

Entrepreneurship and Engineers: how to develop the spirit?

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ABSTRACT

This research takes place in the higher education system in engineering schools and the aim is to measure engineers' mindset changes and their attitude changes after a special new entrepreneurship programme.

This paper first introduces the French higher education system and highlights entrepreneurship education in engineering schools. It also presents the way we consider entrepreneurship, i.e. not only the way to start a business but more broadly, as a "state of mind" in the sense of becoming more entrepreneurial in every action. Then the paper presents three entrepreneurship education new actions in three different engineering schools. The next part of the paper explains our study in order to measure the 4 following criterias: how engineers understand the interactivity between different functions in a company, how they understand who is an entrepreneur, what is the state of their skills before and after the training and finally their career intentions.

This study allows to draw some conclusions, to outline recommendations and raise new questions for the future.

Keywords: Entrepreneurship education in higher education, engineers' intentions, entrepreneurial attitudes.

¿Cómo desarrollar el espíritu emprendedor en los ingenieros?

RESUMEN

En el presente artículo se analizan las motivaciones y la actitud de los estudiantes de ingenierías en Francia frente a un nuevo programa de fomento de la empresariedad.

Tras una primera introducción donde se revisa el sistema de educación superior en Francia, y específicamente a los estudios de ingeniería, así como el concepto de empresariedad que se utilizará a lo largo del artículo, se analizan tres acciones específicas de fomento de la actitud empresarial desarrolladas en otras tantas escuelas de ingeniería. A continuación, se presenta el estudio realizado, y cuyo objetivo básico era el análisis de cuatro dimensiones alternativas: ¿Cómo interpretan los ingenieros la interacción entre las diferentes funciones en una empresa?, ¿Cómo ven a los empresarios? ¿cómo son sus habilidades empresariales, antes y depuse del programa de formación? y, finalmente, ¿Cuál son sus intenciones profesionales?.

El estudio realizado ha permitido extraer algunas conclusiones de tipo general, así como el planteamiento de algunas recomendaciones, al tiempo que ha planteado nuevas cuestiones abiertas para analizar en el futuro.

Palabras clave: Empresariedad, educación superior, intenciones de los ingenieros, actitudes empresariales.

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1. INTRODUCTION

The 21st century could be characterised by knowledge-based and multicultural environment. Thus, economic growth depends on both high technology and entrepreneurship. If we agree with the proposition that entrepreneurship education could be a good opportunity for engineers to access to top careers, by increasing their business and entrepreneurial skills. They are effectively very reactive problems solvers and already possess the analytical tools to succeed in business. Thus, in a multicultural, multifunctional operating environment, the need for flexibility points to an increasing role for entrepreneurial activity.

The thematic of this paper is to point out how entrepreneurship education can help engineers for their studies, career and life.

This paper first introduces the French higher education system and highlights entrepreneurship education in engineering schools. It also presents the way we consider entrepreneurship, i.e. not only the way to start a business but more broadly, as a “state of mind” in the sense of becoming more entrepreneurial in every action. Then the paper presents three entrepreneurship education new actions in three different engineering schools. The next part of the paper explains our study in order to measure the 4 following criterias: how engineers understand the interactivity between different functions in a company, how they understand who is an entrepreneur, what is the state of their skills before and after the training and finally their career intentions.

This study allows to draw some conclusions, to outline recommendations and raise new questions for the future.

2. FRENCH HIGHER EDUCATION SYSTEM

The French higher education system is currently undergoing a great reform, which aims to harmonize it according to the Bologna process. Since September 2005, all universities and all other higher education establishments¹ are in this new operating mode, in conformity with the international system, Bachelor-Master-Doctorate, known in France as “LMD” for “*Licence-Master-Doctorate*” that is to say three years education for bachelor, five for master and eight for a doctoral degree.

The following figure 1 describes the old system and the new one, which will be clearer to understand and in order to make comparisons with other higher education systems from other countries.

¹ All the universities, higher schools and other schools are also called education establishments.

Figure 1 . French higher education system in the universities

PhD	8	Doctorate (PhD)
	7	
	6	
Research degree (called DEA) or Professional Degree (called DESS) in the universities or Master in Business Schools and Engineering degree in Engineering schools	5	Master
Master (called Maîtrise) In the universities	4	
Bachelor (called Licence) In the universities	3	Bachelor
Preparatory years or 2 years degree (DEUG or BTS)	2	
	1	
<i>Old system</i>	<i>years</i>	<i>Bologna Reform</i>

Compared to the previous system, the new system will considerably simplify the complexity of our educational system. In the old system, after obtaining the A-levels (“*Baccalauréat*”), the students could attend different degrees in different kind of higher education establishments.

They could attend:

- a three years programme in engineering or business schools and in “*Grandes Ecoles*” after two preparatory years,
- a two years programme (called DUT) in the Institute of Technology or higher level technicians in secondary schools (called BTS),
- a two (DEUG), three (Licence), four (Maîtrise) or five (DEA or DESS) years programme at the university and a PhD after eight years.

The French higher education system has 80 universities, 230 business schools and 230 engineering schools. In 2003, out of the 2.3 million students, they are 63.2 per cent in the universities, 3.2 per cent in the engineering schools and 3.6 per cent in the business schools ². Women represent 56.4 per cent of all the students. The number of students in 2003 increased by 2.1 per cent compared to 2002 because of

² The others students are in the Institutes of Technology, in the secondary schools or in special or private ones.

a strong increase at the universities (+2.8 per cent), in the engineering schools (+2.5 per cent), even though it is the weakest increase since 1996-97 in these schools, and in the business schools (+8 per cent).

3. ENTREPRENEURSHIP EDUCATION

Since the end of the 1990's in many countries, enterprise education has become an important part of both industrial policy and educational policy. In Europe, the "enterprise culture" has become the *sine qua non* of political response to globalization. At this time, the most typical objective of the programmes was to increase the 'number of start-ups' and it became more and more focused on the development of the entrepreneurial spirit.

Most of the initiatives in entrepreneurship education in Europe emerged from the business school sector (Gibb 2002). More, entrepreneurship programmes in higher French education were mainly focused upon business students as opposed to being more broadly spread across the universities and the engineering schools (Beranger 1998, Levie 2000).

In these conditions, OPPE³ data base has for the moment identified 40 engineering schools which offer 55 entrepreneurship education actions: 21 with the aim to sensitize students, 30 to train them and 4 to support them to start a business.

4. ABOUT THE CONCEPT OF ENTREPRENEURSHIP

The concept of entrepreneurship has always been a problem, between the idea of small independent business and a broader conception.

Entrepreneurship could effectively been considered as:

- The specific activity of business formation and small business management,
- A new style of managerial behaviour in established organisations,
- A more general, and loosely defined, new attitude towards work and leisure (Williams and Turnbull, 1997).

In the USA by mid-1985, entrepreneurship became an academic discipline and expanded considerably. As it expands, entrepreneurial studies will experience some basic changes. This new pedagogy marks a new era of entrepreneurial education (Ronstadt, 1985).

³ OPPE is a new observatory (created in 2002) of the entrepreneurship education actions, hosted by APCE (French Agency for Promotion of Firm Creation).

A major issue in Europe seems to be the simplistic divide between entrepreneurship as an “activity” and as an academic subject (Beranger, 1998). This is sometimes encapsulated as the balance of programmes between whether they are “for” entrepreneurship as opposed as “about” entrepreneurship (Levie, 2000). This dichotomy leads on to a view that activity-based learning focused on an output cannot be academic, whereas traditional teaching with its focus on the “about” and with its use of cases and simulations is acceptable. Even project-based learning in some cases can indeed be criticized for the looseness of its link with an “entrepreneurial” approach (Laukkanen, 1997), as the use of cases (Gibb, 1994, 2002).

More and more, a wide conception of entrepreneurship appeared. So, confusion between these two conceptions concerns both the definition itself and the objectives of entrepreneurship education. At the beginning, entrepreneurship was more considered in a narrow sense of creating and selling new ideas and building new businesses – described by Mendes of the Kauffman Foundation- as “the ability to channel creative innovations into ventures that have value”.

Step by step, this vision became more wider and we can define it with the three sets of aims defined by Gibb (1999), as following:

- “the first objective is to develop a broad understanding of entrepreneurship”, and specifically of the role that entrepreneurs and entrepreneurship play in modern economies and societies;
- the second objective is “learning to become entrepreneurial”, to take responsibility;
- the third objective is to learn “how to be an entrepreneur” by learning how to start a business.

Nowadays, programme objectives included the specific objective of creating more entrepreneurial individuals who will act as independent entrepreneurs and preparing individuals for a world where they will increasingly need to manage their own careers and lives in an entrepreneurial way (Hitty, O’Gorman, 2004).

In the same time, the focus of entrepreneurship teaching and research moved away from the narrow business orientation towards the notion of the development of the enterprising person in a wide range of contexts and the design of organisations of all kinds to facilitate appropriate levels of “effective” entrepreneurial behaviour (Gibb, 1994, 2002; Léger-Jarniou, 2004). Our paper is in accordance with this last conception of entrepreneurship.

5. OUR ACTIONS IN 3 ENGINEERING SCHOOLS

We introduced a new programme in three engineering schools: two public and famous ones (ENSCP and ENSTA) and a very good private one (ECE). The presentation of the three schools will be followed by the description of our programmes and objectives.

✓ ENSCP Ecole Nationale Supérieure de Chimie de Paris

ENSCP is a school for generalist engineers in chemistry with a mission to enhance an engineer's education with training through research, to match with the needs of industry, and to work in close partnership with industrialists. The objective is to train high-level generalist engineers in chemistry (computerized tools and modelization, industrial management (human sciences, economic management), innovation and creativity) who are internationally competitive and capable of adapting to all positions in large enterprises and high-tech small and medium-sized companies.

The selection process of its students is excellent. ENSCP is one of the founding members of ParisTech ("Paris Institute of Technology"). The school is also a member of the Confederation of Engineering Schools (CGE) and the Conference of Engineering Schools of the Ministry of National Education (CDEFI). In addition, ENSCP belongs to the Gay-Lussac Federation which links French engineering schools of chemistry and chemical engineering with professional organizations. ENSCP belongs to the Life Science group of the Montagne Sainte-Genevieve (Life Chemistry). It houses a business start-up facility and is a member of the Agoranov incubator.

With over 250 academics and researchers (140 full-time) the ENSCP is among the largest French public research centres in the field of chemistry and related areas.

Some key figures:

- 233 students
- 90 doctoral and post-doctoral candidates
- 50 teachers and researchers, 17 of whom are professors
- 37 CNRS or INSERM researchers
- 15 visiting lecturers
- 100 engineers, administrative technicians
- 8 research laboratories
- 180 publications per year
- 6 patents per year

✓ ENSTA Ecole Nationale Supérieure des Techniques Avancées

Originally founded in 1741, the École du Génie Maritime merged with four other schools in 1970 to become ENSTA which is today one of the top 10 institutes of higher education for engineering in France. Its students are selected from among the brightest science students of each generation. ENSTA offers high-level training in science, excellent research facilities, an international network and numerous extra-curricular activities.

ENSTA is recognized by industry and the public at large as one of the foremost higher education institutes in France, which are usually referred to as the 'Grandes Écoles'.

The **engineering programme at ENSTA** combines high-level academic training, research projects and industrial internships and aims at developing the students' ability to innovate. ENSTA students also receive training in economics, management, humanities, communication and ethics, ensuring the well-rounded education of future industrial managers and decision-makers.

ENSTA graduates are among the best paid engineers in France in all these sectors: transportation systems, offshore and naval architecture, space propulsion, chemical engineering, electronuclear energy, environment, oceanography, production systems, information systems, multimedia and communications, robotics and embedded systems, optimisation and operational research, finance, system Control and system modelling.

✓ The ECE Group Central School of Electronics

ECE is specialized in the higher education in the field of the TIC - Communication and Information Technologies. ECE was created 85 years ago and in 1990 obtained the recognition by the state authorities of the diploma "engineer ECE".

Today, ECE provides courses on information technologies and communication used by the majority of the companies (data-processing, embarked telecoms, networks, electronics, systems) but also those applied to the most carrying branches of industry: market finance, risk management, electronic money, the intelligent habitat with the service of mobility, top - flow, E-business or wireless. Without claiming to remain the one completed time old pioneers, ECE attaches much importance to put students at the heart of emergent technologies and to give them the taste to discover and undertake.

Some key figures:

- 1161 students over 5 years
- 100 possible courses
- 38% of the students with international mobility
- 29 student's associations
- Partnership with 24 foreign universities
- 8 possible MSc and 6 DEA in last year
- 3 technological major degrees (over 2 years)
- 4 practical training periods (12 months)
- 2 obligatory seminars in Great Britain

In ENSCP and ENSTA, entrepreneurship courses are part of the cursus for the 2nd and 3rd year students. In ECE, they are one of the 6 options the 2nd year students could choose.

The new entrepreneurship programmes started 6 years ago in ENSCP and since 2004 in ENSTA and ECE.

The table 1 describes the number of students and the status of the entrepreneurship programme.

Table 1. Informations on the different programmes

	ENSCP	ENSTA	ECE
Number of students per year	100	46	48
Status of the programme	Obligatory	Obligatory	Option
Duration	6 days (36 h)	6 half days (21 h)	15 half days (60 h)
Year in the cursus (undergraduate)	3rd year	2nd year	2nd year

Our objectives

We started with the idea that high level engineers need to understand business and entrepreneurship. Engineers who understand and apply the key driving forces of business in their sphere of influence are tomorrow's best management candidates. Reaching top corporate management requires years of experience and additional business education. However, those who manage their engineering careers as entrepreneurs from the start will enjoy a higher probability of advancing within the company. Because new engineers may not initially see their direct link to company financial performance, they may become complacent and assume that their job is somehow exempt from the world of investment returns.

Skill development of new generations of engineers and managers is important; economic growth depends on both high technology and entrepreneurship.

Entrepreneurship for engineers

One of the most rapidly growing areas in entrepreneurship education involves the interface between entrepreneurship and such technical fields as the engineering disciplines, chemistry, physics, biology, and computer science. Especially in a technology ages, these disciplines represent vital sources of entrepreneurs with high potential business concepts. Moreover, students from these disciplines play an increasingly prominent role in start-ups of all sorts. While business schools have made some progress in developing curricula that serves the needs of students in science and technology, many of the most exciting developments are occurring outside the business school. And, as Cunningham (1991) noticed, if one accepts the professional performance is a function of the successful combination of knowledge, skills and attitudes, then typically business schools have focused on the first, largely ignored the second and assumed the third.

By nature, engineers are problem solvers who take great pride in designing comprehensive solutions. Entrepreneurship is a state of mind, where investment, risk and return are all factored into the duties you perform for your employer. Engineers already possess the analytical tools necessary to succeed in business. By increasing those tools with business knowledge and strong communication skills, engineers can deliver optimal returns to their companies and also to themselves.

Fortunately, engineering education provides an excellent basis for understanding entrepreneurship concepts. For example, the principles of conserving mass, energy and momentum can be applied directly to money. The same remark can be applied for the return on investment or the ratio of profits to investments (Arnold, 2002).

Now there is a large acceptance that entrepreneurship is a “process that can be learned and hence his teachable” (Drucker, 1985). A wide range of stakeholders are being confronted with the need for entrepreneurial behaviour, potentially everyone in the community. Entrepreneurship is therefore not solely the prerogative of business (Gibb, 2002). It is becoming more commonly understood and accepted that engineers need business, social, and interpersonal skills to operate effectively in the organizational environments in which they work (Gokhale, 1995). An engineer must also understand the interaction among technology, organization, and people critical to successful implementation of innovation. Being able to communicate with other professionals and with business and civic leaders is a key to successful engineering innovation and practice. It is also important to be able to lead and follow in cross functional teams.

Furthermore, the concept of process is well-known by engineers (Ronstadt, 1985). So, entrepreneurship education based on process could easily be taught to this audience.

Our programme

The course provides participants the opportunity to blend their acquired academic knowledge in engineering, their personal skills and life experiences, and to apply it by creating and testing the feasibility of a business opportunity they have chosen. Business entrepreneurship focuses on the concepts, skills, know-how, information, attitudes, and alternatives that are relevant for starting a business.

In the three schools, the objective is to make students discover and understand entrepreneurship and its links with business and their future job. The main point is to develop their entrepreneurial spirit for their future career, in a word, to let them becoming more entrepreneurial in their manners.

There is now a consensus that enterprise education should take the entrepreneurship process as the starting point” (Gibb, 1993; Gibb and Cotton, 1998) and be based on the action-learning approach (Jones-Evans et al., 2000; Leitch and Harrison, 1999; P Jack and Anderson, 1999; Fiet, 2001).

Our programme adopts an “action learning” method where action learning is defined as a means of development, intellectual, emotional or physical that requires

its subjects, through responsible involvement in some real, complex and stressful problem to achieve change to improve their observable behaviour henceforth in the problem field. In this case, students take the primary role because the programme is based on team work and project work with the minimum of teacher's supervision and intervention and coaches.

The practice of enterprise education is one that requires a blend of knowledge, skills and attitudes which recognises the synergistic links between management theory and entrepreneurial practice. It acknowledges the need for the development of both "hard" and "soft" skills simultaneously throughout the period of education and beyond.

The main purpose of this program is to develop this "praxis" style of management education and to focus its application to that of the encouragement of entrepreneurial activity in its many forms.

These include opportunity seeking, initiative taking, making things happen independently, problems solving, and risk taking, commitment to work and tasks, the ability to cope with others, enjoy uncertainty and ambiguity, self-awareness, self-confidence, creativity-perseverance, persuasiveness, resourcefulness, negotiating skills motivation and commitment to achieve (Jones-Evans et al., 2000).

In this way, the real knowledge (defined by Carl Rogers) is more easily obtained when it is "linked to situations that are viewed as problems". In these conditions, the students get knowledge in discovering by themselves.

The programmes

After a short presentation of the objectives of the programme and the way to manage the course, we distribute the students some synthetic notes and a "road book" to help them to work by team.

Team work is organized step by step to facilitate their work on:

- the team to built
- the ideas and the project on which to work
- the market and the business model to define
- the industrial property (in ENSCP)
- the finance.

Students work to make a business plan on the idea they have chosen and prepare its presentation of 15 minutes at the end of the course. Students work by team in the classroom and outside (field studies) and we are facilitators of their experience. They have timetable to respect and documents to produce at each step of the construction of their business plan, but they can organize their team and their time as they need.

At ENSCP and ECE, a conference is also organized in order to discuss with an entrepreneur, based on the role model theory.

Our study

This research is the first step of a larger study among engineering students. The aim is to measure their mindset changes and their attitude changes after the programme.

The evaluation of entrepreneurship programmes is still a question as B  chard and Toulouse already pointed it out in 1998. The questions are still valid: which impact have the programmes in students? Is a relation between programmes (content, teaching methods, etc.) and the intention to start a business? Or Is a relation between programmes and attitude? Do the antecedents (values, knowledge, etc.) have an influence on behaviour and/or attitude? And which indicators should be used? and How to measure them?

A large number of studies on intentions have now been realised on different populations, with comparisons or not, using Shapero's model (L  ger-Jarniou et Klapper, 2004; Linan, 2005) or Ajzen's model (Fayolle, 2004).

This time for this study, we did not want to use one of these models but just tried to identify the variables which could make the difference. The review of the literature gave us ideas to select these criteria.

Herrington (2002) for example argued that four competencies are fundamental:

- to know oneself and work with others;
- to design, build, and implement high value-added systems;
- to identify and solve unstructured problems; and
- to lead change. The coalition emphasizes reality-based, authentic learning situations, where students can take risks, be challenged in meaningful ways, and achieve genuine outcomes.

The review of the literature let us imagine that the following criterias could be very significant to measure the evolution of their skills before and after the programme:

- Seeking opportunities
- Taking initiatives
- Having the ability to cope with others
- Developing self-awareness
- Developing self-confidence
- Increasing creativity
- Taking in account a multidisciplinary vision
- Learning how to negotiate
- Improving communication skills.

We also wanted to measure:

- The understanding' students of the interactivity between different functions in a company before and after the programme,
- Their understanding of who is an entrepreneur, and
- Their career intention before and after the programme.

A questionnaire has been administrated to all the students (auto-administration). All of them answered, so we got 194 valid questionnaires (see in figure 1 the number and the status of the students). All the questions were based on a Likert scale from 1 (low) to 7 (high). The answers showed in tables 1, 2, 3 4 and 5 are an average of all the Likert results. The aim was to compare the results between the students' answers of these three schools and to measure them before and after the programme.

The results

The first results are detailed below.

1. Understanding the interactivity between different functions in a company

Table 2. Interactivity measure

	ENSTA			ENSCP			ECE		
	Before	After	Δ	Before	After	Δ	Before	After	Δ
Level of interactivity	2	6	+4	2	6	+4	4	6	+2

The two major results from this question are the following:

- They all have understood that, in a company, all the functions are linked if we want to succeed in a project. In ENSTA and ENSCP, we have + 4 on 7 and in ECE + 2 on 7. They identified that sometimes they did not have the solution and the solution could come from the market or from other people out of their group. Thus, there is not a real hierarchy between the functions. Human resources and creativity are for example as important as finance and engineering knowledge. It depends of the type of the project and the hierarchy of importance changes as the project evolves.
- The second result is that they discovered that “engineers are not always the bosses”, as they frequently thought. Furthermore, they realised that if they want to have a brilliant career, they must communicate with others and in that case, engineering language is not the only one in a firm.

2. Understanding who is an entrepreneur

Table 3. Entrepreneur's meaning

	ENSTA	ENSCP	ECE
Autonomy	6	6	7
Capability	5	5	6
Creativity	3	4	5
Decision-making	4	5	6
Risk-taking	5	5	6
Ambitious	6	6	6
Money maker	7	6	7
Hard worker	5	5	6
Security	1	2	2

The word *entrepreneur* is derived from a French word meaning *to undertake*, and is defined in Webster's dictionary as *one who directs a business undertaking, assuming the risk for the sake of the profit*. Entrepreneurs seem to thrive in chaotic and uncertain climates far removed from the orderly and methodical world of engineers, where calculations and data are applied to design solutions that eliminate uncertainty and risk.

The entrepreneur is generally described as one who demonstrates behaviours such as creativity, initiative taking, energising events, leading others, thinking of new ways of doing things and as a money maker.

Entrepreneurship culture is not yet so much developed in France and especially in engineers' population, as we noticed. So, we can see here a difference between public (ENSTA and ENSCP) and private (ECE) students.

Then, quite all responses are higher (on 7) in ECE.

The four major characteristics are the fact that entrepreneurs are:

- people with large autonomy (answers 6 and 7 on 7),
- money makers (same results)
- in a non security position (answer 1 and 2 on 7): they take risks and
- are ambitious (answer 6 on 7).

In this part of the study, we must consider these answers are students's meanings about entrepreneurs in general. Note that some students know or have entrepreneurs in their family and some do not know one of them in particular. These answers were obtained at the end of the programme. We did not try to compare before and after the programme. In ENSCP and ECE, a conference of an entrepreneur has been made.

Anyway, these figures are quite similar to the French idea of who is an entrepreneur, even if we can see some little changes since a few years.

3. State of their skills

Table 4. Students' skills changes

	ENSTA			ENSCP			ECE		
	Before	After	Δ	Before	After	Δ	Before	After	Δ
Seeking opportunities	3	4	+1	3	5	+2	4	5	+1
Taking initiatives	4	6	+2	4	6	+2	3	5	+2
Having the ability to cope with others	5	6	+1	5	6	+1	3	5	+2
Developing self-awareness	3	4	+1	4	6	+2	3	5	+2
Developing self-confidence	6	5	-1	5	5	0	6	5	-1
Increasing creativity	2	3	+1	2	4	+2	2	4	+2
Having a multidisciplinary vision	2	4	+2	2	4	+2	3	5	+2
Learning how to negotiate	2	4	+2	2	4	+2	3	4	+1
Improving communication skills	3	5	+2	3	5	+2	3	6	+3

In this question, we have measured here the mindset changes of the students after the programme.

The first result is the positive change in the criteria for all the students. The little change (+1 or +2) depends on their background (family, previous experience and programmes in their schools, etc.). We must also remind that the programmes are short ones and the changes cannot be very significant in these conditions. Furthermore, answers after the programmes were collected just at the end of the programmes themselves.

The second interesting result is the one about self-confidence in their competencies and especially in their engineering' competencies. These very selected students in these very famous schools are really self-confident young people (5 or 6 on 7). The ENSCP students did not change their position after the programme; it remains at 5 on 7. But, the ENSTA and ECE students have changed and are a little less confident after the programme. This result is to be linked with the one on understanding the interactivity of the different functions in a company. This interactivity makes them

becoming less self-confident because decision relies on different kind of people and not only on engineers. Furthermore, they know they are not very well trained on management for example.

4. Their career intention

Table 5. Career intention

%	ENSTA			ENSCP			ECE		
	Before	After	Δ	Before	After	Δ	Before	After	Δ
Employee	75	75	0	77	76	-1	70	70	0
Own business	1	1	0	3	4	+1	10	15	+5
Research	19	19	0	15	15	0	5	5	0
Do not know	5	5	0	5	5	0	15	10	-5

Throughout the world, student interest in entrepreneurship as a career choice is growing (Brenner et al., 1991; Hart et Harrison, 1992; Fleming, 1994; Kolvereid, 1996), while interest in traditional professional employment in big business is gradually declining (Kolvereid, 1996).

The majority of these students imagine their career as employees and in research centres. These figures are typically French ones, where about 3% only of the students of the most famous schools want to create a business. There is a negative correlation between the high level of the school and their willing to become entrepreneur.

The other positive information is that, even after a short entrepreneurship programme, the students who are in relation with firms and business increase their intention to create their own business (from 3 to 4% in ENSCP and 10 to 15% in ECE).

We can see here a huge difference between the students in public and in private schools. The ENSCP students are in the middle because they are frequently in relation with large companies. The ECE students are the one more inspired by their own business. A short entrepreneurship programme based on the idea to let them know what is business and to increase their entrepreneurial spirit can change them a little and above all do not frighten them about business.

6. CONCLUSION

This paper is the first step of a wider study on engineers' state of mind about entrepreneurship. Our study wanted to measure their mindset changes and their attitude changes after a new short entrepreneurship programme.

The idea was to measure these changes, based on the idea that entrepreneurship education and training influence both current behaviour and future intentions (Kolvereid, Moen, 1997; Tkachev, Kolvereid, 1999; Fayolle, 2004). In other words, there are significant differences between students who have taken entrepreneurship courses and those who have not.

Attempts have been made to compare the intentions and/or behaviours of students from different groups. For example, Varela and Jimenez (2001), in a longitudinal study, chose groups of students from five programs in three universities in Columbia. They found that the highest entrepreneurship rates were achieved in the universities that had invested the most in entrepreneurship guidance and training for their students.

Noel (2001) looked specifically at the impact of entrepreneurship training on the development of entrepreneurial intention and the perception of self-efficacy. Noel's findings at least partially confirmed the assumption that the entrepreneurship graduates were more likely to launch businesses and had a higher level of intention and a more developed perception of self-efficacy than students in the other two groups.

Some other empirical researches had shown that the presence of entrepreneurship education programs and a positive image of entrepreneurs within the cursus are both incentives for students to choose an entrepreneurial career. For example, Johannisson (1991) and Autio et al. (1997) underscored the positive impact of students' perceptions of entrepreneurship as a career choice, along with the role played by the resources and other support mechanisms available in the university environment. Other research has shown the importance of the social status of entrepreneurial activities and situations (Begley et al., 1997) and the statistical link between the level of entrepreneurial intention and the number of management courses taken by students enrolled in other programs (Chen et al., 1998).

Our study confirms some changes in career' intentions. Furthermore, we found that entrepreneurship programmes let students imagine the interactivity between the different functions in a firm which is, for us, an interesting result to link with their careers' intentions in large companies. They will be obliged to work and to cope with others and to understand the others' logic way of thinking and doing. Especially with engineers, another challenge is to distance the "subject" from its heroic ideology and association with business and market liberalisation philosophy as Gibb noticed (2002).

Another interesting point, in relation with the previous one, is the difference in their self-confidence after being obliged to make thinks together and to produce documents and a presentation of their work.

The last point is to consider that the ECE students have chosen this programme on a voluntary basis, while in the other two cases the programme was an obligatory one. We can imagine that the first students could be more receptive to the contents of a course they have chosen.

But, as we said, this is the first step of a wider study. We have now to confirm these results with other students in the same schools. And above all, we have to realise

interviews with some of them to better understand their answers. For example, the relation between their family background and their answers about who is an entrepreneur must be deeper analysed. The same remark concerns their previous experiences with companies or job. We must also deeper understand what they really mean with the term of interactivity and with all the characteristics concerning the state of their skills. After this second part of the study, our conclusions will be more detailed and precise.

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