

2006-1914: AN INTEGRATED CIVIL AVIATION ENGINEERING EDUCATION PARADIGM

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An integrated civil aviation engineering education paradigm

Introduction

Instead of operating the airliners made in USSR, China has been keeping on operating more and more airliners from some western aircraft companies such as Boeing , Airbus and BAE since 1980s. This has driven its aircraft maintenance industry to shift and expand very fast. As the fleet of airliners expands, their maintenance service has also developed into an attractive business. Foreign aircraft maintenance providers have gradually entered into this segment and have made this industry come across globalization since early 1990s. The benchmark lies in the establishment of AMECO, Beijing, a joint venture between Lufthansa and Air China, in 1989. After then, Taico, Xiamen and Gameco, Guangzhou and some more other aircraft maintenance or aircraft subsystem and auxiliary parts maintenance companies have also been established as joint ventures or FDI(foreign direct investment) companies. Up to the mid of 1990s, almost all the key players in this industry are FDI companies or joint ventures.

This fast shifting of airliners' operation has provided many challenges not only to Chinese airline companies, but also to aircraft maintenance service segment. The urgent need of qualified aircraft maintenance engineers is a very important one of these challenges. To meet the fast growing demand of high quality aircraft maintenance engineers from aircraft maintenance and airline companies, Civil Aviation Engineering College of Northwestern Polytechnical University (NPU) established in 1994. Operated by its board members, two CEOs from two airline companies and the president of NPU, the college has been cooperated with University of Maryland, USA in senior students' foreign language and western culture training program as well as cooperated with aircraft maintenance companies such as Ameco, Beijing; CNWA (China Northwestern Airline); Gameco, Guangzhou and Hainan airline, etc. in providing students the tailored internship and co-developing their four-years curriculum schedule. The college has sent about a thousand qualified engineers with their bachelor's degree into airline industries since then. About 30% of these engineers are working in foreign direct investment companies at homeland or abroad and 60% of them in joint ventures. This means 90% of our graduates are working in multi-cultural environment and are enjoying the achievements of my college's being adaptive to the globalizing process and the market challenge in this industry.

This paper focuses on the analysis of the characteristics and challenges of this industry at first. Then based on reviewing and analyzing our solution to develop aircraft maintenance engineers, it researches into the challenges and characteristics facing aerospace engineering education in an eastern developing country and the key factors affecting this arena resulted from globalization process. The roles of aerospace engineering education for multicultural environments and the motivations in both university side and industry side are also explored by focusing on market pull and technology push. Aiming at building an effective education paradigm for developing our graduates to work in multicultural or global aerospace industry environment, this paper works on integrating our practices with some modern engineering education theories such as teamwork

based, student -centered methods and lifelong learning concept to achieve a modularized solution. An integrated civil aviation engineering education paradigm for multi-cultural industry environment has been developed in this paper.

Challenges

From the industry perspective, the Chinese aircraft maintenance enterprises have been dealing with many challenges since early 1990s. Table 1 has listed some key characteristics of this industry evolution process.

Table 1 The industry shifting

	Product	Language	Maintenance system	Key Technology resource	Professional-focus	Culture
Soviet era	USSR Airplanes	Chinese or Russian	Product-centered	Basically local aviation industries	Professional knowledge	Localized
Since mid of 1980s	Boeing or Airbus Airliners	English	Operation-centered Service system-based Document-centered International-operation	OEMs	Systematic knowledge And maintenance Operation	Multi-cultural

The aircraft maintenance industry is an after-sale product servicing segment in some sense. With the shifting of the target products from USSR airplanes to Boeing, BAE or Airbus airliners, many challenges to the industry have followed. Technological limitations, human resources, maintenance facilities, management and operation system, organizational context, to name a few, all these aspects have seriously affected its effective operation. The following are some of the principal challenges to the industry

- An industry system shifting from USSR style to a frame for western airliners
- The operation shifting from local aviation industry-based mechanism into a global business-based mechanism
- The matching of cultures and core values as more and more FDI and JV companies established
- The development of technological and managerial competence

As to the industry engineers, the understanding of the new aircraft maintenance philosophy and system formulated by FAA, ATA and Airliners' OEMs, the English application capabilities, technological knowledge and skills, communication capabilities in multicultural environment are some of the most important requirement in the process.

From the university side, the traditional engineering education mainly focus on the knowledge transfer, industry design and innovation to meet the local aviation industry development requirement, not too much on the service, business, economical effectiveness, language application and multi-cultural context. Take the language barrier as an example. To a service

industry without almost any support from the local aviation industry due to the technological limitations, the effective communications between the engineers and OEMs technological support organization or personnel are really very important capabilities for aircraft maintenance system engineers, planning engineers and processing engineers. Therefore, the engineering education has to be changed to meet the industry needs. The challenges are principally related to the following aspects:

- A shift from science-based education paradigm (focus on knowledge transfer, scientific exploration and industry innovation) to engineering-based education paradigm(focus more on learners' skill development, learning by doing, teamwork based, integration and application of systematic knowledge)
- A transfer from serving military aerospace in technology development and science segment to serving civil aviation product and service
- The change of education philosophy from technology-push perspective to market-pull stand, focus more on business and economical effectiveness instead of industry design and innovation requirement
- Culture and language
- Skills and capabilities
- Support from aircraft OEMs, government and industries
- Demand of the qualified engineers from the industries and supply of the supposed-to-be engineers in the university
- Mechanisms and cooperation among academy, industry and government
- Integration of disciplines

Solutions and experiences

Our solutions to these challenges are implemented through the following programs in contrast to traditional degree programs in NPU:

- Operation of the board
- The foreign language training program
- A tailored internship
- Cooperative degree program and certificate program
- Curriculum development
- Exchange scholars

CAEC has had a leadership of the board. The board is consisted of three key members, two CEO from Ameco, Beijing and CNWA(Northwestern airline of China), the other member is the president of the university. They are responsible to policy-making, investment deciding , enactment of the college's development strategy. The market orientation mechanism of the board makes the industry –university cooperation more effective and sensitive to the industry challenges.

English is the language for working in this industry due to all the products are from western countries and all documents are written in English. The foreign language training program includes the following projects:

- Essential English course for students' first two years study

- Professional English course in students' third year
- Reinforced English training program each summer
 - Stage 1 is implemented by home instructors with experience in western countries
 - Stage 2 is carried out by the professors from University of Maryland
- Team based and on-spot learning in the internship
 - English corner
 - Communication with others
 - Translation of English documents such as AMM, MS manual

The tailored internship is an integrated process to develop students in the skills of language, communication, teamwork, and aircraft maintenance. Figure 1 has shown the cooperation between the industries and the university in students' internship, degree thesis and curriculum development. The board sets the policy and strategy for the cooperation. A team of specialists from the industry such as directors of HR, faculty-training center & business departments and professionals from the university implement training plan, schedule and context, coordinate the student training process. Some of the key elements are listed as the following:

- Industries provide accommodation, allowance and internship for the students and our university faculty member every year.
- Developing and implementing internship plan by the training center of industries and the CAEC member to meet the industry demand and academy requirement
- A team of instructors consisted of university professors, senior engineers and directors in the industry have been a network for instructing the students' internship
- Some professional courses are moved from university's classroom to the spot in industries.
- Some senior managers in the industry are invited to give the students lectures and courses related to aircraft maintenance system, management, and technology.
- Build tutor-apprentice relationship between the learners and the corporate key engineers and managers
- Manage student teams and encourage students to work in teams and learn language in teams.

The cooperative degree program and certification program mainly focus on building connections between university and industry or CAEC and other colleges abroad. The process includes:

- Identifying the fields of student's degree thesis
- Organizing team of instructors. Each student may be instructed by at least two instructors, one's from the industry to help the learner deal with engineering context, the other is from the university side to help the learner meet the academic requirement
- The students will defend against their thesis in their presentation before the evaluation committee with members from both the university and the industry

The curriculums are also adjusted to meet the students' four year schedule. Some professional courses once had been moved from university to industries. More and more business and

economical context, airliners systematic knowledge are added into the learners curriculums

Majority of CAEC's faculty member have been abroad to take part in the training programs given by Boeing, and Lufthansa.

Experiences and our paradigm

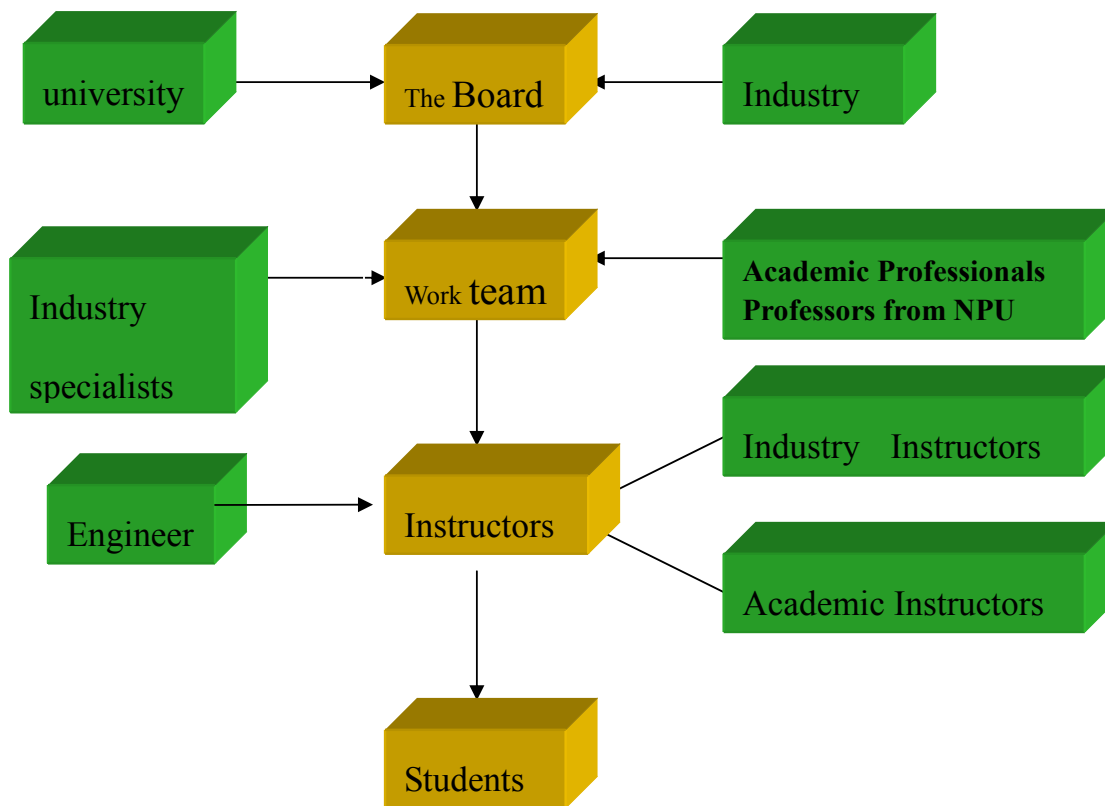


Fig 1 Operation of industry-university cooperation

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Majority of CAEC's faculty member have been abroad to take part in the training programs given by Boeing, and Lufthansa. This helps the faculty member understand more about the modern airliners and its service system. Thus improve their training methods and context in developing our students.

Experiences and our paradigm

The evolution process of Chinese airliners maintenance industry in the past 15 years is a process of modern service system application and development. The engineers for aircraft systems, maintenance planning and maintenance processing have been playing more and more important roles in this industry. They are the bridges between the OEM technological and service support personnel and aircraft maintenance technicians and workers. By focusing on language training, university-industry all around cooperation in students training program, learners are placed in the center of the process and in the environment of industry and academic interaction. They learn more by doing in the industry and by teamwork. The capability of English as working language in application and communication prove to be one of the most important competences of the learners. In reviewing to the students training history of my college, we found almost all of our students graduated are working in this industry. More and more of them have been working directly for foreign OEMs such as GE, P&H, Boeing, Airbus, and Goodrich , etc. as technological representatives in China. This means our paradigm has prepare the learners very well for their career path.

The language training program, the internship management mechanism, the industry-university all around cooperation in the students' training process are definitely key elements to the successful training program