Paradigm Reform of Engineering Education

French engineering education system and its reform

Prof. Fouad BENNIS
Director for International Relations

ENGINEER ?

- The word Engineer / Engineering have different meaning for different persons and countries. Example of definitions (from internet or dictionary)
- **Engineer** : a person whose job is to repair or control machines, engines, or electrical equipment
- **Engineer** = a person trained and skilled in the design, construction, and use of engines or machines, or in any of various branches of engineering : a mechanical engineer; a civil engineer.
- **Engineers** are people who invent, design, analyse, build and test machines, systems, structures and materials to fulfil objectives and requirements while considering the limitations imposed by practicality, regulation, safety, and cost.

ENGINEER ?

- *Engineers* use the knowledge of mathematics and sciences gained by study, experience, and practice, applied with judgment, to develop ways to economically utilize the materials and forces of nature for the benefit of mankind.

- The work of **engineers** forms the link between scientific discoveries and their subsequent applications to human and business needs and quality of life.

SYSTEMS ENGINEERING ?

- **Systems engineering** is an interdisciplinary field of engineering and engineering management that focuses on how to design and manage complex systems over their life cycles.
- **Interdisciplinarity** involves the combining of two or more academic disciplines into one activity. Creating something new by thinking across boundaries.
- **interdisciplinary field,** organizational unit that crosses traditional boundaries between academic disciplines or schools of thought, as new needs and professions emerge.
- Large engineering teams are usually interdisciplinary, melding of specialties.
- **Engineering management** is the application of the practice of management to the practice of engineering.
- **Engineering managemen**t is a career that brings together the technological problem-solving savvy of engineering and the organizational, administrative, and planning abilities of management in order to oversee the operational performance of complex engineering driven enterprises.

FRENCH HIGHER EDUCATION INSTITUTIONS

PUBLIC UNIVERSITIES

- Funded by the national government. Well- distributed across the nation
- Include some of France' s oldest and most prestigious institutions.

GRANDES ÉCOLES

- France's renowned *grandes écoles* are very selective,
- Train students for careers in engineering, management, and public administration,….
-

SCHOOLS OF ART, DESIGN AND ARCHITECTURE

- 60 public art schools and 20 schools of architecture

SPECIALIZED SCHOOLS

- France has more than 3,000 public and private specialized schools : nursing, journalism, social work, fashion, design, tourism, culinary arts, hotel, ….

RESEARCH IN FRANCE

- Research employs 412,000 individuals,
- The impact of French publications is the 4th most significant in the world.
- France Ranked 4th globally for the number of Nobel prizes (62)
- France is ranked 2nd in the world in In mathematics, with 13 Fields medals,

RESEARCH : NATIONAL RANKING

	Country	Documents	Citable documents	Citations	Self-Citations	Citations per Document	↓ H index
1	United States	10193964	9165271	240363880	110517058	23.58	1965
2	United Kingdom	2898927	2499445	60988844	13948928	21.04	1213
3	Germany	2570206	2394158	49023207	12158563	19.07	1059
4	France	1826708	1712312	33910955	7292478	18.56	966
5	Canada	1468796	1338700	31052115	5578703	21.14	963
6	Japan	2367977	2277777	35480575	9503478	14.98	871
7	Italy	1449301	1335074	25366435	5850838	17.50	839
8	Netherlands	816316	745545	20136037	3133734	24.67	835
9	Switzerland	595889	550777	15280692	1969916	25.64	818

FRENCH EDUCATION

- Education in France is compulsory for children aged 6-16.
- The language of instruction is French.
- The academic year : September until the end of June.
- The academic year is divided into semesters

- Middel School (4 years) ≈ 11 to 14 years old
- National competition exam Brevet

- High School (3 years) ≈ 15 to 18 years old
- National competition exam Baccalauréat
- Baccalauréat : National competition exam that give access to Higher Education

FRENCH BACCALAURÉAT & CPGE

BACCALAURÉAT 2016 (≈ 18 YEARS OLD)

- A total of 715 200 candidates (78.6 % of the generation)
- 632 700 got the Baccalaureat (88.6 % of candidates)
- 173 217 Admitted from the Scientific area (24.2 % of candidates)

CPGE

- CPGE: Preparatory Classes of Grandes Ecoles
- 25 573 Accepted in CPGE (3.5 % of candidates)

STUDENTS 2016

- Total Number of registered in Higher Education 2 551 100
- Total Number of Students in Engineering Program 134 523 (5%)

FRANCE HIGHER EDUCATION

LEVEL		UNIVERSITIES	GRANDES ECOLES
9		State diploma of doctor of medecine	
8 7	DOCTORATE 16 semesters (8 years)	• PhD	• PhD
6		• State diploma of dental surgery • State diploma of doctor of pharmacy	
5 4	MASTER 10 semesters (5 years) 300 ECTS	• Master	• **Engineering diploma** • **Business Schools diploma** • Masters of science • State diploma of architect
3	LICENCE 6 semesters (3 years) 180 ECTS	• Licence (bachelor)	
2 1	4 semesters (2 years)	• Associate degrees (DUT, BTS…)	• Preparation for admission to a Grande Ecole • Admission in the first year of a *Grande Ecole* program

AN OVERVIEW OF THE FRENCH ENGINEER « *GRANDES ÉCOLES* » SYSTEM

- French engineer are Master degree (5 years)

- The Engineering *Grandes écoles* of France are elite
- Highly selective
- Srong relation with industry and business
- Internationally-reputed in Education and Research
- Combine fondamental and applied science
- Are widely regarded as prestigious, and most of France's scientists and executives have graduated from a *grande école*
- Have a small size

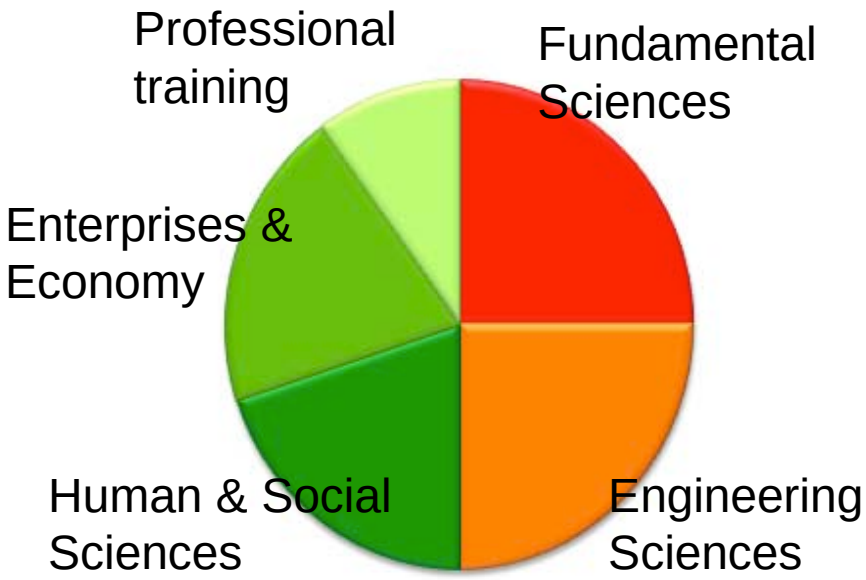
CENTRALE NANTES REFORM

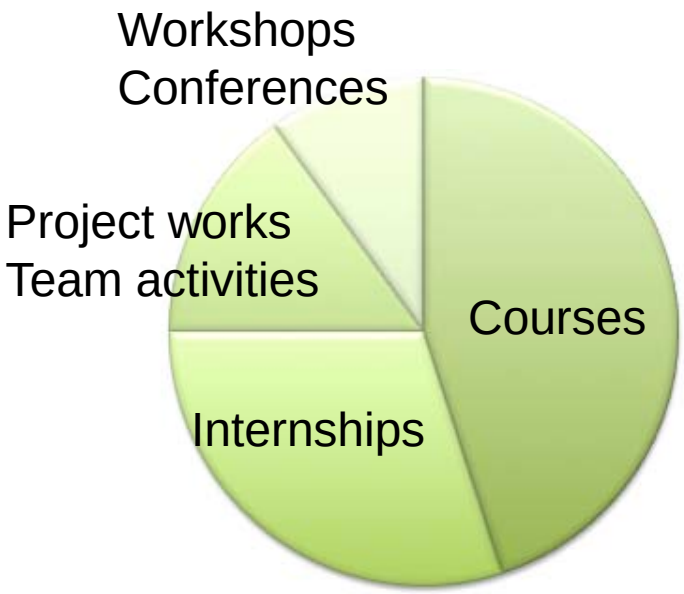
- Public institution of the Ministry of Higher Education
- Created in 1019
- Members of GCE and CDEFI
- 2300 students
- 32% international students,
- 550 resercher and academic staff
- 11 researchs platforms
- 6 research laboratories Associated to CNRS
- Ranked 6th among 206 engineering schools
- Ranked 6th in 2016 U-Multirank, 2016
- Deliver
  - *Diplome d' ingénieur de l' Ecole Centrale de Nantes (Master degree)*
  - *Master in English*
  - *PhD Students*

REFORM AT CENTRALE NANTES
ENGINEER = SOFT SKILLS + HARD SKILLS

- High level of scientific & technical competence
- Deal with complex technological systems
- Manage uncertainty, rapid change, ambiguity, surprises, and a less defined environment
- Manage time, budget and team
- Understand and anticipate the needs of mankind
- Understand the working of companies and the professional activities of engineers
- Develop a sense of initiative and a critical and innovative mindset
- Achieve a fully-developed personality and a broad cultural background
- Learn to communicate and to work in a team
- Develop an international dimension

DISTRIBUTION OF CENTRALE NANTES ENGINEERING PROGRAM





+ Associative Activities & Sport
+ Compulsory :
One semester minimum international mobility (exposure)
& One semester minimum internship in company
& + 850 TOEIC (minimum English level)

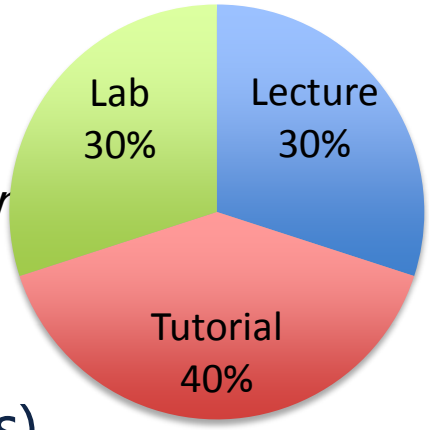
REFORM AT CENTRALE NANTES (1)
NEW PARADIGM

TWO YEARS OF CPGE

- Mainly fundamental sciences : math, physic, chemistry

ONE YEAR COMMON COURSES

- Broad-based multi-disciplinary engineering training
  - *Applied Mathematic, Mechanical modelling, Electronic, information system, Fluid dynamic, Applied thermodynamic …*
  - *Management , Environnement, Social Sciences, language*
  - *800 hours (Lectures + Lab + Tutorial) with professors*



- + First-hand industrial experience :
  - *Industrial study project (defined with partners compar*
- + Internship (4 to 8 weeks: July/August)
  - *Full time in company*
- + Personal Humanitarian work (2 to 3 weeks)

REFORM AT CENTRALE NANTES (1)
NEW PARADIGM

TWO ORTHOGONAL ENGINEERING AREA

LEVEL		UNIVERSITIES	CENTRALE NANTES
5	MASTER 10 semesters (5 years) 300 ECTS	• Master M2	• **5th year :** • Second Engineering Area
4		• Master M1	• **4th year** • First Engineering Area
3	LICENCE 6 semesters (3 years) 180 ECTS	• Licence (bachelor)	• **3rd engineering** : • Common courses
2	4 semesters (2 years)	• Associate degrees • (DUT, BTS…)	• Preparation for admission to a Grande Ecole
1			

REFORM AT CENTRALE NANTES (1)
NEW PARADIGM

Semester 10	**5th year** (M2)	**Student chooses one discipline among 21** Orthogonal to the one of the 4th year	**Internship** company or research lab (Thesis + defence)
Semester 9			Courses of the discipline (lecture, lab and totorial) + **136 hours of courses + project work**
Semester 8	**4th year** (M1)	**Student chooses one discipline among 21**	**Internship** company or research lab (Thesis + defence)
Semester 7			Courses of the discipline (lecture, lab and totorial)

REFORM AT CENTRALE NANTES (1)
NEW PARADIGM

DISCIPLINES

- Priorities defined nationally with regard to industrial policy

Manufacturing	Geomatic, Civil & Environmental Engineering	Responsibility, Society, Management
• Aeronautics • Embedded Control and Power Grids • Mechanical Engineering for Materials and Manufacturing Processes • Product Engineering • Robotics	• Civil Engineering • Engineering Science for Housing and Urban Environment • Digital City	• Industrial Engineering • Management of Digital Business and Information Technologies
Energy, Ocean	**Health**	**Digital Economy**
• Energy Production and Management • Ocean: Hydrodynamics and Marine Engineering • Propulsion and Transport	• Connected Home for Healthcare • Digital Sciences for Life Sciences and Healthcare	• Computer Science • Data Analysis and Applications in Signal and Image Processing • High Performance Computing in Engineering Science • Mathematics and Applications • Modelling and Simulation in Mechanics • Virtual Reality

REFORM AT CENTRALE NANTES (1)
NEW PARADIGM

- In Addition to the selected area in the 5th year, students choose a professional option
- It focuses on a particular sector of activity or function.
  - *Business Finance*
  - *Entrepreneurship*
  - *Manager, Leader, Communicator*
  - *International Business Development*
  - *Personal Project*
  - *Engineering and digital sciences for art, culture and heritage*
  - *Research and Development*
  - *Perception and Sound Design*
  - *Science and Music*
  - *Sustainable City*
  - *Sustainable Industry*

- Centrale Nantes Enginneer are able to :

- Adapte to new discipline
- Create something new by thinking across boundaries
- To deal with the interface of disciplines
- Be technological and scientific project manager
- Innovate and evolve with new technology

Paradigm Reform of Engineering Education

Thank you

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