Convergence between French Multidisciplinary engineer curriculum and Chinese Bachelor degree: application to the project activity

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Abstract： Multidisciplinary engineering has a long history in French “Grande Ecole” system. Ecole Centrale Paris (ECP) is one of the most famous “Grande Ecole”. In 2005, Beihang University and Group of Ecole Centrale has signed an agreement to cooperate in the construction of Ecole Centrale Beijing.

The differences, especially the advantages in both sides have been investigated through a comparison of the bachelor project ideas between French “Grande Ecole” and Chinese traditional high-education. The common points and the merits of Chinese university and French “Grande Ecole” are exposed. After several years, a new method has been used to student’s bachelor project, taking into account the Beihang traditional curriculum system and the advantages of Ecole Centrale which pays attention to business practice, and team work. With 4 years working, results sound promising.

This paper, is divided in three parts: i) a presentation of the Bahelor project activity in Beihang University ii) a presentation of the project activity in one institution of the Group of Ecole Centrale, the case of ECP ; iii) the concept we have developped at ECPk.

Key words: Multidisciplinary Engineering, Bachelor Project, Companies, Team Work

Project activity is one of the most important activity in the final year of the Bachelor in a Chinese University as well as in the first year of a French engineering « Grande Ecole ». Under a same name « project activity » different goals, different organizations exist. As a starting point, one can observe that the Bachelor project corresponds to the last activity of a cycle, leading to the Bachelor graduation, while the project activity in the first year engineering school is one of the first activities of a three years curriculum.

From the Chinese side, Bachelor project help students to summarize and digest what they have learnt, to finish the elementary scientific research and engineering design, to master the fundamental scientific paper writing method. At last, the students will get the synthetic ability of theory and practice, the individual ability to solve an actual problem under the direction of their Bachelor tutor. On the basis of regulations of the People’s Republic of China on academic degrees, the students can be graduated only by have finished their bachelor project and public reply successes.

From the French side, project activity is mainly used to confront students at a team-work activity, to face to a client need (generaly a company), to develop autonomy, leadership, and to confront them to take risks. This is the first time that students are exposed to such context. They will have the occasion to redo such experience during the 2nd and the 3rd year of their engineering activity.

1. -Traditional Bachelor Project in Beihang University

Traditional bachelor project process

The traditional bachelor project process is divided in 6 parts: subject selection, opening subject, design research and intermediate inspection, report written, open reply and the evaluation of the report. Generally, the project is finished individually. The subject is proposed by a researcher-teacher, the students select one and discuss with their

tutor. Then they begin their project research. After 6-9 months, they have to finish a graduate thesis in about 25-30 pages in Chinese (with an abstract in English) and well succeeded a public defense.

Problem of the Traditional Bachelor Project system

During the Traditional Bachelor Project system, one frequently observed that supervisors assign the topic, introduce the solution to apply the problems and even the concrete steps, so the students accept and carry out their topic passively. More concretely, one can define three main points:

A, the topic selected corresponds to one part of the supervisor's research work therefore some topic is oversized or uncertainty. Generally, the topics type could be far from an engineering experience.

B, during the research step, the students have make huge efforts to understand the background of the subject and their deep theories.

C, generally, students have finished their internship and thesis individual, so, during their 4 years bachelor study, they have no chance to work in team and not be able to be trained the team-work experience.

In order to improve our bachelor project cultivate model and deep-going the pedagogic innovation in bachelor project, the Project Activity mode in Ecole Centrale de Paris has been used for reference.

2. Project Activity in the first year of Ecole Centrale Paris

In project activity system of Ecole Centrale de Paris, in order to imitated the real companies' work environment, the students were divided by 5 students/group randomly, the students have to be familiar with their classmates, so that their team spirit and team work communication experience can be trained. Companies proposed a subject and their problems to be solved, engineer is therefore the client who has a need. With searching for the optimum solution, students are trained to find key problems, to solve problems and to combine knowledge and realities.

French engineering school has a long tradition to cooperate with industries, especially for Ecole Centrale Paris founded during the Industrial Revolution in Europe. The industries involve in practically all lift of the school such as the representative member in the Jointed Management Committee, definition of the training program, engagement of the their experimented employee to give lecture in the school, offer internship and subjects for project activity, aso…

At ECP, the first part of the project activity consist in a serie of conferences in order to help students: i) Better understand their future role as engineers facing 21st century challenges ii) Discover in depth one of the many challenges they could have to work on during their career, iii) Tackle fuzzy problems and uncertainty, iv) Work in team on a real project. The seven thematics studied are the following: Economic mutations, Energy, Environment, Health and biotechnologies, Information and knowledge, Territory: sustainable construction, Transportation and mobility. Practically the organization is the following: i) General introduction seminars to each of the challenges (six 3-hr seminars) ii) Conferences on one of the challenges (eight to ten 1.5-hr conferences) iii) Bibliographic study on one of the challenges iv) A team project, continued next semester. Each challenge is directed by professionals from academia (Référent Enjeu Interne or REI) and industry (Référent Enjeu Externe or REE).

The team project has the following obhectives i) Develop the ability to work within a team ii) Develop a multi-disciplinary approach to problem solving: technical, economic, marketing, social, etc. iii) Expose students to complexity (fuzzy problems, multi-solutions problems) iv) Expose students to "real life" problems v) Apply techniques of problem solving, communication, etc. vi) Acquire knowledge in the field of the project.

On completion of the course, students should be able to i) better work within a team ii) increase their ability to deal with complexity iii) better communicate (written and oral communication) iv) have acquired knowledge on one of the global challenges v) solve problems with a 360° approach (technical, marketing, economical, social, etc.) vi) increase their ability to deal with fuzzy problems

Each project rolls with a team of 5 students chosen by their interest, and each team benefices a coach from the enterprise and a scientific reference from the school in order to ensure the scientific support if need. Project methodology is given through Workshops on Professional Development and Leadership (ADPL). Course Objectives are i) Develop a set of key skills to become an innovative engineer: teamwork, communication, complex problem solving and creativity ii) Move from a school paradigm into a professional one iii) Build one's

academic and career plan. On completion of the course, students should be able to i) work effectively in a team, ii) master the basics of oral / written communication, iii) master basics of problem solving iv) develop their professional project. ADPL help students to i) Develop a set of key skills to become an innovative engineer: Teamwork: organize, decide, manage within a team; team member roles; influence of character on team performance; Written and oral communication: structure and synthesis, increase written and oral impact, interpersonal communication, public speaking; Approach to solve complex problems: frame the issue; inductive, experimental and recursive approaches; doubt and complexity, Creativity: group creativity methods ii) Build one's academic and career plan : Discover the work of an engineer; Start anticipating one's professional career; Understand Centrale's curriculum choices iii) Move from a school paradigm into a professional one: From receiving a well-framed problem set, to framing yourself the problem, From understanding, to making real, From individual performance, to team performance, From certainty, to uncertainty. The activity is organized the first year with 5 seminars of 2 days in groups of 40 students supervised by 2 professors (academic or having a professional activity), with the support of invited speakers. 2,5 days are also shared in the whole year to help students to construct their professional project.

3. Concrete method and executive regulation of Ecole Centrale Pékin

Advantages and shortcoming of the 2 systems are summarized in the Table 1.

	Beihang Univercity	Ecole Centrale de Paris
Advantages	1. Able a very close relationship between the tutor and the student. 2. A simple way for implementation	1. Emphasizes the team cooperation 2. Close to reality of company
Shortcomings	1. No team cooperation 2. Topic tutor oriented than student tutor	1. Unable to inspect each person's working condition in the team 2. Imply a real ccoperation between the different people around the team

Table 1 Comparison the advantages and shortcoming of the bachelor project system between Beihang University and Ecole Centrale Paris

After a phase of discussion with the Chinese and French professors we have established answer to the following actions.

A, a team defense and an individual defense

Ecole Centrale Pekin mix the two project modes, and put forward a new mode. Students are grouped of 5 persons by interest; they chose a topic and work in close cooperation with an appropriate division of their labour. At last, they must finish a group thesis and a individual thesis respective, after succeed the group public reply and individual reply, they will acquire their bachelor degrees. The team defense is the place where students give to the client their answer to his nead. The motto is “ONE project for ONE client with A need and ONE anwer (through deliveries given by the student team).

B, Unify the industrial and academic topics

Considering the specificities in China, the French “project activities” mode could not be imported as it is in the traditional Chinese university training program. As a matter of fact, some modification and adaptation have been done in this direction. Generally speaking, Chinese universities mix the engineering training and academic career, it means some students are dedicated for a long research work and the others will be putted directly in the employment market. Moreover, the students in this level could not have a precious idea for their future career. The subjects of “project activities” in Centrale Pekin provided from both industrial and academic world. The percentage is around 50%/50%. This mode of function permit student to have more choices and to have different

experiment. The students that chosen an academic subject must be permuted their second project to an industrial one. This permutation allows the students for a better understanding of different careers.

The figure following indicate the topic distributions of class 2006-2009.

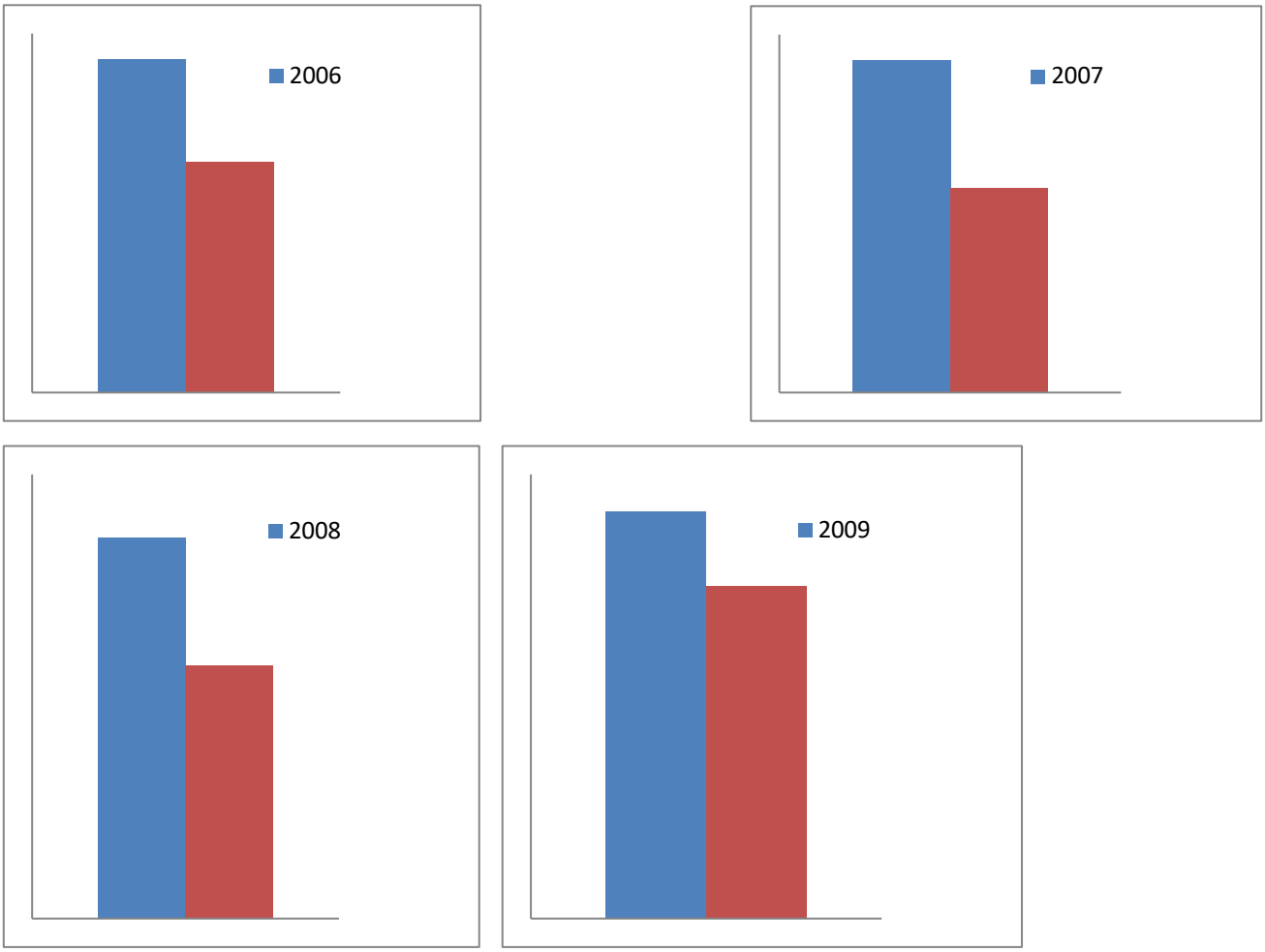

Figure1 Topic Distributions of Class 2006-2009, where blue represent academic topic, red represent industries topic.

C. During the Bachelor project, we focus mainly on capacity of students as well as the service for enterprises. Three parts could be identified in this process:

Opening defense

As mentioned therefore, the subjects provide from both industrial and academic world, called “client”. The “client” defines the title, the needs and the final deliverable. According to the requirement, the students must check the related information by themselves and identifier the tasks, and then a work planning, should be established with tasks’ repartition and the advancement for each step. This method allows motivating the students and a better comprehension of their subject. This process of opening defense permits the school to evaluate their work and the client to measure their satisfaction.

Middle evaluation

In order to ensure the good advancement of each project, the school organizes in the mi-term a middle evaluation. The client is invited to joint this control to identifier as soon as possible the difficulties for the project.

Final defense

At the end of the semester, the evaluation of the work is organized by two processes:

Group defense: with the presence of their client, the group must explain the background of the project, identifier the need of the client, define the way for the problem and finally, present their deliverable. The defense must be held in a European language (English and French) as well as the report.

Individual defense: to explain the contribution of their work to the whole project. For this part, the report could be

written in Chinese according the requirement of university.

4. Conclusion

With 5 years actualization of the new mode of bachelor project, we have succeeded enormously. The students have not only the group-working esprit, but also engineering experience training. They will be cultivated the international global engineers with multi-cultured, wide range knowledge and solid foundation. We hope that the mode of bachelor project can be intensive studied and widely popularized.

References

1. 林健，“卓越工程师教育培养计划”通用标准研制，清华大学工程教育研究中心;清华大学教育研究院;清华大学公共管理学院，高等工程教育研究，2010 年 4 期。 Lin Jian, "Porgram for Engineering formation of excellence", Tshinghua University, Engineering formation center of TshingHua， High Engineering Education research， 4,2010

2. 毛　帽，储召生，北航探索“通用”工程师教育新模式，中国教育报，2009 年 3 期。Mao Mao，Chu Zhaosheng，New model for general engineer formation in Beihang， China Eduacation Nouvelle， 3,2009

3.Jean DOREY，法国高等工程师教育解析，易起论文网（http://www.17net.net/Article/Class29/12068.html），更新时间 2010 年 4 月 15 日。 Jean Dorey，Rview of French High engineering formation

4. 刘丽华，法国工程师教育及对我国理工科高等教育的思考，江苏高教，1996 年 4 期。 Liu Lihua，Influence of French Engineering Education in Chinese scientific education， 4.1996