학교육 제도를 신기로 하였다. 영문으로 작성된 이 원고는 프랑스 문화원에서 집필하였으며 좀 더 자세한 내용을 알기 원하는 독자는 CEDUST(전화 : 02-735-9294)로 문의하기 바란다.

〈편집자 주〉

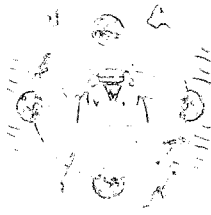
## 1. Scientific and technical education

Some peculiarities of the French higher education system may at first surprise foreign students :

- ◆ it does not only take place in universities, but also sometimes in high schools(“lycées”) even after having obtained a Baccalauréat(special courses preparing for specialized colleges, special technical sections-“STS”) and many engineering schools are small compared to their foreign equivalents(from 30 to 500 students per year).
- ◆ French universities themselves normally don't select among candidates : the Baccalauréat itself opens the doors to higher education.

Competition among students occurs for the entry into smaller colleges, like IUT(technical institutes), STS(special technical sections), CPGES(preparatory classes for engineering colleges), engineering schools. Competitive examinations are organized at





the Baccalauréat level, or two years thereafter when leaving preparatory classes(bac+2 level).

## 2. Types of scientific and technical Curricula

### 2.1 Short university-level technical curricula :

There are two large categories of short, two-or-three-year, technical programs :

- Technical institutes(IUT) are semi-autonomous structures within universities, leading to a University Degree in Technology(DUT).
- Special technical sections(STS) take place within certain high schools and lead to an equivalent degree, the Higher Technician Certificate(BTS).

These curricula last two years after the Baccalauréat. As they are short and technology-oriented, they directly lead way to employment. The delivered degrees are valid at the national level. The students may pursue another year of studies in some particular area and get the National Specialized Technology Degree(DNTS).

Students may also pursue longer studies, for instance in Professional University Institutes(IUP) or engineering schools.

### 2.2 Scientific and technical programmes within universities

Scientific university curricula are divided into three levels

- First level(two years), leading to the Non-Specialized Studies Degree(DEUG)
- Second level(two years), leading to the Licence degree(bac+3 level) and to the Maitrise degree(bac+4 level)
- Third level(up to five years), with the Doctoral Qualifying Degree(DEA) at the end of the first year, and the Doctoral Degree after approximately three more years of research activity(bac+8 level).

Universities deliver other more technically-oriented degrees.

- at the bac+2 level : Non Specialized Scientific and Technical Studies Degree(DEUST) and University Degree(DU).
- at the bac+4 level : Bachelor Degree in Science and Technics(MST).

Bachelor Degree in Corporate Computer Applications(MIAGE) both requiring two years of study after a previous bac+2 degree.





Professional University Institutes(IUP) which requires three years after a competitive examination at the bac+level.

- at the bac+5 level : Magister Studies(Magistères) requiring three years after a bac+2 level. DESS requiring one year after a bac+4 level.
- at the bac+6 level : Technical Research Degree(DRT) given to students having conducted technological research in close relation with a company.

All these curricula take place within universities and aim at providing specialists to industry.

### 2.3 Long technical studies : the engineering programmes

There are a lot of engineering studies in France. They differ from one another on several grounds : programme duration, kind of entrance examination, areas covered. Foreign students can't easily grasp a clear picture with such a large number of sometimes small schools. Common characteristic of these engineering schools : the engineering degree is at bac+5 level.

The classical model of the specifically French engineering education system includes two stages :

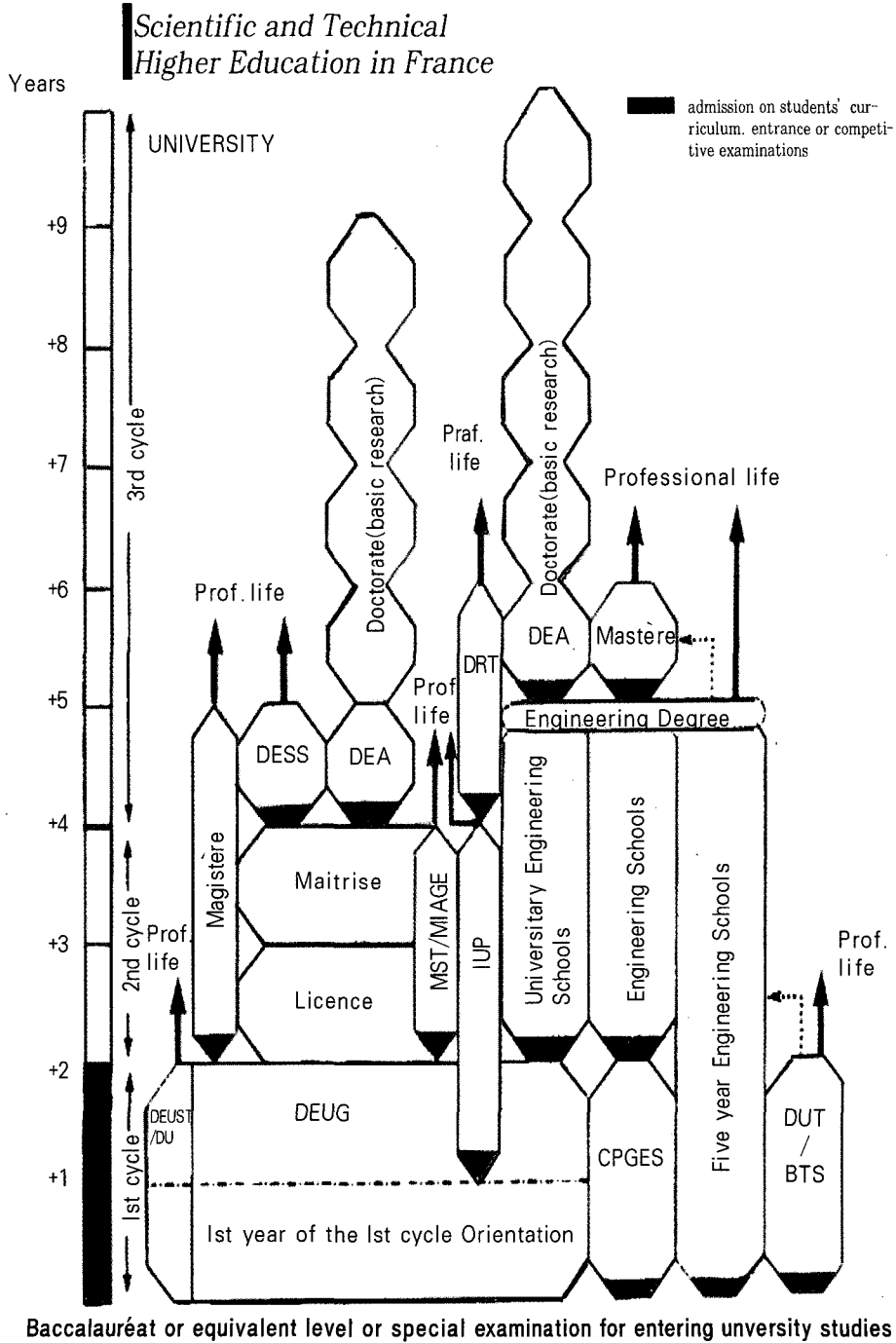
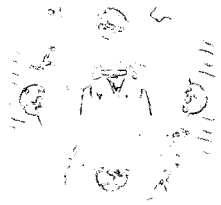
- two years of preparatory classes(Classes Préparatoires aux Grandes Ecoles Scientifiques). Preparatory sections are part of some high schools. In these sections, students are being prepared for the competitive examinations for entry to Engineering Schools(Grandes Ecoles Scientifiques technically oriented). A few schools of education(Ecoles Normales Supérieures, more scientifically oriented) also recruit that way.
- three years of higher technical education within schools.

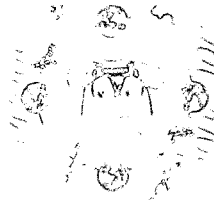
The better known engineering schools, some of which are 200 or more years old, follow this model.

However, in the last forty years, new engineering programmes have been developed :

- some engineering curricula recruit students at the Baccalaureat level(most of them without a special exam), and give them a 5-year training :
- others still recruit at the bac+2 level, but accept students who have already got a degree(DEUG, DUT or BTS) instead of organizing a competition for students coming from preparatory sections.

Most engineering schools take a few university graduates(bac+4) who then follow the last two years of engineering school with the other students.





## 2.4 Mastères

In France, “Mastères” are additional one-year programmes for graduate students, offered by engineering or business schools.

## 3. Various educational paths for engineers in France :A diversified landscape with common characteristics

◆ A competitive system where the scientific baccalauréat is prevalent  
Competition and selection are strongly connected to any engineering education, Selection occurs :

- either by the competitive examinations at the end of preparatory classes(leading to the most prestigious engineering schools),
- or immediately after the Baccalauréat based on students grades and interviews,
- or after a few university years, or after IUT or STS.

Access to engineering schools is only open to good or very good high school students with sufficient scientific background. However, opening engineering schools to graduates of DUT, BTS or DEUG, and developing new engineering schools(NFI) has allowed high school students with a technological background to enter engineering schools.

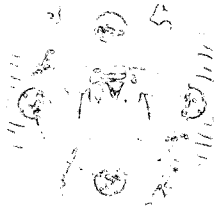
### ◆ Connection between engineering schools and companies

In the last 15 years, many relationships have developed between schools and companies, aiming at adapting the programmes to needs of the job market. They may lead to true partnerships between schools and companies(sponsoring student activities forums and seminars, lending equipment, teaching by company representatives). Companies appreciate getting students involved in internships scheduled within the school curriculum.

Internships were first established because companies claimed that studies were too abstract, and to prepare future engineers for the workplace. Internships are now offered in all schools and at least one internship is mandatory in 90% of the schools.

Three kinds of internships are organized by schools :

- observation or workman internships
- technician internships



- engineering internships

These various internships are part of the study programme, and follow one another in a pedagogical progression. Some of them occur during summer vacations.

The average total duration of all internships is 28 weeks, but there are big differences between engineering schools. The last internship(engineering internship) is usually the longest, lasting about 18 weeks. The total duration of internships is between 15 and 30% of total study time and sometimes more than that.

The quality of the internships is important to get a degree : most schools give it a weight of 10 to 30% in the final grade and some of them only give the degree after competition of the internships.



## 4. French Engineering Education Programme Types

### 4.1 Traditional programme types

◆ Studies organization in traditional engineering schools .

In traditional schools, the engineering degree can usually be obtained after five years of higher education.

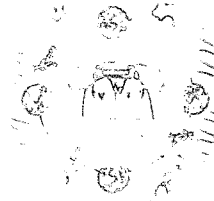
Within these five years, the first two years aim at giving the students basic scientific training, and a work methodology(first years of five-year engineering schools, or DEUG, DUT, BTS or preparatory classes).

The engineering training proper lasts three years(about 3000 hours) and includes :

- basic scientific training, with many different subjects, covering with less depth the field of several university four-year curricula(“maitrises”)
- basic technical training, more or less bound to a large application sector(chemistry, mechanics....),
- basic diversified training(about 20 to 30% of the allotted time), foreign languages, economy(economic computations useful for engineers), humanities.
- practical training, sometimes very important, with short or long internships within companies(with usually at least one personal project ending studies, more or less similar to an actual industrial case)

Both small and large schools are trying to adapt to their environment





through changing stress on options which are often revised according to companies needs.

◆ Schools that recruit mainly through Competitive Examinations after scientific or technical preparatory classes

These are the most numerous : 112 among 202 in May 1996.

Competitive examinations for entering engineering schools are prepared with-in preparatory classes of lycées(“classes préparatoires aux grandes écoles scientifiques”). Preparation lasts two years after the Baccalauréat or three years if the student decides to repeat the second year(the year called “mathématiques spéciales”)

Engineering training then follows for three years.

Some competitive exams permit access to several schools, and such unions create groups of schools. For instance, the “Mines/Ponts” exam groups 8 schools, while the “Centrale/SupElec” exam groups 7 schools and the “Polytechnique” exam groups 37 schools(23 in physics and 14 in chemistry).

Studies in preparatory classes are particularly tough, because of the intense effort required and give character reference to those students who were able to sustain such efforts.

12,478 engineers graduated in 1995 within these programmes(57.7% of the degrees delivered by schools mainly entered after initial studies).

◆ Schools recruiting mainly at bac+2 level, 2 years after high school degree(DEUG, DUT, BTS level)

41 engineering programmes recruited mainly bac+2 students in May 1996. Those are almost exclusively programmes internal to Universities.

Recruitment in these programmes occurs mainly through analysis of the students' curriculum vitae(resume) and interviews. Most of the candidates have a DEUG A(earth and life structure sciences)or B (life or natural sciences)or a DUT/B. Percentages of course vary from one programme to another. Selection is most severe:DEUG in no more than 2 years. excellent DUT/BTS with a relevant major.

These schools also recruit a few students of preparatory classes. provided they have at least successfully passed the written part of the competitive examinations for the better schools(“admissibilité”). These programmes pro-



duced 2.638 graduates in 1995. which is more than 12.2% of the total number of engineering graduates.

◆ Schools recruiting mainly at the baccalauréat level

Forty nine among the 202 schools recruit directly at the Baccalauréat level. These programmes are close to their foreign counterparts. such as German Technical Universities.

Their advantage lies in studies designed from the start for engineering training. They allow students to choose a major without risks of competitive examinations.

These schools often join together for selection (INSA. ENI. schools of FESIC) : recruitment may use the students curriculum vitae(INSA), or examinations(FESIC.ENI), with a complementary discussion with the jury.

Priority is given to scientific high school graduates. whose percentage varies according to the schools. ENI recruit also technological high school graduates.

Training occurs in 5 years, usually with two cycles(INSA, FESIC):

- ◆ a first cycle of 2 years. organized according to a plan which can be
  - either one of preparatory classes(FESIC type schools).
  - or one of a probation year followed by an orientation year(INSA schools).
- ◆ a second cycle of actual engineering training which lasts three years.

Other schools do not distinguish these two cycles(ENI. ESIEE). 6 185 students graduated from these programmes in 1995.

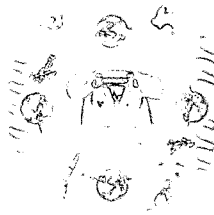
#### 4.2 Preparing a Doctoral Degree in Engineering Sciences

Obviously, doctoral studies are the most important scientific exchange programmes of engineering schools or universities(percentage of foreign doctoral students in ENPC : more than 50%, in ENST 43%, in INSA, the Institut National Polytechnique, UTC... : 40%).

The duration of the preparation of a doctoral degree ranges from 3 to 5 years, according to the following scheme.

- year one of DEA (Diplome d' Etudes Approfondies)is a preparatory and qualifying year for doctorate studies. including lectures and research work and being concluded by the presentation of the research work.





- 2 to 4 years devoted to research work leading to the writing and presentation of a doctorate thesis. Candidate selection and admission are under the responsibility of a committee which usually meets twice, in June and September.

Admission may occur at two levels :

- DEA-level(Ph D qualifying year)for foreign students whose degree is least at bac+4 level : the DEA is usually considered as a preparatory year for the doctorate thesis, but it may also be a final degree in some engineering schools,

students registered in the last year of the engineering curriculum may prepare simultaneously the DEA. with some additional research work:

- thesis preparation level(after exemption from DEA) for foreign students whose degree is at least at the engineering degree or bac+5 level.

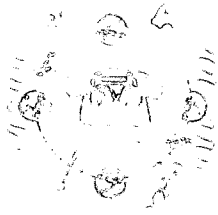
There is no automatic equivalence system for recognizing foreign degrees. The admission committees, when deciding the admission of students in DEA or thesis studies, take into account all previous studies of the candidates, their grades, personal projects, and their ability to follow the French doctoral studies. Therefore a well-ranked foreign engineering degree does not guarantee exemption from the DEA.

Before worrying about administrative procedures for registering in doctoral studies, the candidate should get in touch with the faculty member in charge of the programme in order to tell him about his ideas and motivation.

- ◆ Thesis under joint sponsorship by French and foreign higher education institutions

In January, 1994, the French Minister for Higher Education and Research decided to authorize French higher education institutions to give doctor titles jointly with their foreign equivalent. This aims at developing scientific cooperation between French and foreign research teams by facilitating mobility of Ph.D.students.

These thesis are being alternatively prepared within both institutions under the supervision of both advisers. The thesis has to be written in one of the national languages of the two countries, and a summary has to be written in the other language. The thesis is submitted only once to a jury including the same number of scientific representatives of both countries.

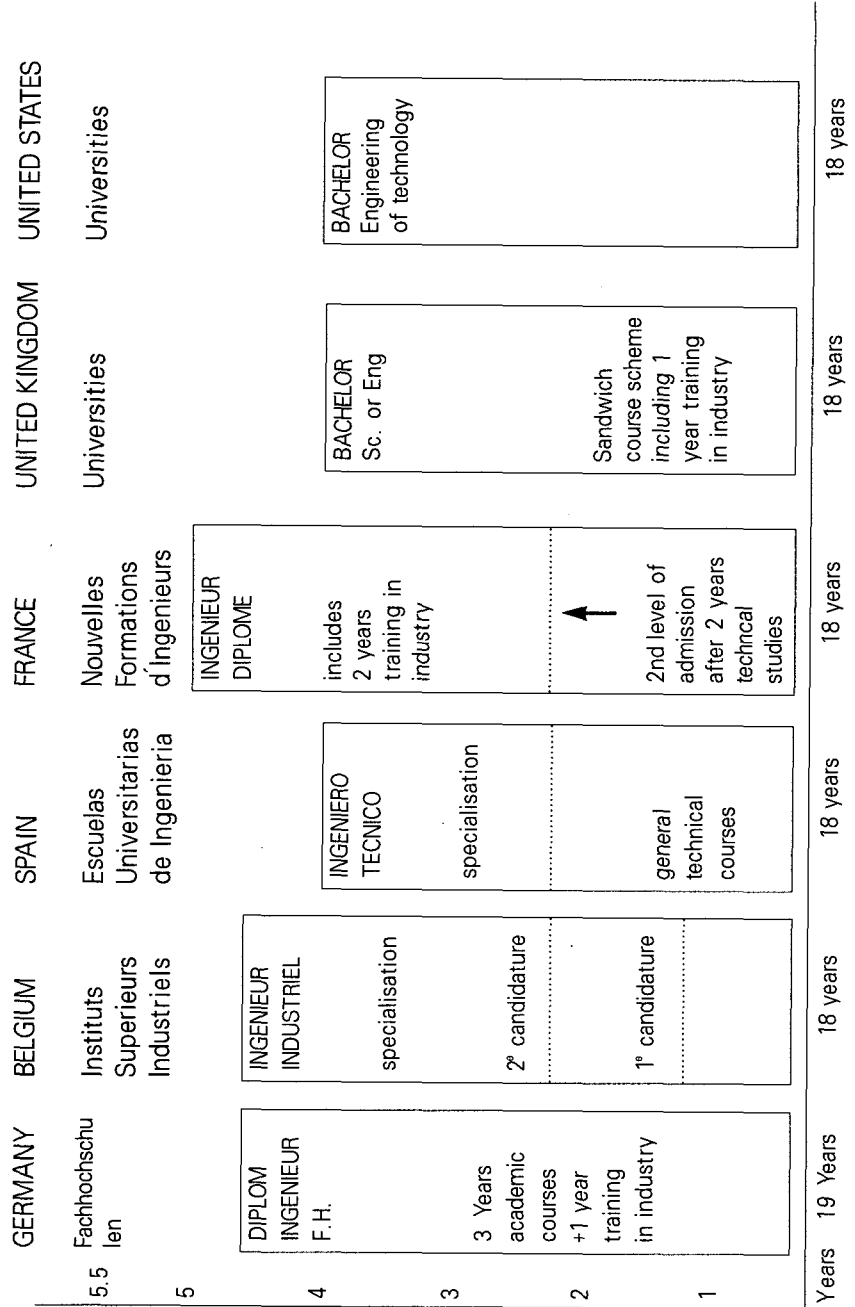


COMPARATIVE SCHEMES LEADING TO THE ENGINEER DEGREE OR TITLE IN DIFFERENT COUNTRIES						
	GERMANY Technical Universities	BELGIUM Universities	SPAIN Universities	FRANCE Engineering Schools	UNITED KINGDOM Universities	UNITED STATES Universities
5.5						
5	DIPLOM INGENIEUR	INGENIEUR civil	INGENIERO	INGENIEUR DIPLOME		MASTER Sc. or Eng.
4	Specialisation including 6 month Practical training	Specialized Engineering Cycle	Specialisation	Specialized Engineering Cycle		BACHELOR Sc. or Eng.
3					MASTER of Sc. or Eng.	
2	VORDIPLOM		1° CYCLE	preparatory classes (maths/physics) or other type of preparation according to the different Eng Schools	BACHELOR Sc. or Eng.	
1	General scientific courses	2° candidature CANDIDATURES	general scientific courses			
	19 Years	18 years	18 years	18 years	18 years	18 years





COMPARATIVE SCHEMES OF PRACTICE ORIENTED ENGINEERING PROGRAMS IN DIFFERENT COUNTRIES





### 4.3 Conference des Grandes Ecoles

#### ◆ The “Grandes Ecoles”

Some facts

Over 60% of the managing directors and the chief executives in France’s 100 largest firms are graduates of the “Grandes Ecoles” (GE). Broad courses of study enable them to assume top positions and offer them different career possibilities.

What are the “Grandes Ecoles”?

They are higher educational institutions primarily in engineering and management, that award degrees after the “baccalaureat” (secondary school diploma)+5 or 6 years of study. They are accredited by the Ministry of Higher Education.



#### Characteristics of the Grandes Ecoles

- small size(300 to 1000 students)
- highly selective admission process
- quality programmes, integrated and flexible
- traditional close ties with industries
- autonomy within the French educational system
- high calibre research
- European and international focus

#### ACCREDITED PROGRAMMES

##### 1) THE “GRANDES ECOLES D’INGENIEURS”

-3-year Grandes Ecoles : 113<sup>(\*)</sup>

duration of studies: 3 years

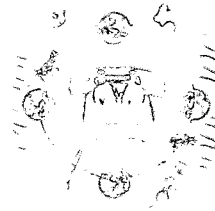
entry level : nation-wide “concours” after the “classes préparatoires”

(= specific 2-year undergraduate programme)

number of graduates(1995):127480

(\*) A few Grandes Ecoles have a 4-year programme and recruit after the first year of classes Préparatoires.





-5-year Grandes Ecoles:49

- the INSA in Lyon, Rennes, Rouen, Toulouse, the ENI, in Belfort, Brest, Metz, St Etrenne, Tarbes
- most Private institutions
- 15 other institutions among which UTC

duration of studies : 5 years

entry level : nation-wide "concours" after the "baccalaureat"

number of graduates(1995) : 6,170

-the specialised Grandes Ecoles : 21

(+ specialised programmes in the above mentioned 3-year and 5-year Grandes Ecoles)

duration of studies : 1 year

entry level : engineering degree(=bac + 5years)

number of graduates(1995) : 860

2) UNIVERSITY ENGINEERING PROGRAMMES(about 92)

duration of studies : 3 years

entry level : university degree at level bac+2 years i. e. DEUG, BTS, DUT

number of graduates(1996) : 7,605

3) CONTINUING EDUCATION PROGRAMMES

- mainly at CNAM, CESI, INPSA, EITARC/CNEARC

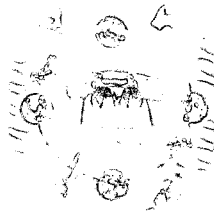
duration of studies : variable

entry level : variable

· the so-called programme "Fontanet" : in about 30 Grandes Ecoles among those mentioned above

duration of studies : 2 years(after the last two years of the main engineering studies in a Grande Ecole)

entry level DUT/BTS+3 years of professional experience



4) The “NOUVELLES FORMATIONS D’INGENIEURS(NFI)” :Sandwich  
-courses

Created in 1991 in order to meet the demand of industry for production engineers and allow the social advancement of technicians.

They involved several partners:

- a professional sector
- big-sized companies
- educational institutions

-main studies : 25 courses

duration of studies : 5 years or 3 years

entry level: “baccalauréat” or DUT/BTS(degree after 2 years at the university)

continuing education : 58 courses

duration of studies : 2 years

entry level : degree after 2 years of university studies professional experience

**TRANSFER POSSIBILITES**

Holders of an academic degree(DEUG, BTS, DUT, Maitrise) may apply through a selective admission process to a Grande Ecole.

**YEARLY OUTPUT OF GRADUATES**

TYPES OF PROGRAMMES	1992	1993	1994	1995	1996
GRANDES ECOLES OF ENGINEERING	16,201	17,705	20,562	18,650	15,084
UNIVERSITY STUDIES	1,622	1,805		2,660	7,605
<b>TOTAL</b>	<b>17,823</b>	<b>19,510</b>	<b>20,562</b>	<b>21,310</b>	<b>22,689</b>



**NUMBER OF STUDENTS**

Institutions and ministries	Types of Institutions		Number of students 1996-97	
			Registered 96-97	Degrees awarded in 96
124 public institutions (authority : Ministry of Education)	92 university programs		24,839	7,605
	32 autonomous institution	5 ENI	902	694
		4 INSA	1,870	1,544
		11 ENSAM+ alike	1,459	1,419
		12 Others	1,683	1,460
		TOTAL	5,914	5,117
46 public institutions (authority : other ministries)	15 Agriculture		3,635	1,215
	13 Defense		3,572	1,230
	7 Industry		2,653	635
	3 Post and telecommunications		1,630	638
	5 Equipment, housing		1,342	469
	2 City of Paris		357	108
	1 Employment, social affairs		13	17
	TOTAL		13,202	4,312
68 private institutions		18,993	5,655	
<b>TOTAL : 238</b>		<b>76,841</b>	<b>22,689</b>	