COALITION OF VOCATIONAL AND REGULAR AVIATION MAINTENANCE TECHNICIAN EDUCATION

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Abstract - *The Aviation Maintenance Technician training programs are divided into, vocational and regular, two categories in Taiwan. Each program is monitored by one of the two governmental agencies, namely, the Civil Aeronautics Administration and the Ministry of Education. Due to the different natures of the two categories, the vocational training is dedicated to the professional skills only. And, the regular training requires the graduates to be balanced both mentally and professionally. Therefore, the curricula of the training programs are designed differently, and the graduates can get either professional certificate or BS degree. In order to meet the incentive of students to accomplish both programs, and to minimize the duplication of the training of the skills that the students already learned in their original program, which is also required in this program, a conversion method is developed in the paper.*

Keywords - *aviation maintenance technician training, education coalition*

INTRODUCTION

The Jumbo commercial airplanes are flown all over the world, a great number of them arrive to and depart from the highly population dense cities. Once the flight accident occurs in those cities, it will cause a disaster to the local residents, as we can see from the 911 affair happened in the New York City, on September 11th, 2001. Therefore, the aviation safety is one of the major concerns of the public safety of every government in the world. Their concerns are devoted to the aviation related areas, like the design, manufacture, operation and the maintenance of the airplanes. Every aircraft flying within their territory are their concerns, no matter those are the domestic or the foreign airplanes flying into the territory. And because the modern airplanes are very sophisticated and complicated electro-mechanical systems, the stringent laws are legislated to monitor those aviation activities. The responsible governmental agencies are formed, like Federal Aviation Administration (FAA) in US, Joint Aviation Authorities (JAA) in European countries and Civil Aeronautics Administration (CAA) in Taiwan, etc.

The operational airmen are divided into flight crewmembers and the ground members. Federal Aviation Regulation (FAR) [1] distinguishes those ground airmen as the Air Traffic Control Tower Operators, Aircraft Dispatchers, Mechanics, Repairmen and Parachute Riggers. All of them should be certified to practice their professions. The Repairmen, also called Aviation Maintenance Technicians (AMT), can be trained either from the Aviation Maintenance Schools [2] or from any other regular maintenance educational institute where they offer the degrees to their graduates. Both graduates have to be certified under the same FAR Part 65 standards. The Aviation Maintenance Schools graduates can take the certification tests right after their graduation, but the graduates from the regular educational institute must have at least 2 years experience in the Repair Stations (RS) prior to the tests. Joint Aviation Requirements (JAR) established a similar system for the Maintenance Staff [3] and the Approved Maintenance Training/Examinations [4].

The Repair Stations of the airplanes are supervised by the governmental agency, CAA in Taiwan, and also inspected by the foreign governmental agencies, namely, FAA and JAA, etc., of the aircraft manufacturer's nations and of the airplanes' flight destination countries. The RS are under the FAR Part 145 [5] regulations. It requires the RS must have enough qualified employees, certified AMT, to keep up with the volume of work in process. Therefore, the RS want to hire as much of the certified AMT as for the new employees, and the RS evaluate the new employees by the degree and the certificate that they hold which reflects on the offered salaries. Thus, the students have the incentive to pursue both educational programs before they apply for the jobs at the RS.

The China Institute of Technology (CIT), Taiwan, and Lufthansa Technical Training (LTT), Germany, formed the only FAR Part 147 Aviation Maintenance School in Taiwan, which is called China Aviation School (CAS), located at CIT, and was certified by CAA and JAA. The training program at CAS is defined as a vocational training with the curriculum originally designed in FAR Part 147 and was amended in CAR Part 147 by CAA. It is a one-year program with 1,358 hours of lectures and practical applications on the general, airframe and powerplant. By the mean time, CIT also offers a regular maintenance two-year training program for the Associate BS degree students to obtain their BS degrees. It requires 72 credit units, 12 units of humanity and 60 units of professional courses. Based on the incentive of the students to accomplish both programs and to minimize the duplicated training, this study proposes a conversion method to fulfill the needs of the students. At the same time, the requirements of both the CAR Part 147 and the regular training curriculum, which is supervised by the Ministry of Education (MOE), are met.

GOVERNMENTAL AMT TRAINING

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REGULATIONS

The large commercial airplanes are designed, manufactured, operated and maintained at the similar standards in the world. But the AMT training standards are varied slightly from one region to another region. Although Baldwin [6] promotes the International Aerospace Training Standards (IATS) to unify the global AMT training standards, which can reduce the certified AMT and industrial efforts in obtaining several certificates with the similar standards. But it is still at the initial state, the AMT candidates have to be certified for each regional certificate at the present time. The FAA, CAA and JAA's AMT training standards are shown below.

FAA Regulations (FAR Part 65 and 147)

The Eligibility Requirements for a repairman certificate are:
(a) Age: Be at least 18 years of age.
(b) Language: Be able to read, write, speak and understand the English language.
(c) Experience: have either -
  (i)At least 18 months of practical experience in the maintenance duties.
  (ii)Complete formal AMT training.

The Curriculum Requirements having 1900 hours are:
(a) General curriculum subjects, at least 400 hours.
  A. Basic electricity.
  B. Aircraft drawings.
  C. Weight and balance.
  D. Fluid lines and fittings.
  E. Material and processes.
  F. Ground operation and servicing.
  G. Cleaning and corrosion control.
  H. Mathematics.
  I. Maintenance forms and records.
  J. Basic physics.
  K. Maintenance publications.
  L. Mechanic privileges and limitations.
(b) Airframe curriculum subjects, at least 750 hours.
  (i) Airframe Structures
    A. Wood structures.
    B. Aircraft covering.
    C. Aircraft finishes.
    D. Sheet metal and Non-metallic structures.
    E. Welding.
    F. Assembly and rigging.
    G. Airframe inspection.
  (ii) Airframe Systems and Components
    A. Aircraft landing gear system.
    B. Hydraulic and pneumatic power system.
    C. Cabin atmosphere control system.
    D. Aircraft instrument systems.
    E. Communication and navigation systems.
    F. Aircraft fuel systems.
    G. Aircraft electric systems.
    H. Position and warning systems.
    I. Ice and rain control systems.
    J. Fire protection.
(c) Powerplant curriculum subjects, at least 750 hours.
  (i) Powerplant Theory and Maintenance
    A. Reciprocating engines.
    B. Turbine engines.
    C. Engine inspection.
  (ii) Powerplant System and Component
    A. Engine instrument systems.
    B. Engine fire protection systems.
    C. Engine electrical systems.
    D. Lubrication systems.
    E. Ignition and starting systems.
    F. Fuel metering systems.
    G. Engine fuel systems.
    H. Induction and engine airflow systems.
    I. Engine cooling systems.
    J. Engine exhaust and reverser systems.
    K. Propellers
    L. Unducted fans.
    M. Auxiliary power units.

CAA Regulations (CAR Part 147)

The Eligibility Requirements for an AMT certificate are:
(a) Age: Be at least 18 years of age.
(b) Education and Experience: have one of the following-
  (i) Senior High School graduates with complete formal AMT training at a CAA certified AMT training school.
  (ii) Senior High School graduates with at least 4 years of practical experience in the maintenance duties of airframe, powerplant or the relevant systems.
  (iii) Associate BS degree graduates from the engineering departments of Aeronautics, Mechanical, Electrical or Electronics with at least 3 years of practical experience in the maintenance duties of airframe, powerplant or the relevant systems.
  (iv) BS degree graduates from the engineering departments of Aeronautics, Mechanical, Electrical or Electronics with at least 2 years of practical experience in the maintenance duties of airframe, powerplant or the relevant systems.

The required curricula of the CAA certified AMT school are designed in two different systems, one for the senior high school graduates and the other one for the college or university graduates. All the 45 training modules as specified in FAR Part 147 and two more English language modules are included in both curricula, those contain 2,060 training hours in one and a half years for the senior high school graduates and 1,358 hours in one year for the college or university graduates. CAS, the only CAA certified AMT training school in Taiwan, offers a training program to the college or university graduates only. Its

curriculum is shown in Table 1 for four categories, i.e. common, airframe, powerplant and English.

TABLE 1.
Vocational Training Curriculum

Module	Subjects	Training Hours
Common		
1A	Basic electricity.	50
1B	Aircraft drawings.	18
1C	Weight and balance.	21
1D	Fluid lines and fittings.	18
1E	Material and processes.	54
1F	Ground operation and servicing.	18
1G	Cleaning and corrosion control.	24
1H	Mathematics.	0
1I	Maintenance forms and records.	14
1J	Basic physics.	20
1K	Maintenance publications.	12
1L	Mechanic privileges and limitations.	18
Airframe		
2A	Wood structures.	11
2B	Aircraft covering.	27
2C	Aircraft finishes.	16
2D	Sheet metal and Non-metallic structures.	100
2E	Welding.	26
2F	Assembly and rigging.	26
2G	Airframe inspection.	22
3A	Aircraft landing gear system.	50
3B	Hydraulic and pneumatic power system.	48
3C	Cabin atmosphere control system.	17
3D	Aircraft instrument systems.	18
3E	Communication and navigation systems.	26
3F	Aircraft fuel systems.	22
3G	Aircraft electric systems.	68
3H	Position and warning systems.	8
3I	Ice and rain control systems.	8
3J	Fire protection.	7
Powerplant		
4A	Reciprocating engines.	97
4B	Turbine engines.	100
4C	Engine inspection.	20
5A	Engine instrument systems.	14
5B	Engine fire protection systems.	8
5C	Engine electrical systems.	16
5D	Lubrication systems.	30
5E	Ignition and starting systems.	26
5F	Fuel metering systems.	25
5G	Engine fuel systems.	16
5H	Induction and engine airflow systems.	12
5I	Engine cooling systems.	8
5J	Engine exhaust and reverser systems.	14
5K	Propellers	44
5L	Unducted fans.	5
5M	Auxiliary power units.	20
English		
6B	Basic Technical English	68
6C	Advanced Technical English	68
Total Hours		1358

JAA Regulation (JAR Parts 66 and 147)

The Eligibility Requirements for a certifying staff of aircraft maintenance are:

(a) Age: Be not less than 21 years of age.

(b) Language: Be able to read, write and communicate to an understandable level in the language(s) in which the technical documentation and organization procedures are performed.

(c) Experience:

(i) Category A (Line maintenance certifying mechanic): 3 years minimum.

(ii) Categories B1 and B2 (Line maintenance certifying technician- mechanical and avionic): 5 years minimum.

(iii) Category C (Base maintenance certifying engineer): 3 years minimum.

(iv)Complete JAR-147 approved training.

Different from the FAA's certificate tests, JAA specifies the Basic Knowledge for the certifying staffs in three levels. Each category of the AMT should meet different levels of the basic knowledge on the different modules. Those three levels are defined as:

Level 1: A familiarization with the principal element of the subject.

Level 2: A general knowledge of the theoretical and practical aspects of the subject. An ability to apply that knowledge.

Level 3: A detailed knowledge of the theoretical and practical aspects of the subject. A capacity to combine and apply the separate elements of knowledge in a logical and comprehensive manner.

The training Curriculum and the required Basic Knowledge Levels for the categories A, B1 and B2 are distinguished into 17 major subject modules in JAR 66. The basic knowledge levels are defined only for the sub-modules of every major subject. It is quite a long list of the sub-modules, so, only the major 17 subject modules are listed in Table 2.

TABLE 2.
JAA training module

MODULE	SUBJECT
M1	Mathematics
M2	Physics
M3	Electrical Fundamentals
M4	Electronic Fundamentals
M5	Digital Techniques Electronic Instrument Systems
M6	Materials and Hardware
M7	Maintenance Practices
M8	Basic Aerodynamics
M9	Human Factors
M10	Aviation Legislation
M11	Aeroplane Aerodynamics, Structures and Systems
M12	Helicopter Aerodynamics, Structures and Systems
M13	Aircraft Aerodynamics, Structures and Systems
M14	Propulsion
M15	Gas Turbine Engine
M16	Piston Engine
M17	Propeller

VOCATIONAL TRAINING

The China Institute of Technology (CIT), Taiwan, and Lufthansa Technical Training (LTT), Germany, formed the only FAR Part 147 Aviation Maintenance School in Taiwan, which is called the China Aviation School (CAS), located at CIT, and was certified by CAA and JAA. The training program at CAS is defined as a vocational training with the curriculum originally designed in FAR Part 147 and was amended to CAR Part 147 by CAA. In order to reduce the training period from 1,900 hours, as FAR Part 147 required, to 1,358 hours, CAA requires the trainees must be college or university graduates. For them, enough academic training were taken and possess the necessary basic knowledge that AMT required. Although the AMT practices engineering profession, but many applicants, who graduated from the business or the humanity departments, such as insurance, foreign language, and news media, etc., applied for the admission to CAS. After a proper entrance examination to all the applicants, CAS accepted some of non-engineering background applicants, but who do have enough engineering knowledge. The qualifications and the entrance examination for the applicants are:

1. Age: 20 to 35 years of age.
2. Education: the applicant must hold either an Associate BS or a BS degree.
3. The applicant must pass the following written and practical tests:
   a. Written test includes:
      (i) English language.
      (ii)General mechanical knowledge (i.e. physics, electronics, mechanical drawing, etc.)
      (iii)Oral examination.
   b. Practical test includes:
      (i) Hand tools operation.
      (ii)Model assembly.

Statistically, CAS accepted about 78% of the engineering educated graduates and 22% of non-engineering educated graduates. Since the establishment of the CAS in 1999, there were 5 classes of 142 students graduated. CAS urged all of them to take the CAA's AMT certificate test, which includes a written and a practical tests. 32 of them passed both of the tests, and the other 79 passed the written test only, at the time they graduate. And there are 3 classes of 69 students studying at the school.

JAA certified CAS, in 2001, as a JAR 147 training school, but the additional courses, with 115 training hours, must be added to the CAS original curriculum. Those additional courses are shown in Table 3.

TABLE 3.
JAA required additional courses for CAS

Module	Subject	Hours
M1	Mathematics	3
M2	Physics	5
M5	Digital Techniques, Electronic Instrument System	2
M7	Maintenance Practices	33
M9	Human Factors	16
M10	Aviation Legislation	21
M11	Aeroplane Aerodynamics, Structures and Systems	35

After JAA certified CAS, 40 of the CAS graduates took the JAA's AMT certificate test and 30 of them passed at the time they graduate.

REGULAR TRAINING

At the China Institute of Technology (CIT), Taiwan, the Department of Aeromechanics is dedicated to the education of the aviation engineers, the teaching subjects include the airframe and powerplant of the airplane. In this department, a two years college level program and a two years university level program are offered. The graduates can get either an Associate BS or a BS degree. Those programs are defined as the regular education systems those are supervised by the Ministry of Education in Taiwan. Because the graduates from the CAS are already holding either an Associate BS or a BS degree, only the graduates with their Associate BS degree are interested in pursing the BS degree at the Department of Aeromechanics. Therefore, the two years university level program in this department is introduced.

There is an entrance examination for this program, it requires the applicants the following:

1. Age: no limitation.
2. Education: the applicant must hold an Associate BS degree.
3. The applicant must pass a written test which includes the following subjects:
   a. Chinese and English languages.
   b. Mathematics.
   c. Professional subjects include applied mechanics,

thermodynamics, mechanical design, mechanical drawings, etc.

Because the written test is devoted to the mechanical engineering subjects, so most of the students majoring in the aeronautics, mechanics and a few in the electronics can pass the test. The vocational trained students, i.e. CAS graduates, should pass that entrance examination also.

In this two years BS degree program, a semester system is used and the students need to complete 72 units of the course works. Among them, 12 units of courses are of the humanities, and 60 units are of the professional training which include 43 units of the required courses and 17 units of the optional courses. The required professional courses are listed in Table 4 for the purpose of the comparison between the vocational and the regular training curricula. The units and the training hours for the required courses are included.

CONVERSION METHOD

In the regular training, the semester system is utilized which consists of 18 weeks of teaching works per semester. For the lecture courses, each credit unit represents 1 hour of lecture per week in the whole semester, 18 weeks. It means 18 hours of lectures. But for the practice courses, each unit represents 1.5 or 2 hours, which depends on the degree of difficulty of that course, of practice per week in the 18 weeks of a semester. It means 27 or 36 hours of work per unit. But in the vocational training, the teaching hours are varied for each module, and are not divided equally in the basis of the 18 weeks as the semester system does. The total 1,358 training hours are arranged in a proper sequence for the 47 modules. Due to the different nature of the two training systems, only the similar courses with the similar contents and equivalent training hours can be converted between the two systems. At the time being, only the CAS graduates, who are holding the Associate BS degree, have the incentive to attend the regular training to pursue their BS degree. None of the graduates holding BS degree from the regular system is interested in attending CAS. So, only the conversion method for the CAS graduates with the Associate BS degree is studied. The convertible courses are shown in Table 5.

TABLE 4.
Regular training curriculum

Course Subjects	Units	Training Hours
Strength of Material	3	54
Advanced Engineering Mathematics	3	54
Fluid Mechanics	3	54
Thermodynamics	3	54
Introduction to Aviation Engineering	3	54
Flight Mechanics	3	54
Dynamics	3	54
Airplane Hydraulic and Pneumatic Systems	3	54
Airplane Electrical System	2	36
Jet Powerplant	3	54
Airplane Instrumentation System	3	54
Applied Aerodynamics	3	54
Airplane Maintenance Practice	2	36
Powerplant Practice	2	36
Aviation English	2	36
Independent Study	2	36
Required optional courses for non- aeronautical educated students:		
Airplane Introduction	3	54
Aviation Basic Practice	3	54
Powerplant Disassemble Practice	3	54

The other optional courses are not listed here.

TABLE 5.
Courses conversion table

Vocational Training			Regular Training		
Module	Course Subject	Training Hours	Course Subject	Units	Required/ Optional
2F	Assembly and Rigging	26	Airplane Maintenance Practice	2	Required
3A	Landing Gear System	50			
2G	Airframe Inspection	22			
3B	Hydraulic and Pneumatic System	48	Airplane Hydraulic and Pneumatic System	3	Required
3G	Aircraft Electrical System	68	Airplane Electrical System	2	Required
1E	Material and Processes	54	Composite Material	3	Optional
3D	Aircraft Instrument System	18	Airplane Instrumentation System	3	Required
3E	Communication/Navigation System	26			
5A	Engine Instrument System	14			
1F	Ground Operation and Servicing	18	AMT Practice	1	Optional
1I	Maintenance Forms and Records	14			
1K	Maintenance Publications	12			
4A	Reciprocating Engines	97	Powerplant Disassemble Practice	2	Optional
4B	Turbine Engines	100	Jet Propulsion	3	Required
6B	Basic Technical English	68	Aviation English	2	Required

Totally, there are 15 units of the required courses and 6 units of the optional courses can be deducted from the regular BS degree training program.

DISCUSSIONS

The Aviation Maintenance Technician training is one of the foundations of the aviation safety operation. Although the AMT training standards are varied slightly from one region to another region in the world, it should set to the highest standards to unify the global standards. For the coalition of the vocational and regular AMT education, the duplication of the training subjects should be minimized to save the student's efforts. In this paper, the conversion method for the vocational CAS graduates with the Associate BS degree to attend the regular BS degree program was discussed. The reverse conversion method for the regular Associate BS degree graduates attending CAS, needs further investigation. To validate the conversion method, it needs to be recognized by both the vocational and regular training institutes. It is feasible for the CAS and the Department of Aeromechanics to carry out this method within the China Institute of Technology. For the institutes outside of the China Institute of Technology, the conversion method needs further negotiation between the institutes for the recognition. Once the global vocational AMT training standards are established as Baldwin expected in [6], and the universal regular training curriculum is established also. The general conversion method can then be developed for the exchange of graduates between the two educational systems universally.

REFERENCES

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