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Students “without vocation” in French Engineering Schools at the end of their curriculum

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INTRODUCTION

This paper prolongs the study we presented at the 2011 SEFI Annual Conference: *Why – and how – do they choose to become engineers?*² We had shown then, that among typical students beginning their higher education course in French Engineering Schools, only some of them had chosen these studies with a strong will to take up an engineer career. Conversely, much of them did not really know what their future dream was, or even had chosen this course believing that it was quite a good training for another career outside engineer. These students are now completing their fifth and last year of studies.

In this paper, we focus on the students studying in 5-years continuous curriculum Engineering Schools³ (HEI, ISA, ISEN), and we try to figure out how they end up, as nearly graduates in Engineering, comprehending themselves as true “engineers”.

After a quick presentation of the context of our study and its first results, we will present in greater detail the data of the last interviews with these students. Then, we

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² Simonnin P and Didier C [1]. Since this SEFI conference, this first work has been deepened taking more into account the specificity of the French Higher Education context. See: Didier C [2] Since much of the useful bibliographical references were given in this first paper, this latter presents a very short bibliographical section.

³ We limit ourselves to this very subgroup of Eng. Schools, because students having gone through Preparatory Classes to “Grandes Ecoles” and “concours” appeared to be rather different in their motivations and orientation choices. They thus deserve a special paper.

will try to draw some conclusions on their individual pathways. Finally, we will propose some reflections with educational purpose.

1 THE SPECIFIC FRENCH CONTEXT: “GRANDES ECOLES” VS. UNIVERSITY

Despite the fact that we have already developed this aspect in our first paper, we found necessary to quickly highlight the outline of the very specific French context. Higher education in France is divided between University and ‘*Grandes Écoles*’: which are often seen as two enemy sisters⁴. The latter are said to provide a better (even the best) education and to throw wide open the doors of the *elite*. Since Engineering education has historically and now predominantly been offered in ‘*Grandes Ecoles d’Ingénieurs*’ (from now on, abbreviated GEIs), many students choose this curriculum, without a real passion for Engineering.

2 OUR STUDENTS AT THE BEGINING OF THEIR CURRICULUM

Before presenting the evolution of our students, we have to quickly remember (cf. *Table 1*) their social background, their grammar school level and the motives of their reasons to study in a GEI.

But first, it is necessary to characterize the three GEIs (HEI, ISA, ISEN) where our students have been studying.

Table 1. Characteristics of HEI, ISA, ISEN

	HEI	ISA	ISEN
Curriculum	5 years continuous		
Status	Private (Catholic University of Lille)		
Specialisations	Various majors after 3rd year	Agriculture, Agrifood, Environment, Agricultural Finance	Computing, Electronics, HighTech
Ranking ⁵	11 of 68	59 of 68	17 of 68
Graduates/year	≈ 450	≈ 135	≈ 115
Webpage	www.hei.fr	www.isa-lille.fr	www.isen.fr

Table 2. Characteristics of the students⁶

Student	Family	Grammar School	Reasons for choosing to study in a GEI
MP (F, HEI)	Upper-middle class. Father = graduated engineer. Several friends and cousins already studying in GEIs.	Good. Attracted by science	A “normal choice” in his family; she was “floating” about her future and followed their advice. Sailing fan, considering working in sailboats building.
MB (M, HEI)	Upper-middle class Father = self-taught	Good. Passion for	Failed after the 1 st year of Medicine. Chose HEI because of its major in “Medical Engineering”.

⁴ Bonnard & al. [3], 603.

⁵ 2013 Ranking according to *L’Express* [4].

⁶ From the nine students belonging initially to this cohort, we have now only eight, since GH (M, ISEN) had to repeat twice during these 5 years.

	engineer	Medicine	
CL (F, ISA)	Upper-middle class Family of pharmacists.	Quite good. Fond of biology.	Thinking of studying pharmacy, but this was a tough sector. Chose ISA to work in the food process sector and possibly to design new healthy aliments.
JB (M, ISA)	Upper-middle class Father = physician	Low-average	Was looking for a good 5 years higher education. ISA was the only GEI in which he was accepted. Vaguely thinking about working in Environment.
MH1 (M, ISA)	Rural low middle class family. Father = farmer	Rather good	Chose ISA because he wanted to work in his original agricultural environment (probably as a Sales Application Engineer)
MD (F, ISA)	Rural low middle class family. Father = electrician	Very good. Interested in mathematics and biology	Had applied to HEI, ISA and ISEN altogether. She chose ISA by a default, being frightened by the oral interview for HEI, and "cooled down" by the very masculine population of ISEN. Considering working in public research.
CD (F, ISEN)	Upper class Parisian family of business owners and entrepreneurs	Low-average	Studying in an GEI was her family's and teachers' advice. Would have preferred to study in a Business and Management GE but failed at the "concours". Chose ISEN believing it was a generalist GEI with paths to many different jobs.
MH2 (M, ISEN)	Upper-middle class Both parents = Algerian physicians, in France.	Good	Wanted to get a high quality technical education. Insisting on the social utility of his future job. Considered starting his own business later on.

We had been able to distribute these students amongst three distinctive ideal types:

1- Floating: Socially determined and/or personally undetermined students.

2- Pragmatic: Studying in a GEI is for these students a compromise. GEIs are supposed to offer a high quality higher education, with a very good scientific and technical underpinning, but broader than a mere Master in Technics and Sciences at the University (Management, Economics, Communication, Humanities...). They believe that this kind of higher education is the best one to go in for a career in superior management for example.

3- Determined: Students strongly decided to become engineers and willing to exercise this profession.⁷

Table 3. Distribution between the 3 ideal types

Name	Ideal Types ⁸		
	Floating	Pragmatic	Determined
MP (F, HEI)	1		
MB (M, HEI)		1/4	3/4
CL (F, ISA)			1

⁷ There is evidently a clear-cut frontier between the first ideal type and the two others: on the one hand, students are uncertain about their future, on the other hand, they are not. However, the first and the second ideal types are close together with relation to the "utilitarian" attitude towards the fact of studying in a GEI. The only difference is the subjective attitude towards the future.

⁸ Since these groups were defined as Weber's Ideal Types, some students would necessarily fall between two categories. In such a case, their belongings to each group were set to 1/2, or a 1/4 and 3/4 in order to obtain a total belonging of 1.

JB (M, ISA)	$\frac{1}{2}$	$\frac{1}{2}$	
MH1 (M, ISA)		1	
MD (F, ISA)	$\frac{1}{2}$	$\frac{1}{2}$	
CD (F, ISEN)	1		
MH2 (M, ISEN)		1	

The most striking observation from this table was that only 2 of our 8 students were clearly willing to practice as engineers at the end of their curriculum. Given this, assessing their evolution in terms of professional identity and self-projections, during their curriculum, gives cause for hope of interesting results.

3 OUR STUDENTS AT THE END OF THEIR CURRICULUM

We present now a synthesis of the most characteristic data gathered during the last semi-directive interviews we conducted with these students during May and June 2013, only some weeks before the end of their curriculum. For practical reasons of allowed space in this paper and better clarity, these data are split into two tables, the first one trying to reflect more the “objective” data, while the latter is more concentrated on “subjective” declarations and representations.

3.1 “Objective data”

Table 4. “Objective data” at the end of the curriculum

Student	Specialization/Major	End-of-curriculum internship	Career aspiration
MP (F, HEI)	Mechanical Design	Quality and Economic Risk Management in aeronautics industries	Aeronautics Production Engineer
MB (M, HEI)	Medical Engineering	Medical Engineering in Korea	Medical Technologies Engineer, abroad for several years. Willing to create his own business after some experience in the industry
CL (F, ISA)	Innovation and Valorisation of agricultural products and foodstuffs	R&D in the agrifood area	A 1-year Specialized Master in product engineering at the interface cooking/industry. Willing then to work as a R&D engineer in this area
JB (M, ISA)	Environmental Expertise and Treatment	Manure valorisation and management for small farms of French Guyana (with local NGO)	Agronomous Engineer in local development, for an integrated agriculture ⁹ , with a NGO in South-East Asia
MH1 (M, ISA)	Agriculture, Development and Agribusiness	Sales Application Engineer in crop protection products	Sales Application Engineer in Agriculture. Later on, could take over a high added value crops farm
MD (F, ISA)	Enterprise Management and Finance	BNP Paribas – Agricultural Credit Risk Analyst	Agricultural Business Manager at BNP Paribas (a career path all laid out, since this bank has been hiring ISA engineers for 25 years)

⁹ Close to “bio/sustainable agriculture” (no chemical fertilisers and pesticides at all), but allowing some chemical inputs, in limited quantities.

CD (F, ISEN)	High Technologies and Innovation Design ¹⁰	Management of the switchover to a totally digital Maintenance Document Management System in a company producing electronic fire detection and control systems	Several years in a very technical job, then planning to pursue an MBA enabling advancement in technical projects management
MH2 (M, ISEN)	Project Management and Business Development ¹¹	Hardware Design for Radar Systems, in Germany	Hesitating. One year for personal reflection and improvement of foreign languages (English/Arabic). Thinking of several years in a very technical area, then planning to set up his own business.

3.2 “Subjective data”

Table 5. “Subjective data” at the end of the curriculum

Student	Decisive elements in the curriculum	Global appreciation on the curriculum
MP (F, HEI)	4 th year 4-month internship, at Airbus Industries, totally by chance: it was a subduing and passionate discovery of this activity sector, to the point that MP decided to undertake her compulsory Study abroad semester during her 5 th year of studies at La Plata's University (Argentina) well known for its Aeronautics Department, which confirmed her passion Project-based learning and multidisciplinary approaches with real partner companies, which helped to understand the usefulness of theoretical knowledge. Involvement in various associations, which helped her to grow humanly.	An overall good theoretical and technological education and training. But this GEI (HEI) is maybe oversized (more than 500 students/year); consequently, the students don't get help to build their personal project (contrary to what she could find in Argentina, where professors are very accessible and even friendly with students)
MB (M, HEI)	Study abroad semester during his 5 th year of studies, in Memphis (USA), with the shocking discovery of an unofficial but real “apartheid” system, a new kind of higher education, based on project learning, with several possible solutions to one problem (a less academic approach), and above all, readily available and supporting professors (in France, professors are too often keen to denigrate their students!). This semester in USA allowed him to discover that biomedical engineering is really is really a successful and forward-looking sector. 4 th year 4-month internship followed by the eleven Week	An overall good higher education, but somewhat too generalist ¹² , providing a wide knowledge, but not indepth enough to be directly operational. But the good thing about it, is that this education gives the students whatever is needed to get adapted. Complains about the lack of availability of some professors,

¹⁰ This Major mixes High Technology and Commercial Management. A way for CD to conciliate her first desire to study Business and Management, with High Technology, which constitutes the very specificity of ISEN.

¹¹ “This Major prepares engineers having a wide technical background with emphasis on project management, negotiation, marketing, team leading and intercultural communication. This major is proposed with a technological expertise in the field of Information Technology (IT) or in the field of System Technology (ST)” (cf. http://www.univ-catholille.fr/our-academic-departements/training-details.asp?etb_id=24&parc_id=1221).

¹² At first sight, this would sound as a somewhat paradoxical complaint, since a great part of engineering students try to find the most generalist GEI. Following this trend, even the most specialized GEIs try to present themselves as “generalist”. But one must remember that MB knew clearly from the beginning of his curriculum what kind of specialization he wanted to follow.

	<p>Project (at the beginning of the 5th year) altogether in the same company: a real discovery of business world, which strengthened his will to study.</p>	and their excessively "academic" requirements.
CL (F, ISA)	<p>Entering the specializing Master: this enabled her to plan for the future and to understand the usefulness of the theoretical three preceding years.</p> <p>Vice-presidence of the Student Sports Association: a strong human experience, which helped her to learn practical management.</p> <p>Meeting some professors, professionally exciting and humanly really impacting.</p> <p>End-of-curriculum internship, a real discovery of the professional sphere.</p>	<p>A really good and thorough higher education, scientific as well as human. Humanities (personal development, ethics, communication) are seen as particularly important.</p> <p>The first 3 theoretical years are now seen as necessary, but rather harsh</p>
JB (M, ISA)	<p>"4-month Gap" at the end of the 2nd year (a total autonomy period, half a world away, with the requirement to work to earn their food and lodging): a real initiatory experience.</p> <p>Discovery of Sustainable and Integrated Agriculture during the curriculum, which made him change his initial orientation (Environment and/or Urbanism).</p> <p>Study abroad semester during his 5th year of studies in San Francisco, specializing in Environmental Science.</p>	<p>Very happy with these 5 years at ISA, which allowed him to discover many different areas, to learn many things, to discover himself along with his professional desire.</p> <p>Availability and "human valour" of the professors, which helped him in several occasions.</p>
MH1 (M, ISA)	<p>Participation in the "Agri-club" of ISA, a student association the aim of which is to help students coming from a non-agricultural milieu to discover this area: a deep human experience, which helped him to build some self-confidence.</p> <p>Non-technical classes: law, ethics, conflict management, communication which opened his mind and helped him grow up.</p> <p>4th year internship: a rather difficult challenge, but his chief trusted him and helped him grow up.</p> <p>Entering the Master courses: this was what he had dreamed about for years. This specialization came as a confirmation of his desire.</p>	<p>Very happy with these 5 years at ISA, which allowed him to to get to know what it means to work as an engineer.</p> <p>Professors paying attention to the students.</p>
MD (F, ISA)	<p>Though arrived at ISA by chance (see <i>Table 1</i>), discovered Economics and Financial Management during the curriculum, and became passionate about this field.</p> <p>"4-month Gap" at the end of the 2nd year (woofing and farming in Australia): a powerful initiatory experience, which was her transition to adulthood.</p> <p>3rd year internship at Crédit Agricole, which allowed her to confirm in the field her theoretical interest for Economics and Financial Management.</p>	<p>Very positive. This curriculum allowed her to discover her passion for Economics and Financial Management, where she wants to work.</p>
CD (F, ISEN)	<p>Surprisingly happy discovery of computer programming, whilst she thought she was not cut out for this.</p> <p>Extra-curricular activities: Vice-presidence of the Student Arts Association, and working as a waitress in a restaurant: strong human experiences which helped her to grow socially and personally and to learn practical management.</p> <p>Choice of the specializing Master, just because of its specific pedagogy based on project learning with real partner companies, and its mix of technology and management: it was the first time she could feel a real passion for her studies!</p>	<p>Very happy of these 5 years curriculum, and amazed at what she received.</p> <p>Really supporting professors, even in case of personal difficulties.</p> <p>She has now found her own path, and doesn't need any more to "compare herself to her parents who studied in the most famous Business Schools".</p>

MH2 (M, ISEN)	Humanities (communication skills, conflict management) Elective Learning Units: entrepreneurship, corporate commercial management	A globally good higher education with interesting good level courses, providing tools for an autonomous lifelong learning
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4 A KIND OF CONCLUSION

4.1 A surprise: all students, even the most floating, stepped into the engineer's shoes

One of the first questions we asked to our students during this last interview was to give their own definition of an engineer. Rather surprisingly, the various answers were quite convergent¹³. All of them gave elements such as: an engineer is a multi-skilled professional (sciences, technology, methodology, management, human competences), able to adapt quickly to changing circumstances and various environments, provided with a specific problem-solving methodology using broad technical and non-technical culture and knowledge, with the ability to get by oneself the missing knowledge, someone who has acquired a typical way of thinking – even in his non-professional life. Quite surprisingly too, these definitions dovetail with the “official discourse” of GEIs directors or companies hiring engineers¹⁴. These students were not reluctant at all to say that they were feeling totally at ease in this model, and were showing a real passion in their sayings. Three students (MB, CL and MH2) mentioned explicitly some kind of social responsibility of the engineer; this may be regarded as rather encouraging for Ethics professors!

4.2 About the individual paths

The first striking observation is that all surveyed students, at the end of their 5-year curriculum, even the most “floating” ones (first Ideal Type), did happily find their own way of being true engineers.

When one looks closer at the individual paths, some unexpected emergences do appear (MP, MD, CD), mainly for initially “floating” students. For others, the initial orientation was confirmed (MB, MH1), or (sometimes slightly) redirected (MD, CL, JB, MH2).

Nevertheless, keeping in mind the possible influence of some social determinants, it appears that MH1, son of a farmer, did not imagine that he could dare to become an engineer in another world than his native milieu. In a similar way, MD, from a modest rural family, moreover being a woman, did not dare to enter HEI because she had not enough self-confidence to cope with an interview (HEI), or to project herself in a very masculine professional world (ISEN). Neither did she consider a risky career (at the beginning, she was considering working in the area of public research – a very secure and quite traditionally feminized career; at the end, she will quite probably spend her career working in the same bank, a quite traditionally feminized career too). These pathways are of course nice examples of upward social mobility. But dreams of aeronautical engineering (whilst being a woman - MP), entrepreneurship (MB, MH2) or high level business management (whilst being a woman - CD) are reserved for students coming from more culturally and economically doted “milieus”.

¹³ Because of this strong convergence, we preferred not to report the various answers to this question in Table 5, but to give a synthesis of these answers here below.

¹⁴ See the comments made by a director of a GEI and by the Human Resources Director of Alten, an Engineering and technology consultancy company, in: *Le Monde* [5]

4.3 Decisive elements in the curriculum

From all the interviews, it appears that, except for one student (MD, who discovered Economics and Financial Management), theoretical courses do not really help to find one's own path. Afterwards, they are seen as highly necessary, but rather boring.

The decisive elements and devices are: internships, Study abroad semesters, project-based learning with real partner companies, multidisciplinary approaches, and “extraordinary” experiences (4-months Gap, working as a waitress, associative involvement).

A happy finding at the end of this modest study could be that, year in and year out; French GEIs with a 5-year continuous curriculum do finally a good job¹⁵. Of course, the orientations chosen by the students are indeed conditioned in some way by their original milieu. Maybe an emphasis on self-confidence acquisition, through humanities classes, role playing, etc. could help. But the most important point is that several students find their own path only “by chance”, and that others find some taste to their studies quite late, after some internship, Study abroad semester, or because of “unconventional” pedagogical devices.

We hope that our observations could serve as a contribution for a re-evaluation of the global pedagogy in French GEIs.

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¹⁵ We would not readily extend this kind of conclusion to all types of GEIs : at a first sight, our observations from the last interviews with students who passed through the canonical system “Preparatory classes to GEIs” and “concours”, and then are studying in 3- or 4-years curriculum GEIs would not allow us to be as positively categorical as here