

## **AVOSTTI: A project dedicated to increase gateways between curricula**

### **AM Jolly**

Emeritus Professor  
Polytech Orléans  
Orléans, France

[anne-marie.jolly@univ-orleans.fr](mailto:anne-marie.jolly@univ-orleans.fr)

### **C Léger**

Dean  
Polytech Orléans  
Orléans, France

[christophe.leger@univ-orleans.fr](mailto:christophe.leger@univ-orleans.fr)

### **R Le Gall**

Dean  
Polytech Nantes  
Nantes, France

[rené.le-gall@univ-nantes.fr](mailto:rené.le-gall@univ-nantes.fr)

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## **INTRODUCTION**

Diversity is the key for the future of higher education. In France, the first historical attempt to reach this diversity was to open Grandes Ecoles (*prestige university-level College with competitive entrance examinations*) to students others than those coming from Preparatory classes to Grandes Ecoles. It happened in the 70's...40 years later these schools became members of the Polytech network. At this time the decision to open one third of the seats to professional bachelors holders, one third of the seats to students coming from universities (higher education institutions?) and one third of the seats to students from CPGE (preparatory classes) was considered to be very innovative.

The French Government decided at the end of 2011 to allocate money to pedagogical innovations. Through a call for projects, the one named IDEFI (Initiatives for Excellence in Innovative Courses), whose aim was, for the first time, to give value to the teaching and to the efforts made by the institutions to innovate in the field of quality of course contents, a very ambitious initiative.

The Polytech Network submitted a project called AVOSTTI (Support for Scientific and Technical Vocations in Earning an Engineering degree). Over 37 projects submitted this AVOSTTI project was approved by a French speaking international jury composed of 27 members. It started on the 01/05/2012 and will last until 31/12/2019. It includes 2 different aspects, the first one is concerning French students and the other one is concerning international students.

European companies need engineers to face the complexity of new technologies. However very few young people actually intend to study engineering they prefer to study management, law or medicine. This is why we need to open engineering curricula to new populations of students, while ensuring “security” for the students in these gateways.

# 1 THE CONTEXT OF STUDIES IN FRANCE

## 1.1 The general context of orientation

Nowadays with the diversification of curricula in the secondary schools and at the university, it is necessary to understand the logic of the choices made by students concerning their orientation because France is a country where orientation looks very often like a tunnel.

The *Figure 1* illustrates the complexity of this orientation. We have represented the curricula corresponding to scientific interest in the broad sense.

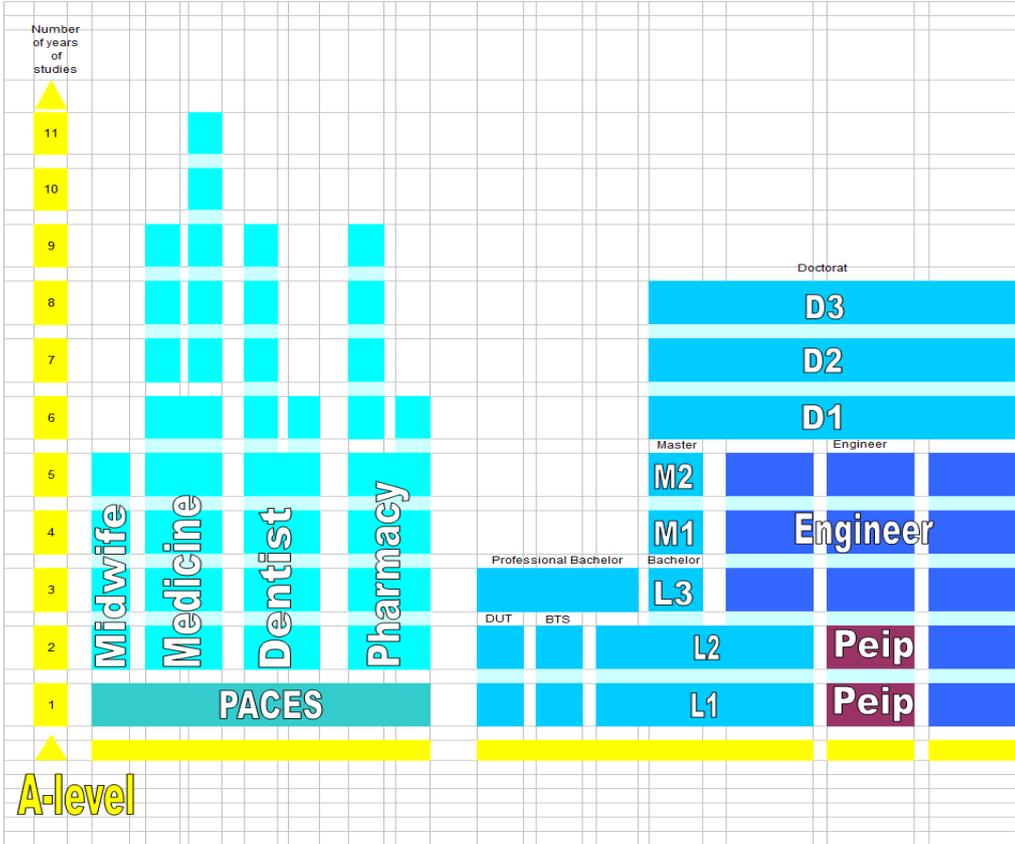


Figure 1

## **1.2 The Polytech Network**

The 13 engineering schools in the Polytech group fall within the public service (university tuition fees) and their degrees are accredited by the French Accreditation Board for Engineering (CTI), the studies last 5 years after A-level. (A-Levels pour les britanniques et High school diploma pour les US)

Polytech engineering students come from preparatory classes for Grandes Ecoles (CPGEs), University Institutes of Technology (IUT), Bachelors programmes or the Polytech Engineering Student Pathway (PeiP) (integrated 2 years preparatory classes). They receive a strong scientific education before choosing a speciality.

Polytech Engineers specialise in order to be quickly operational after graduation. They are trained to work in a world where technologies are becoming multi-tech or “polytech”. With more than 80 majors, the Polytech group allows its engineering students to customize their study programmes based on their career plans. As much as possible confronted with higher education institutions, research laboratories, competitive clusters or international research networks, Polytech engineers acquire a true culture of innovation through hands-on experience.

The 80 majors are divided in 12 major scientific fields of study in which 10 400 engineering students are registered in, there are also 2 830 PeiP students, students attending the integrated preparatory classes. The 125 laboratories of Polytech include 1 200 PhD students.

The project AVOSTTI is considered as a first step into the national opening of the teaching global offer in engineering.

## **1.3 The AVOSTTI project**

Western companies increasingly need more and more engineers to deal with ever more advanced technologies and support the re-industrialisation of our societies. But one of the foreseeable difficulties and one that is already being felt, is the lack of qualified staff at all levels, especially a shortage of engineers. There is also an imbalance between the need for engineers and the number of high school students choosing this path. This is why it is so important to provide new tracks enabling young talents to choose studies which will lead towards rewarding and successful careers in science and technology.

French engineering schools today graduate about 35 000 engineers per year and it is generally believed that a few thousand more are needed. Some sectors are more severely affected by the shortage of engineers than others: digital tech engineers, aerospace engineers for example.

The issue of education and employment prospects for future engineers is clearly a problem that concerns both business and potential graduates, so we need to provide new and attractive training programs suitable to a larger audience.

The AVOSTTI project aims to address the current difficulty of switching tracks in higher education.

## **2 STUDIES OF MEDICINE**

### **2.1 Paces exam**

The first gateway is offered to students firstly oriented towards studies in medicine. It is a pity in France very good scientific pupils prefer to study medicine rather than engineering, especially girls.

The first year of studies common to health studies has been put in place in 2010. In 2010, 47 000 students were registered in this curriculum for only 8 000 seats in the studies for medicine in the second year: the first year exam in medicine (PACES) is very selective and that is why many of them fail this examination.

The PACES exam is common for medicine, pharmacy, odontology and midwives: amongst students competing for this exam, 90% have a scientific A-level and 50% have a distinction, the mention Very Good and 30% mention Excellent at A-level.

This exam lets in a no-win situations a very important number of students having a good potential.

## 2.2 What Polytech-offers

The solution proposed by Polytech is represented by the arrow on *Figure 2*

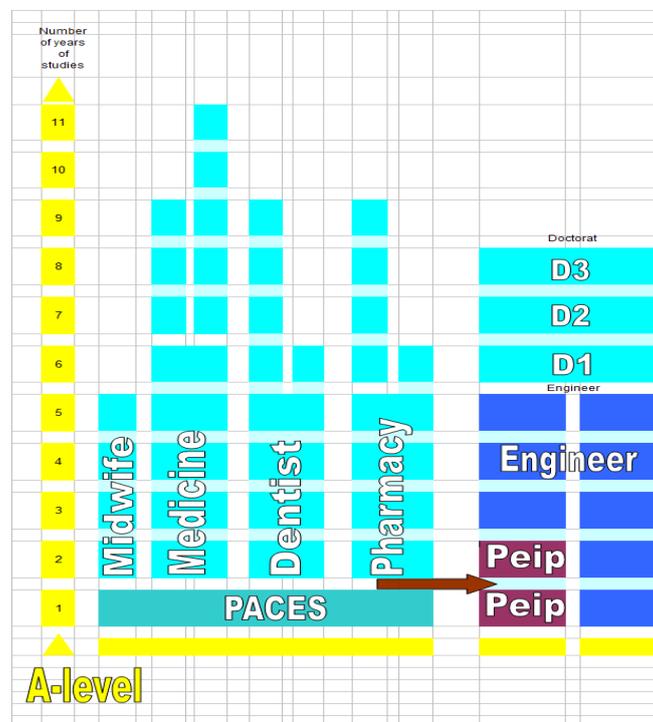


Figure 2

Polytech gives students of Paces the opportunity to integrate an engineering orientation. Engineering studies are more and more oriented towards biomedical applications, so this curricula is a really good idea and the opening of seats for engineering inside a health examination is a very original possibility and brings a beginning of solution to this very old problematic in France..

The students integrate directly the second year of the Peip and this motivates them because they don't feel they have-lost their time.

Partnership with medicine department of faculties allow an admission on file an discussion with the Polytech concerned, in case of the partnership is not established, the students have to undergo an examination. It must be noted that both the Polytech engineering school and studies of medicine belong to the university. Polytech proposes to these students a specific mentoring (8h) as well as specific modules of mathematics and physics during the second year of Peip (112, 5 h). integrated preparatory classes.

### **3 TECHNOLOGICAL STUDIES**

#### **3.1 Coming from vocational high school diploma**

Some years ago, the ministry of education decided to reform vocational studies that were at this moment very tubular and only devoted to technology so as to make them more transversal and general.

Vocational high school diploma is now called STI2D that means “Sciences and technologies for industry and sustainable development”. This diploma is declined in 4 specialities: technologic innovation and Eco design, information systems and digital technology, energy and ecology, architecture and building. The first students have been graduated in 2013. This transformation of technological studies was aimed at making them more attractive, improving their image and opening them to high level studies, it has also been reinforced in scientific fields to give scientific tools necessary for technological teaching.

During the studies in STI2D, teaching insists on processes of investigation and projects, case studies and practical activities so as to acquire multipurpose capacity tools and scientific knowledge necessary for industry and sustainable development. The technologic teaching stand on an analytic demarche based on 3 complementary points of view: energy, information and material. There is also each week one hour of scientific teaching taught in foreign language. During the 2 last years of secondary school, there is for all students 2 hours of personal tutorials and 2 hours of optional teaching.

It has of course an impact on diversity because STI2D traditionally attracts pupils coming from less favoured social classes: pupils and parents of those social classes look for security that is to say that they can obtain intermediate level diploma. That is what is proposed in the second pathway of AVOSTTI: a specific competitive examination allows them to integrate a path organized together by an IUT (the two first years of professional bachelor) and Polytech. So, an access to the labour market is available at each level of studies.

This gateway proposes to accompany technologic A Level students to engineering universities. The technological studies have much evolved in the past years and they have integrated sustainable development concepts, however they still have difficulties to recruit (only 30 000 students in 2010). The secondary schools authorities together with Polytech network tries to make them more attractive by proposing studies continuation after A level.

#### **3.2 Presentation of the program put in place**

What is proposed in the second pathway of AVOSTTI is the entrance in a school of engineers (see arrow) on *Figure 3*: there is now a specific competitive examination that allows them to integrate a path organized together by an IUT (the two first years of professional bachelor) and Polytech.

It is a secured gateway because either, after 2 years the student decides to integrate the engineering cycle in one of the 80 specialities taught in Polytech, either he goes to the labour market with his DUT.

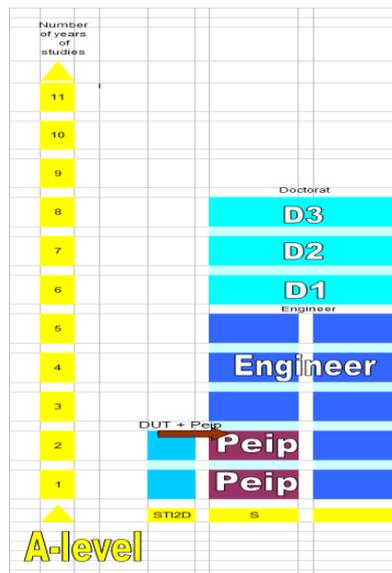


Figure 3

The aim is to simplify the registration procedures to enter higher education institutions, grouping them on a unique website for all the course offer (IUT and Ecole d'Ingénieurs from university technological institutes and engineering schools) opening specifically the doors to STI2D pupils. Both Polytech and IUT belong to the university.

Polytech puts in place complementary modules for the students of STI2D studying in IUT.

Each year the content of those modules is discussed between partners to improve the success of students. During the first year the program requires mathematic reinforcement and tutorials, while during the second year, scientific modules are necessary as well as a technological project linked with a customer. This project could be as well realised with students belonging to one of the specialities of Polytech.

During this second year the volume of complementary teaching hours is about 50 each semester. The pedagogy used is continuously discussed inside national pedagogic commissions where PPN (National Pedagogic Programs) of DUT are examined. This pedagogy is then put in place at the local level according to the specific requirements and adjusted each year.

#### 4 THE INTERNATIONAL DIMENSION OF AVOSTTI

The Polytech strategy is to promote the well-known model of French engineering degree and to strengthen international collaborations by establishing long term mutually rewarding academic cooperations, all over the world, with prestigious institutions which are sharing the same strategy on engineering education and research development: so, the second aspect of AVOSTTI aims at establishing long term academic cooperations at the international level by exchanging students and staff through a structured network of partner institutions.

This strategy is developed with the support of a major representative entity from industry-the UIMM which is an employer's association whose mission is to represent and promote the interests of companies of all sizes and types engaged in metallurgy.

Together with the AUF (Agence Universitaire de la Francophonie) which is one of the most important higher education and research association in the world, the Polytech Group wishes to facilitate the integration of foreign students in the existing engineering courses delivered by the 13 schools in the network and develop a general offer of double degrees jointly awarded with partner institutions.

#### 4.1 Approach of Polytech

It is based on the N+1+2 concept. In such approach after N years in higher education, the applicant follows a specific year within his home institution in order to improve his level in French language and his knowledge in some technical/scientific domains.

Following this preparatory year, he joins, for two years, one of the engineering specialty offered by the Polytech Group. At the end of the course, the applicant can receive both the “Diplôme d’Ingénieur” from one of the 80 engineering courses of the Polytech Group and a master degree from his home institution. It is necessary to know that the French “Diplôme d’Ingénieur” is by law, since 1934, guaranteed by CTI (Commission des Titres d’Ingénieurs) and cannot be awarded for less than two years of studies in a French institution.

#### 4.2 Support given by the Polytech Group

The Polytech Group wishes to establish a close cooperation with the partner institutions by supporting the development of the preparatory year together with the partner institution. This support could be implemented through various actions like providing teaching resources, staff exchange, eLearning materials, capacity development...

The objective is to consolidate both engineering degrees and to establish mutual recognition through multiple degrees: funding is organized for a certain number of students based on their academic merit in the framework of our agreement. The partner institution participates to the selection and decision for this Scholarship Program. The Polytech Group ensures to the partner institution the possibility to send annually the defined number of qualified students in the different engineering fields which are identified as priorities. This pedagogic collaboration opens up doors to additional actions like faculty exchanges, joint research projects.

### 5 FIRST RESULTS OF AVOSTTI

To realise these gateways, it is necessary to use a new pedagogy fitted and innovative including mentoring. Mathematics is a very important course in French engineering studies, reinforce them for new students is something very important.

In 2014, concerning the technological part, 18 collaborations between POLYTECH and IUT were already existing, they opened 242 places seats to young people; on these seats, 116 students were recruited, which leads to an occupancy rate of 48%. The table given below shows data for a larger range of schools that Polytech network.

GEIPI Polytech STI2D/STL	2013	2014	2015
Applicants registered to admission	798	897	988
including women	43	65	54
Including grant holders	132	194	168
Written test attendees	609	679	

Motivation interview attendees (best students)	189	218	
Student capacity	384	400	
Enrolled students	122	150	
Filling rate	31,6%	37,5%	
A and B grade rate	76,2%	73,7%	

The final aim at the end of this project is to recruit 400 students from this field. However, the reflex for continuing studies towards Master level, for vocational students is not yet established, while they are encouraged to follow this route by the Ministry of education and rector authorities.

Concerning students from medicine studies, 12 collaborations existed between faculties of medicine and POLYTECH, there were 216 seats opened to recruitment. Only 135 young people were actually recruited.

The students have a good level of success (80%) at the first semester; this encourages to continue the pedagogic development of the curricula.

More than 160 teachers-researchers are involved in this project. And this project reinforces the internal of collaborations within the universities (IUT, Engineers, and PACES). The industrial support shows us clearly the interest of the industrial environment for the project.

Concerning international dimension, in 2013-2014, agreements were signed with networks of foreign universities to build the international component. A dozen countries have signed or are in the process of signing partnerships with the Polytech Group. Incoming mobility is being deployed gradually with the selection of six Polytech Excellence scholarship recipients in 2013. Given the decision to develop partner networks, the international component is being structured around two actions: the first one (a priority for 2013-2014) aims to at building targeted partnerships (prerequisite skills before mobility, specific educational programmes). The second action involves awarding incoming mobility scholarships and launching communication campaigns about the project. Six universities networks have already signed the Polytech Excellence programme MOU, these are: the Alliance E9 (consortium of 11 Chinese universities), Uni-tech Group (3 Vietnamese universities), the university of Yaoundé (Cameroon), Technology Group (15 Taiwanese Universities), 3 Canadian universities and Polytechnic University of Catalonia. The implementation is more gradual than for the other components of AVOSTTI given its magnitude; a document identifying the skills and knowledge needed to enrol in the 4<sup>th</sup> year of the engineering program had to be built. However in 2013, 100 spots in 9 fields and majors were offered with 20 scholarships available.

There is still a lack in of communication towards potential students that must be improved as well as some pedagogical aspect, but steering committees meet quite often and readjust the necessary sequences.

We now think that this project is transferable to other schools of engineering in all its dimensions and can contribute to the development of the engineering curricula.

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