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Facing Globalization: How to Adapt Engineering Education?

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Ecole Centrale Paris



Ecole Centrale Paris – Key Facts

- **Founded in 1829, Ecole Centrale Paris was the first Grande Ecole to train engineers and managers for industry**
- **Extremely selective**
- **High level generalist training based on science and technology:**
 - «The doctors of plants and industry»
- **International outreach**
 - Founder of T.I.M.E. network
 - More than 100 international partnership agreements
 - Ecole Centrale Beijing (founded in 2004)
- **100 partnerships with major companies**

ECP, The School for Companies

The teaching staff

- ◆ Faculty members, employed on a permanent basis
- ◆ External lecturers employed on a part-time basis whose main professional activities are not within higher education
- ◆ Conference Speakers

The curriculum

- ◆ Delivered in close collaboration with companies
- ◆ Within the framework of original partnership programs

Corporate sponsorships

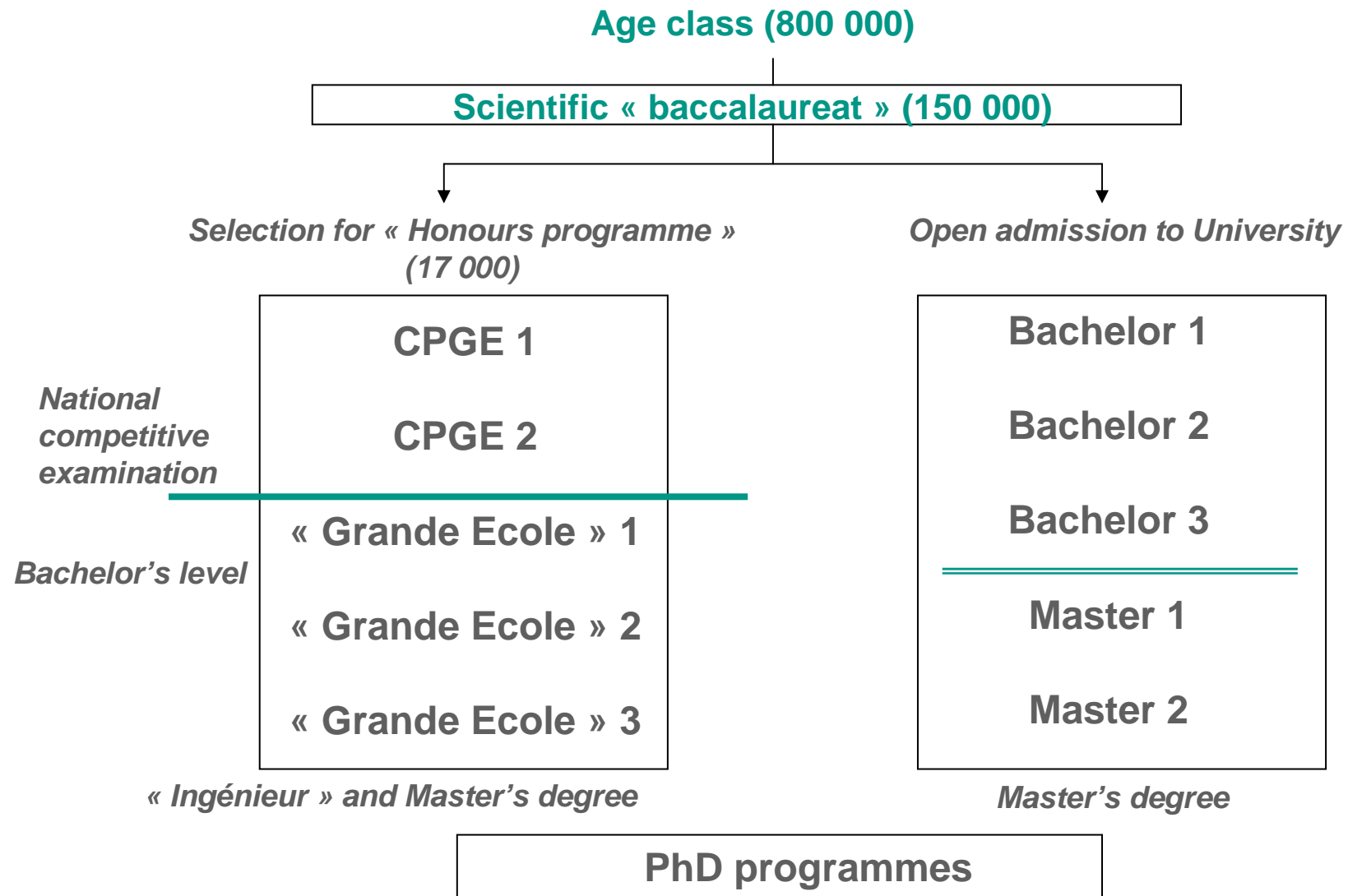
- ◆ Educational sponsoring: 100 major companies
- ◆ Club TIME Plus: 20 companies

Contractual research carried out by our laboratories

ECP Degrees

- ***Ingénieur Diplômé de l'École Centrale des Arts et Manufactures*** or ***Ingénieur ECP***, the ECP Engineering Master's degree,
-> 460/year
- ***Master Recherche***, the Research Master's, the French equivalent to the Master's of Science, preparing PhD candidates,
-> 150/year
- ***Docteur de l'École Centrale des Arts et Manufactures*** or ***Docteur ECP***, the PhD degree,
-> 60/year
- ***Mastère Spécialisé***, a specialized professional degree at Master's level
-> 250/year

The French System of Higher Education



Student selection for the *Diplôme d'Ingénieur*

	<u>Students</u>
Age Class in France	800,000
Baccalauréat	520,000
Scientific Baccalauréat	130,000
Admission to <i>Prep. Classes</i>	17,000
Applicants for admission to <i>ECP</i>	13,000
Rank of last student admitted	750
Number of places at ECP	330

The “Centraliens”

- **Top positions in companies, including majors ...
...or developers of their own company!**
- **In all sectors**
- **Considered to be:**
 - **Competent**
 - **Adaptable**
 - **Highly committed**
 - **Pragmatic**
- **...and very effective**
 - **to solve complex problems**
 - **to tackle complex situations**

ARIANE

Training new “Centraliens”

top-level multidisciplinary engineers...

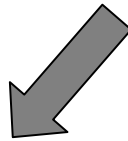
**...who can effectively impact today’s world
through their strong leadership,
entrepreneurship and innovative spirit.**

The Centralien

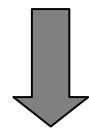
Excellent on a scientific and technical basis

And...

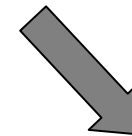
« Entrepreneurial / Innovative »



**Capacity to
innovate**



**Ability to initiate,
manage and
succeed at
change**

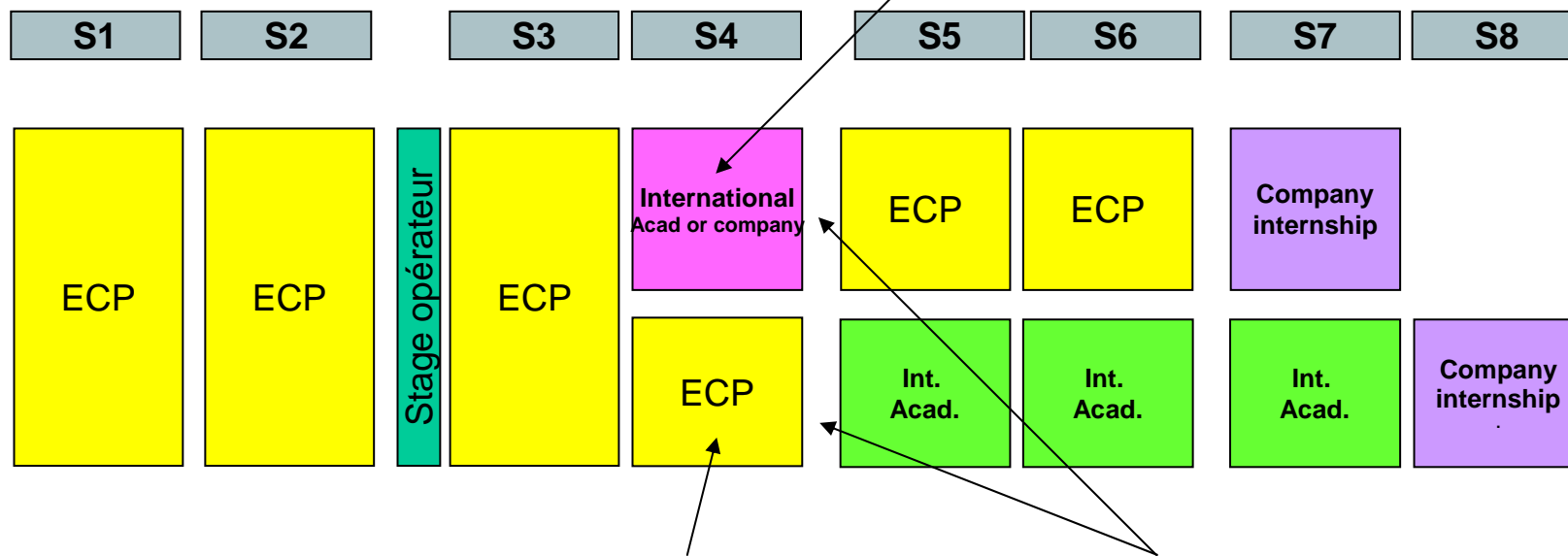


**Ability to deal with
more and more
complex
interdisciplinary
issues**

New curriculum

- > 1 semester in a company
- > 1 semester abroad

French students



Students in a double diploma programme

One year break possible

A brand new course scheme for the first two years

S1, S2

S3

S4

Common Core

**Differentiated
course scheme**

Electives

Providing the essential
skills and knowledge for
any “Centralien”

Proposing an initial
differentiation of the
curriculum while
maintaining a
multidisciplinary profile

Providing the opportunity
to build a personal track at
ECP or abroad

Various educational innovations with a single commitment to excellence

- ❑ a broader range of multidisciplinary electives in science, technology, business administration and humanities;
- ❑ additional projects and case studies to understand complexity and get involved in the major challenges of the 21st century;
- ❑ an integrated workshop program over the first two years to develop professional leadership skills through group and individual coaching;
- ❑ international and intercultural experiences through extended study periods and internships in foreign countries, courses in English, and international students representing about 30% of the student body.

The new curriculum

Common core S1 and S2: a great variety of courses for a multidisciplinary program

Fundamental sciences (mathematics, physics, biology, heat transfer, thermodynamics ...)

Engineer sciences (mechanical engineering, programming, embedded systems, information systems, simulation and optimisation, industrial engineering)

Project and lab work

Business administration (economics, company administration, finance, law...) and the engineer's know-how

Social and human sciences (cultural awareness, philosophy, ethics....)

Foreign languages

Sport

Placing the student at the heart of the challenges of the 21st century :

6 major issues to be discovered throughout the curriculum

Energy

Including inflation and depletion of fossil fuels

Environment

In terms of the preservation of environmental balances

Health and biotechnology

Inputs the trades of the engineer into the field of health

Information and knowledge

Impacts of the emergence of digital technology and the convergence of systems on society

Territory

Issues of urbanism, mobility and transport

Economic Changes

Understanding the economic challenges of the twenty-first century and becoming actors in those changes

Through conferences, workshops, and a project with a company client

43 different companies for 86 projects

Energie	Environnement	Info - Connaissance
   	    	        
Mutations économiques	Santé - Biotechnologies	Territoire : Urbanisme, Transport, Mobilité
        	      	        

First year industrial project

- **Teams composed of 5 students**
 - who have never worked together before
 - the team includes at least
 - one female student
 - one foreign student who is not very fluent in French...
- **Take on a real, not well-defined, industrial problem**
- **With the support of**
 - An academic tutor
 - An industrial tutorwho are supposed to very busy persons
- **Evaluated on**
 - The quality of the team work
 - The methodology used to reach the solution,
 - The manner in which all the aspects of the problems have been taken into account: scientific but also economic, environmental, human, social etc...

Ariane workshops: Major issues for an engineer in the 21st century

Groups of 40 students, from S1 to S3, with two facilitators

Professional Project

Becoming an engineer

Professional project

Career management

The Engineer's Know-how

Problem solving and multidisciplinary

Teamwork

Communication

Project Management

Leadership and Creativity

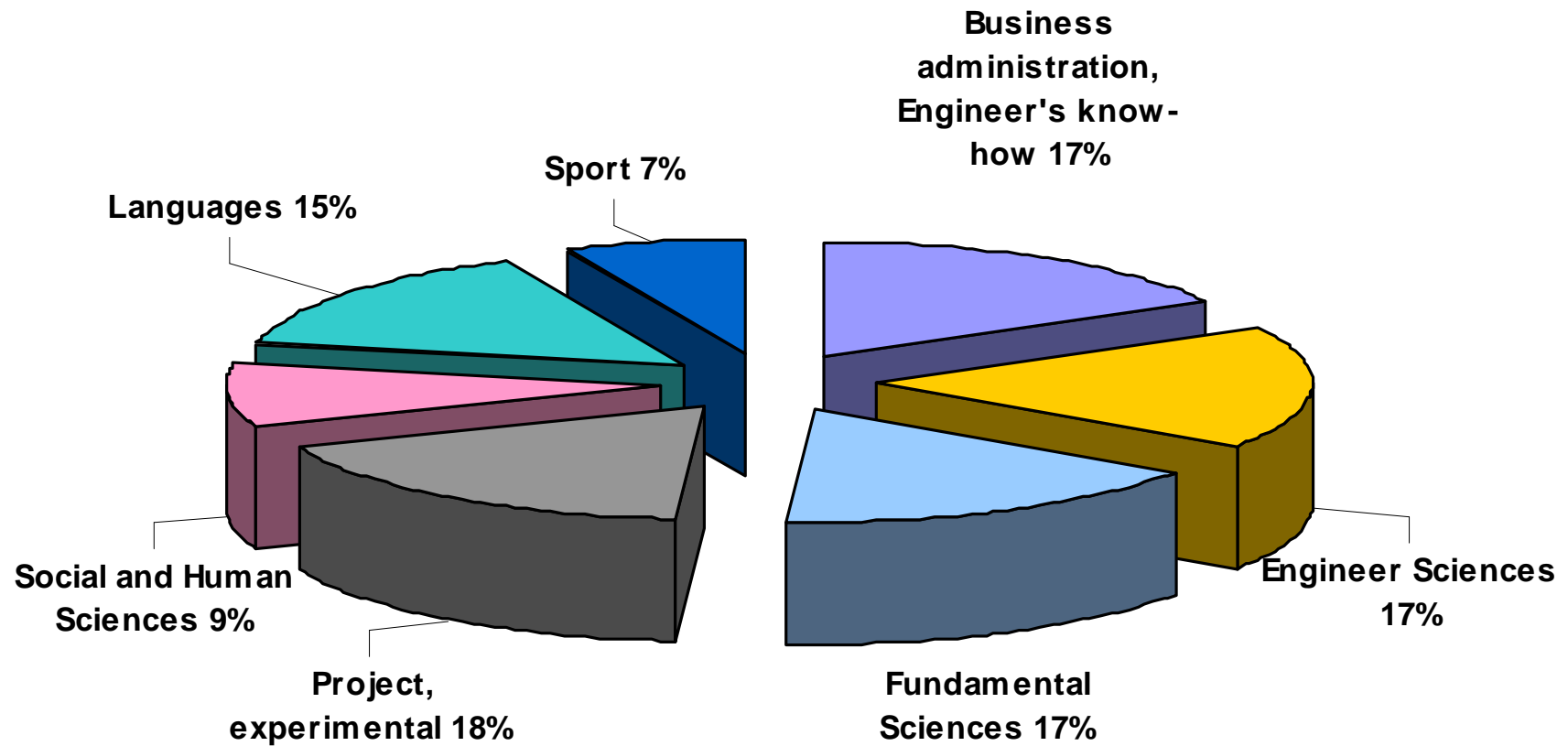
Self awareness

Creativity

Complexity

Change management

Common core



The new curriculum

A great variety of electives for S3...

... with rules preserving generalist education

Fundamental sciences: maths, physics, chemistry, solid and fluid mechanics...

Engineering sciences: civil engineering, materials, chemical engineering, energetics, ...

Business administration: finance, law, company administration...

+

An innovation project (research or company)

Languages, Sport

The Objectives of the Innovation Project

- **Contribution to an innovation process**
 - Generation of new knowledge, technologies, techniques, concepts and functions, marketing offers, business developments, companies...
- **Demonstration by the students of the value of their contribution by**
 - understanding the global process in which the project is included
 - proving the validity and relevance of their results
 - and their ability to find an original solution

The new curriculum

Electives: S4

At ECP for Double Diploma students (French and international)

- o 3 to 5 electives in sciences and business administration
- o Project in a research lab or company

The new curriculum

Electives: S4

Abroad for the French students who will spend their third year at ECP

- International academic experience
 - courses or research internship at a foreign university
- International internship in a company

Possibility of one year break, « sandwich year », between the 2nd and 3rd years

The third year

- Allows the deepening and the application of the knowledge and know-how acquired by the student in the first two years
- Prepares the student for his/her integration in a company
- Gives him/her the initial impulse for a successful career
- Continues to confront him/her with the major challenges of the world

9 options: 23 weeks

Industrial sector, academic discipline

6 professional tracks: 8 weeks

Preparation for the initial engineering position

Third Year

9 options

- Civil Engineering
- Energy
- Environment, Materials, Life sciences
- Operational research and industrial engineering
- Computer Science
- Applied Maths
- Mechanical engineering and aerospace
- Applied Physics
- Embedded Systems

6 professional tracks

Company start up

Research

Conception and industrialisation of innovative systems

Project management

Operations management

Consulting and Finance

A dynamic progress...

... The “Learning” Ecole Centrale Paris

Continuous improvement of the educational program

Regular Review:

- Trends and objectives
- Content
- Teaching methods

Based on

- surveys on the needs of companies, the development of sciences and educational innovations
- the performance scoreboard of the curriculum

Involvement of the whole teaching body

- professors involved in the process of continuous improvement, individually and collectively

Conclusions

Very satisfying results

- Clear improvement of students' satisfaction
- Impressive results obtained by team projects
- Excellent appreciation of partner companies
- More students involved in start-up creation

Next phase under preparation, to further develop

- our students' leadership
- their entrepreneurial spirit
- their sense of innovation
- their awareness of the World