Current Human Capital Requirement of Aircraft Engineering in Malaysia

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1.0 INTRODUCTION

Some of the questions that are often asked include "what is aeronautical engineering?", "what is the difference between an aircraft engineer and a flight engineer?" and "what is aerospace engineering?" A report on human resource requirement of the Malaysian aviation industry by the Malaysia Industry – Government Group for High Technology (MIGHT) stated that the country requires 20,000 technical personnel to support the local aviation industry in 2010 [1]. Utusan Malaysia (17 July 2009) also quoted an announcement by the Minister of Rural Development that the country now has 40,000 engineers and technicians in the aviation industry, and it will require between 55,000 to 60,000 engineers (sic) and technicians by 2020 [2]. That means there is a shortage of approximately 15,000 skilled workers in aircraft engineering.

The headline of the Utusan Malaysia's article is "Jurutera Penerbangan Kurang" [2], when translated literally, it reads as "Shortage of Flight Engineers". So, what is a flight engineer then? The aviation industry is also mired in other designations: aeronautical engineer, aerospace engineer, aircraft engineer, license aircraft engineer, license aircraft maintenance engineer and aircraft mechanic. So, what does each of these terms really mean?

This article tries to explain the various categories and classifications of engineers and the differences between each "branch" of this exciting field in the context of Malaysia's human capital requirement in aircraft engineering.

2.0 DIFFERENT ROUTES AND LEVELS OF STUDY OR TRAINING

2.1 Aeronautical Engineers

The American Engineers' Council for Professional Development (ECPD, the predecessor of the Accreditation Board for Engineering and Technology or ABET) has defined engineering as follows:

"*The creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilising them singly or in combination; or to construct or operate the same with full cognisance of their design; or to forecast their behaviour under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property.*"

As such, aeronautical or aerospace engineering encompasses the study of scientific principles, and all other knowledge to design, build and operate flying vehicles safely and economically. Traditionally, aeronautical refers to the engineering of flight within the Earth's atmosphere while the term aerospace, which most universities began to use in the 1970s, refers to the engineering of flight outside of this atmosphere. Note that, generally, flying vehicles can be divided into flying within the Earth's atmosphere (aircrafts, missiles and rockets) and/or flying outside the Earth's atmosphere or space vehicles (rockets, satellites and spacecrafts). Today, the term aeronautical and aerospace engineering are synonym and used interchangeably throughout the industry.

In Malaysia, aeronautical or aerospace engineering programs are being offered by various institutions of higher learning, which include Universiti Teknologi Malaysia (UTM), International Islamic University (IIUM), Universiti Sains Malaysia (USM) and Universiti Putra Malaysia (UPM). These programs aim to produce design engineers who are prepared for work in new aircrafts design and construction projects. These courses normally include understanding the basics of flight; the design, analysis, development and testing of a new aircraft or its derivatives

(To be continued at page 12)

(although each institution has a different emphasis); and modification designs. Other subjects include gas turbine engine (jet engine) technology as well as non-core subjects such as management and economics.

Graduates of aeronautical or aerospace engineering are basically the creative component of the industry, as such, they would be able to secure work in a variety of industry environments: aero and aero-related industries such as aircraft design, wind tunnel design and operations, flight simulator design and construction, gas turbine design, construction and operation (in the power generation sector), ground vehicle design and testing, industrial aerodynamics including building aerodynamics and wind energy. The graduates would also be familiar with design reviews of satellite technologies, rockets and helicopters, to enable them to venture into these fields.

It is worthwhile to list here some of the related aviation and aerospace companies which are also major employers of aeronautical and aerospace engineers in Malaysia. They are Composite Technology Research Malaysia (CTRM), SME Aviation Sdn Bhd, Hexcel and Spirit Aerospace (designing and building aircraft, Tier 1, major aircraft component manufacturer) STRAND, Avcen Ltd (aircraft design, aircraft structural stressing and aircraft control design), Astronautics Technology Sdn Bhd (ATS) (manufacturer and operator of Malaysian satellites), Royal Malaysia Air Force (RMAF), Malaysia Airlines (MAS), Malaysian Navy Air Squadron, Army Air Squadron (aircraft operators and MROs), GE Malaysia, Eurocopter Malaysia, AIROD, Satang Jaya Sdn Bhd, ATSC (maintenance, repair and overhaul of aircrafts – MRO), Ikramatic Systems and Sapura Aviation (flight simulator design, avionics and control system design and maintenance). Of course, there is also a multitude of aircraft and aircraft parts suppliers and distributors.

These graduates are also able to secure employment in other fields of engineering, especially in mechanical engineering, as the programs are designed with a strong grounding in basic sciences and basic engineering in that discipline. Some of these graduates are employed by the power generation industry, as well as the oil and gas industry. Some are involved in specialised consultancy fields such as vibration and noise, and also in the energy audits of buildings. Basically, graduates in aero engineering are quite nimble, and are adaptable to many other engineering fields.

2.2 LICENSED AIRCRAFT ENGINEERS

It is a norm for the aviation industry that technical and maintenance skills are taught in programs to produce Licensed Aircraft Maintenance Engineers – sometimes referred to as LAEs. In Malaysia, these programs are offered by UniKL-MIAT, RMAF Technical Institute, MH Academy and several private colleges. The main emphasis of these programs is to train skilled technicians to maintain an aircraft to serviceable standards as required by a particular authority or regulatory body – in Malaysia, it is the Department of Civil Aviation (DCA) for civilian aircrafts and the Safety Directorate of the RMAF.

Graduates of university programs are not trained to attain skills as required by a LAE. Graduates who want to be a LAE need to undergo the required skills training as required by the DCA which, in current Malaysian practice, requires another three years of training (A fresh school leaver requires five years).

After obtaining the proper qualification, LAEs will be further trained on "specific parts of the aircraft" (*i.e.* airframe, power plant or avionics) and on "specific types of aircraft". They are then called LAE with TYPE RATING, *e.g.* airframe engineer rated for Boeing 737. An LAE could also be licensed or rated for multiple aircraft types. However, it is rare for someone to take up different disciplines, such as avionics and airframe. UniKL-MIAT, MH Academy, TAFE College and the Royal Malaysian Air Force Engineering School now conduct courses at Certificate and Diploma levels which produce LAEs Without Type Ratings. These graduates have to undergo further hands-on training on specific aircrafts to qualify for Type Ratings.

In the aviation industry, LAEs are normally employed by airlines and aircraft operators such as MAS, AirAsia, the RMAF, Malaysia Helicopter Services, AIROD, and other maintenance, repair and overhaul organisations (MROs). Their employability is less flexible – basically they are attached to the MRO, but they are quite mobile across aircraft operators as most aircraft operators operate a standardised maintenance procedure (most nations employ safety standards based either on the British or the American Standards), and operate the same popular aircraft models. Clear examples are MAS operating Boeing 737s while AirAsia operates and ordered up to 225 Airbus A320s.

Some LAEs do opt to be Engineering and Aircrafts Inspectors, *i.e.* they work with DCA to certify LAEs and certify aircrafts. They are basically the enforcers of the various aviation laws in the country.

2.3 FLIGHT ENGINEERS

A flight engineer monitors, sets and adjusts engine power during take-off, climb, cruise and go-arounds, or any other time the pilot requests for a specific power setting. The flight engineer also sets and monitors the following systems during flight: cabin pressurisation, fuel, engine carburation, air conditioning, hydraulic and electrical systems. These were the norms when aircraft engines were complex systems and each aircraft was fitted with multiple engines.

The flight engineers will also be responsible for the pre-flight and post-flight aircraft inspections [3, 4]. A flight engineer is basically the aircraft systems expert onboard, and is responsible for troubleshooting and suggesting solutions to any in-flight emergencies and abnormal technical conditions. They also sometimes have to do minor in-flight repairs of the systems [4, 5].

(To be continued at page 14)

Now, many new technologies are employed in modern aircrafts and aircraft engines to help pilots perform the many flight tasks previously handled by the flight engineers. Virtually all new types of aircrafts now fly with only two pilots, who rely more heavily on these technologies without a flight engineer on board.

On the other hand, military transporters of late are becoming more sophisticated, as such, flight engineers are in demand more than ever. It has to be remembered that in times of war, the number of well trained ground crew to help load the aircraft would be limited, and while in the air, the pilots require the presence of a flight engineer onboard while they are busy evading attacks. Furthermore, in such times, the probability of aircraft systems suffering damages is higher due to enemy action or due to incessant flight operations.

The progression of training for secondary school leavers in each branch of engineering is summarised in Figure 1. For students who want a career in Aircraft Maintenance Engineering, they would be able to start their training immediately after obtaining their Sijil Pelajaran Malaysia (SPM) certificate. They can go for either a certificate-level program or straight to a diploma program. In the program, their competencies would continuously be evaluated and tested, and they would have to improve their skills at every level until they were certified as LAEs Without Type Rating.

For those who are more interested in the aero design type of work, they should aim for a degree in aeronautical or aerospace engineering in a university. Upon graduation, they could register with the Board of Engineers Malaysia (BEM), and after acquiring enough relevant experience (a minimum of three years), they could apply to be a registered professional engineer which carries the title of Ingenieur (Ir.).

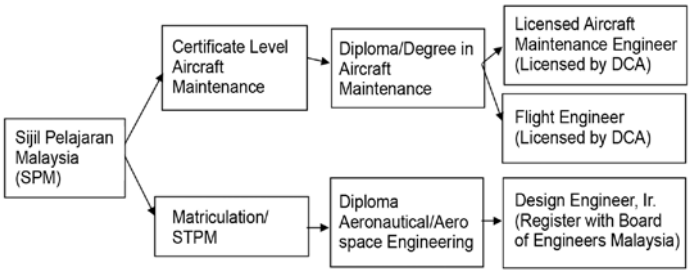

Figure 1: The general progression of training to be Licensed Maintenance Engineers, flight engineers and aerospace or aeronautical engineers

Table 1: Malaysian aircraft operators and their current and future fleet

Company	Aircraft Fleet	Numbers	Remarks
Malaysia Airlines	Total current fleet	100	In service
	A380	6	On order
	B737-800	35	On order [10]
	A330-200F	2	On order [10, 11]
	A330-300	15	On order [10, 11]
Air Asia	A320	61	In service
	A320	164	On order
	A430	2	In service
	A350	15	On order
Malaysian Armed Forces	Fleet of various fixed wing aircraft types	About 100	
	Various helicopters	32	Nuri to be replaced soon
	A400M	4	On order
Malaysian Police	Fixed wing	14	3 X Cessna 206G to be taken out of service soon
	Helicopter	6	In service
Malaysian Maritime Enforcement Agency	A139 helicopter	3	On order
	AS365N3 Dauphin	3	In service
	Canadair CL415MP	2	1X in service, 1 X on order

3.0 MALAYSIAN HUMAN CAPITAL REQUIREMENT IN AIRCRAFT ENGINEERING IN MALAYSIA

Looking at the statistics of aircraft operating fleets in Malaysia, and those that are on order by Malaysian aviation operators (Table 1), it is clear that the MRO activities in Malaysia would be very busy for the next 20 to 25 years. These MRO activities do not only include the normal services to keep the fleet in operation, but would also include major overhaul and Life Extension Programs for ageing aircrafts. In 2002, the value of MRO activities in Malaysia was RM1.4 billion [6].

The Government of Malaysia is also encouraging MRO activities, not just for Malaysian aircrafts, but also for external MRO contracts. This is very attractive as the value of external MROs is very lucrative, not just in monetary terms, but also for the standing of Malaysian technical expertise especially within the region. The experiences of AIROD and CTRM illustrate this case in point.

One sure benefit is the potential aircraft components design and manufacturing contracts from various aircraft manufacturers. In October 2009, CTRM signed a major business deal worth RM3.5 billion over 20 years which would boost its position as a world player in the airline component manufacturing industry [7, 8], and it is trying to increase that to RM8.5 billion [8]. In another development, MAS and renowned engine manufacturer, Pratt and Whitney, had signed a memorandum of understanding in December 2009 to set up a joint-venture facility for engine nacelle repair in Malaysia [9].

The next potential benefit is the design and manufacturing of aircraft as a whole. This will not be done by Malaysia alone, but in collaboration with other countries. This was announced by

Spirit Aerosystem Inc. which has just started operation in Malaysia. The company aimed to start the design and manufacture of carbon composite aircraft to replace about 8000 metal single-aisle aircrafts now in service worldwide [9, 10]. The potential in this market is about RM60 million per aircraft, giving a total of RM480 billion.

Aeronautical engineers are also employed in other fields of engineering that are directly or indirectly related to aeronautical engineering. Fields that are directly related to aeronautical engineering are those that require solutions involving air (and gas) flow such as the vehicle, gas pipeline and vacuum cleaner industries. Other fields include the structural design and power industries.

4.0 CONCLUSION

Aeronautical and aerospace engineering involves the design, fabrication, testing and development of new aircrafts, their components and systems. It requires engineers to apply the underlying sciences towards viable technological solutions of the projects. Furthermore, they have to design the maintenance and servicing regime of the aircrafts until the end of its service life.

Aircraft maintenance engineering involves the actual maintenance and management of the life of the aircraft systems and their components once they are actually in use. It can be said that they are more involved with the hands-on work to keep the aircrafts in safe operation. Its demand in Malaysia is increasing as Malaysian aircraft operators continue to increase their fleets. On the other hand, the requirement for flight engineers keep reducing as the fleet is being replaced by modern aircrafts, except in the military.

It is hoped that this article provides the understanding of the differences of the various designations of engineers in the aviation industry. In short, the aeronautical or aerospace engineers are the creative branch, while LAEs and flight engineers are the skills side of the industry. ■

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