Integrated Aviation Maintenance Technician Training for Multi-level Educational Institutions

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ABSTRACT: *The Aviation Maintenance Technician (AMT) was trained from two different educational systems, namely, the vocational and regular training systems. The vocational training system is for the aviation maintenance technician schools; those were formed and approved by following each governmental aviation agency's regulations, i.e. Federal Aviation Regulations (FAR) in US, Joint Aviation Regulations (JAR) in European countries and Civil Aviations Regulations (CAR) in Taiwan, etc. And, those schools are also monitored by the same governmental aviation agency of their trainings. It is a one level and simple ruled system dedicated to the professional skills only. But, the regular training system is a complicated multi-level education system, which is monitored by the Ministry of Education (MOE). This multi-level system includes four different education programs, a three years vocational high school level, a two years junior college level, another two years senior college level and a common four years undergraduate university level. The curriculum of the vocational high schools is unified by MOE. But, for the other three college/university levels, the curricula vary from school to school, due to the different design philosophies. It may cause a difficult situation to the student, who completed his lower level of education from one school, and attends a higher level of education at another school. Due to the inconsistent curricula, he may need to take the same courses twice, or may miss some important items to study.*

Although the two systems have different philosophies in designing their curricula, to fit in their own training calendars, the teaching material of both systems is selected partially from the global widely used AMT training publication series, such as JEPPESEN, ASA, etc. These publication series cover the fully fundamental knowledge for the AMT in practicing their professions. In this paper, the multi-level educational system is considered integrally in designing the desirable curricula for each level of educations, which can avoid the duplications and confusions among them.

1 INTRODUCTION

The Jumbo commercial airplanes are the most convenient, fast and comfortable mass transportation carriers for the long range travels in the world, and have been widely used globally. A large amount of fuel is carried in the airplanes for the long range and inter-continental flights. It may cause a disaster to the cities where the planes are flying through, once an accident occurs. The stringent laws are legislated by every government in the world 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.

Due to the importance of the operational airmen (i.e. flight crewmembers and ground members) in operating and maintaining of the airplanes, the aviation agencies regulate their eligibility requirements, training curriculums and the certification systems, etc. 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 before practicing their professions. The Repairmen, also called Aviation Maintenance Technicians, 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. Although the training systems are different, the graduates from both systems must be certified by the same aviation agency, under the same standards, in order for them to serve at the Repair Stations. The responsible monitoring governmental agencies of the two AMT training systems are different. CAA is responsible for the Aviation Maintenance Schools, and the Ministry of Education (MOE) is responsible for the multi-level regular educational institutions.

The regulations for the Aviation Maintenance Schools are specified by CAA as CAR Part 147, which is originally designed in FAR Part 147 and was amended by CAA, and it is a one-level and relatively simple ruled system dedicated for the professional skills only. A one-year program, with 1,358 hours of lectures and practical applications on the general, airframe and powerplant, is included. 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 regular training system, which is monitored by MOE, is diversified due to the complicated multi-level education systems. This multi-level system includes four different educational programs, a three years vocational high school level, a two years junior college level, another two years senior college level and a common four years undergraduate university level. The MOE specifies the curriculum for the vocational high schools, so there is only one common standard for this level. But for the other three college/university levels, MOE gave the entire freedom to each school to decide their own curricula. Every school has a different philosophy in designing their own curricula for different levels of education. Without a common standard, the curricula vary from school to school. Once a student completed his lower level of education from one school, and attends a higher level of education at another school; he may face a problem of taking the same courses twice, it will waste of his time, or may miss some important items due to the inconsistency of curricula in the two different schools.

The global widely used AMT training publication series, such as JEPPESEN[3,4,5], ASA[6,7,8], etc., cover the full fundamental knowledge for the AMT in practicing their professions. But, due to the limited training hours of both systems, only the important items were selected, with each institution's own perspective. In this paper, the college/university levels curricula in Taiwan were collected and were carefully compared to investigate the design philosophies. The second system, vocational high schools and college/university levels of education, is considered integrally of what are the necessary training contents, by comparing their curricula with the first system's curriculum, the aviation maintenance technician schools, and also with the important items selected by the experienced instructors from the JEPPESEN series. An integrated training curriculum is designed in this paper to avoid the duplication and confusion of the multi-level educational institutions for the second system.

2 JEPPESEN SERIES

The JEPPESEN series is one of the globally wide used publications of the aviation technician education. It contains the full knowledge of the basic training of the AMT, and three volumes, General, Airframe and Powerplant, are published. Parts of their contents are selected for the different levels and different systems of AMT education. The contents of the three volumes cover a long list. Due to the page limits of this paper, only the chapter subjects are listed below. It shows the complete necessary knowledge of AMT, and it can also be used to compare with the designed curricula of various institutions.

Table 1. JEPPESEN series contents

Volume 1: General	
Chapter	Subject
1	Mathematics
2	Physics
3	Basic Electricity
4	Electrical Generators and Motors
5	Aircraft Drawings
6	Weight and Balance
7	Aircraft Structural Materials
8	Aircraft Hardware
9	Hand Tools and Measuring Devices
10	Fluid Lines and Fittings
11	Nondestructive Testing
12	Cleaning and Corrosion
13	Ground Handling and Servicing

14	Maintenance Publications, Forms, and Records
15	Mechanic Privileges and Limitations
Volume 2: Airframe	
Chapter	Subjects
1	Aircraft Structures
2	Assembly and Rigging
3	Aircraft Fabric Covering
4	Aircraft Painting and Finishing
5	Aircraft Metal Structural Repair
6	Aircraft Wood & Composite Structural Repair
7	Aircraft Welding
8	Ice and Rain Control Systems
9	Hydraulic and Pneumatic Power Systems
10	Aircraft Landing Gear Systems
11	Fire Protection Systems
12	Aircraft Electrical Systems
13	Aircraft Instrument Systems
14	Communications and Navigation Systems
15	Aircraft Fuel Systems
16	Aircraft Cabin Atmospheric Control Systems
Volume 3: Powerplant	
Chapter	Subjects
1	Reciprocating Engine
2	Reciprocating Engine Operation, Maintenance, Inspection, and Overh
3	Turbine Engine
4	Turbine Engine Operation, Maintenance, Inspection, and Overhaul
5	Induction Systems
6	Exhaust Systems
7	Fuel and Fuel Metering
8	Ignition and Electrical Systems
9	Lubrication Systems
10	Cooling Systems
11	Engine Fire Protection
12	Propellers

3 VOCATIONAL TRAINING SYSTEM

The required curricula of the CAA certified AMT schools are designed in two 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. China Aviation School, the only CAA certified AMT training school in Taiwan, offers a training program to the college or university graduates only. Instead of the semester system, as of the regular educational system, AMT training school uses Modules system with several training hours for each Module. Its curriculum is shown in Table 1 for four categories, i.e. common, airframe, powerplant and English.

TABLE 2**.** Vocational training curriculum

Module	Subjects	Training Hours	Relevant JEPPESEN Subjects
Common			
1A	Basic electricity	50	Vol. 1 Chap. 3
1B	Aircraft drawings	18	Vol. 1 Chap. 5
1C	Weight and balance.	21	Vol. 1 Chap. 6

1D	Fluid lines and fittings.	18	Vol. 1 Chap. 10
1E	Material and processes.	54	Vol. 1 Chap. 7
1F	Ground operation and servicing	18	Vol. 1 Chap. 13
1G	Cleaning and corrosion control.	24	Vol. 1 Chap. 4
1H	Mathematics.	0	Vol. 1 Chap. 1
1I	Maintenance forms and records	14	Vol. 1 Chap. 14
1J	Basic physics.	20	Vol. 1 Chap. 2
1K	Maintenance publications.	12	Vol. 1 Chap. 14
1L	Mechanic privileges and limitations	18	Vol. 1 Chap. 15
Airframe			
2A	Wood structures.	11	Vol. 2 Chap. 6
2B	Aircraft covering	27	Vol. 2 Chap. 3
2C	Aircraft finishes.	16	Vol. 2 Chap. 4
2D	Sheet metal and Non-metallic	100	Vol. 2 Chap. 5, 6
2E	structures	26	Vol. 2 Chap. 7
2F	Welding.	26	Vol. 2 Chap. 2
2G	Assembly and rigging.	22	Vol. 1 Chap. 11
3A	Airframe inspection.	50	Vol. 2 Chap. 10
3B	Aircraft landing gear system.	48	Vol. 2 Chap. 9
3C	Hydraulic and pneumatic power	17	Vol. 2 Chap. 16
3D	system.	18	Vol. 2 Chap. 13
3E	Cabin atmosphere control system.	26	Vol. 2 Chap. 14
3F	Aircraft instrument systems.	22	Vol. 2 Chap. 15
3G	Communication and navigation	68	Vol. 2 Chap. 12
3H	systems.	8	Vol. 2 Chap. 14
3I	Aircraft fuel systems.	8	Vol. 2 Chap. 8
3J	Aircraft electric systems.	7	Vol. 2 Chap. 11
	Position and warning systems.		
	Ice and rain control systems.		
	Fire protection.		
Powerplan			
4A	Reciprocating engines.	97	Vol. 3 Chap. 1
4B	Turbine engines.	100	Vol. 3 Chap. 3
4C	Engine inspection.	20	Vol. 3 Chap. 4
5A	Engine instrument systems.	14	Vol. 3 Chap. 4
5B	Engine fire protection systems.	8	Vol. 3 Chap. 11
5C	Engine electrical systems.	16	Vol. 3 Chap. 8
5D	Lubrication systems.	30	Vol. 3 Chap. 9
5E	Ignition and starting systems.	26	Vol. 3 Chap. 8
5F	Fuel metering systems.	25	Vol. 3 Chap. 7
5G	Engine fuel systems.	16	Vol. 3 Chap. 7
5H	Induction and engine airflow	12	Vol. 3 Chap. 5
5I	systems.	8	Vol. 3 Chap. 10
5J	Engine cooling systems.	14	Vol. 3 Chap. 6
5K	Engine exhaust and reverser	44	Vol. 3 Chap. 12
5L	systems.	5	Vol. 3 Chap. 5
5M	Propellers	20	Vol. 3 Chap. 3
	Unducted fans.		
	Auxiliary power units.		
English			
6B	Basic Technical English	68	none
6C	Advanced Technical English	68	none
Total Hours	1358		

As we can see from the Table 2, the AMT training covers most of the contents in the JEPPESEN series, those are incompletely covered in the regular education system. That is why, the graduates from the AMT school, are eligible to take the CAA's certification test. But, the graduates, from the regular schools, have to work at the Repair Stations for two or three years before they are eligible to take the same test.

4 REGULAR TRAINING SYSTEM

Unlike the vocational training schools which are dedicated to the skills training only, the regular training system devotes to the balanced education to the students both mentally and professionally. Besides the skills training, the humanities and fundamental engineering theoretical courses are also included in their curricula. In other words, there are not enough skills training hours that can be inserted in the tight scheduled curricula, as of the vocational training schools can do. So, only the important items are selected for the AMT training, by each institutes perspectives, of the different levels of programs that they have in their school.

The regular training system for AMT training is complicated in Taiwan, which includes three different levels of education, namely, the three years vocational high schools program, the two years junior college program, another two years senior college program and the common four years university program. There are six vocational high schools and five college/university levels schools in Taiwan. Among the five college/university level schools, one of them has the junior college level program, three of them have senior college level program and all five of them have the university level programs. The semester system is used for all the three levels of programs. But, in the vocational high schools, it has twenty two weeks per semester, and, in the college/university levels of schools, it has eighteen weeks per semester. So, in the vocational high school, it has longer training hours for each credit unit than it has in the college/university levels of schools. The curriculum of the vocational high schools is unified by the MOE, and it is listed below in Table 3.

TABLE 3. Vocational high school's curriculum

Course Subjects	Units	Training hours	Relevant JEPPESEN subjects
Aircraft drawings	2	44	Vol. 1 Chap. 5
Aircraft structural repair	3	66	Vol. 2 Chap. 5
Aircraft principles	3	66	Vol. 1 Chap. 2
Precision measurement	2	44	Vol. 1 Chap. 9
Basic maintenance skills	3	66	Vol. 1 Chap. 8
Powerplant maintenance practice	4	88	Vol. 3 Chap. 3
Aircraft material	2	44	Vol. 1 Chap. 7
Aviation quality assurance	1	22	Vol. 1 Chap. 13
Aircraft maintenance practice	8	176	Vol. 2 Chap. 2

As we can see it from the Table 3 that it covers all three volumes in JEPPESEN series, but the courses are mostly in Vol. 1, which is suitable for the lowest level of AMT education. But, for the college/

university AMT education, there are three different levels of programs in five schools. The curricula are vast and are varied due to different design philosophies, and those are not listed in this paper. The author carefully examined those curricula, and found that all three volumes of JEPPESEN series are covered. Some schools are more emphasized on the Airframe, and the others concern more about the Powerplant. And there are duplications of courses for different levels of education. It means that some of the students may face a problem of taking the same course twice when he/she enters two different programs in two different schools. The college/university AMT education recruits students from various fields. So, they have to add some fundamental skills courses, as defined in Volume 1 in JEPPESEN series, as the optional courses in their curricula, those are already been taught in the vocational high schools.

5 SUGGESTED CURRICULA

The vocational high school's curriculum is unified by MOE, which covers the basic skills as defined in Volume 1 of the JEPPESEN series and three introductory courses in Volume two and three. It is enough for the lowest level of education. The total training hours for the aviation maintenance skills are 616 hours. The three programs in the college/university level of education have each own minimum required credit units of their students. Take the China Institute of Technology for instance. The junior college requires 82 credit units, 71 of them are required and the other 11 are optional. The senior college requires 72 credit units, 56 units are required and 16 units are optional. And the university requires 136 credit units, 102 required and 34 optional. Every unit means 18 training hours of the semester system. As we can see, the students who take both the junior and senior colleges of education, he will have more training hours than the university students in the same four years of education.

Three categories of courses, humanities, engineering theories and the aviation maintenance skills, are included in their curricula. The training hour percentages of each category in the curricula are 20%, 50% and 30%, respectively. It means that the training hours of each category in the universities are 295, 738 and 442 hours, respectively. It is equivalent to 25 credit units of the skills training. Obviously, there are totally 1,058 training hours of the maintenance skills in the regular training system, it counts for both the vocational high school and the university, which is 300 hours less than the vocational training system. In the vocational training system's curriculum, the percentages of the training hours of the three JEPPESEN Volumes are 20%, 37%, 34% respectively, and additional 9% of English courses. The Volumes 2 and 3 need more training hours than Volume 1. But, in the regular training system, the vocational high school pays too much attention on Volume 1. And there are not enough training hours that can be used to teach in college/university on Volumes 2 and 3. Therefore, only the important items should be selected from Volumes 2 and 3 and be used to teach at the college/university levels. Without changing the curriculum of the vocational high schools, which is already been designed by MOE, the curricula of the college/ university are suggested below in Table 4, where A/C stands for aircraft.

TABLE 4. Suggested college/university curricula

Junior college			
Course Subjects	Units	Training hours	Relevant JEPPESEN subjects
Sheet structures	3	54	Vol. 2 Chap. 5,6
Airframe & engine inspection	2	36	Vol. 1 Chap. 11, Vol. 3 Chap. 4
A/C landing gear system	2	36	
A/C instrument, communication & navigation systems	3	54	Vol. 2 Chap. 10 Vol. 2 Chap. 13,14
A/C & engine fuel systems	2	36	
A/C & engine fire protection systems	1	18	Vol. 2 Chap. 15, Vol. 3 Chap. 7 Vol. 2 Chap. 11, Vol. 3 Chap. 11
Senior college			
Course Subjects	Units	Training hours	Relevant JEPPESEN subjects
Turbine engine	3	54	Vol. 3 Chap. 3
A/C & engine electrical systems	2	36	Vol. 2 Chap. 15, Vol. 3 Chap. 8
A/C hydraulic & pneumatic systems	3	48	Vol. 2 Chap. 9
Engine Ignition, starting & lubrication systems	3 1	48 18	Vol. 3 Chap. 5,12
Position, warning & engine instrument systems			Vol. 2 Chap. 14, Vol. 3 Chap. 4

The suggested curricula can be used for the junior and senior colleges, and can also be used for the university level by combining them together. Additional subjects can be added in the curricula, if more training hours are available.

6 CONCLUSIONS

The Aviation Maintenance Technician training is important to maintain the commercial airplanes. Both the two different educational systems, vocational and regular, can produce adequate graduates to participate in the Repair Stations. The vocational system is oriented to the skills only, and has more training hours and teaching subjects than the regular education system. There are three different levels in the regular system. Without a systematic consideration of the curricula design, it causes confusions among these levels of education and the different schools. In order to avoid the duplications and confusions, the curricula of the five schools were collected and examined carefully.

The widely used AMT training material, JEPPESEN series, and the vocational training curriculum, which is supervised by CAA, are considered in this paper as a standard to design the suggested curricula, with the integral considerations of the college/university for different levels. The Volume 1 has been taught fully in the vocational high schools. And as we can see from the last chapter, there are limited training hours, 25 credit units or equivalent 450 hours, can be used in the university, so, only the subjects from Volume 2 and 3 are selected. These suggested curricula need further discussions among the five schools to reach the acceptable curricula of all schools.

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