SPECIAL KNOWLEDGEAND SKILLS NEEDED FOR AVIATION MAINTENANCE, REPAIR AND OVERHAUL (MRO) INDUSTRY

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ABSTRACT

The aviation industry is one of the most regulated global industries that connects people, create new travelling to various places and worldwide transportation. The aviation industry includes Airports, Airlines, Aero-manufacturing, Aircraft maintenance, Repair, and Overhaul (MRO), system integration, logistics, and other relevant businesses. As the recent Thailand strategic development plan aims to be an aviation hub in ASEAN, the aircraft MRO industry is in need for urgently and efficiently development. This research focuses on the aircraft MRO industry and the required specific knowledge and skills for MRO workforce development in this industry. The objective of this research is to identify gaps between the workforce demand for specific knowledge and skills complied with the MRO industry regulations and the current supply, which are the courses offerings in Thailand. The qualitative research method has been applied to identify the special knowledge and skills and regulation standard for the MRO industry. The literature review method has been conducted for understanding the current supply of the course offerings in Thailand. Finally, the gap findings from this study showing the demand for the industry-specific knowledge and skills and the supply from academic and non-academic institutes will be used for MRO workforce planning in the future.

Keywords: Maintenance, Repair and Overhaul (MRO), Aviation, Workforces, Knowledge and skills, Training

1. INTRODUCTION

The aviation industry is a significant turning point in current because the aviation industry is an industry that connects modernity and successful in all aspects making the world today become a globalised era (Price and Forrest, 2016). The aviation industry includes Airports, Airlines, Aero-manufacturing, Aircraft maintenance, Repair, and Overhaul (MRO), system integration, logistics, and other relevant businesses. In this research will focus on Maintenance, Repair and Overhaul (MRO).

MRO will cover general maintenance and aircraft maintenance before takeoff which may be different for the number of hours spent flying according to the number of ups and downs of the areophane or the lifespan of the aircraft. (Business Innovation and Skill, 2016). This industry spend billions of dollar every year to comply with such requirements, which represent a relevant portion of their total operational costs. The world's trend found MRO relocation to Asia-Pacific, Middle East, and Latin America has higher rate because of the lower wage and more workers. In

these countries, there will be the maintenance in the newly built airport or the second airport to avoid the heavy traffic of the main airport. In current, MRO Clusters in the Asia-Pacific will be in Singapore, Hong Kong, East China, and Australia. (Office of Transport and Traffic Policy and Planning, 2015)

Nowaday, Thailand has planned to develop the country as an Aviation Hub, according to The Twelfth National Economic and Social Development Plan (2017 - 2021), which has an aviation industry as one of its development goals and The Ministry of Transport Strategic Plan (2017 - 2021) with focus on human resource development, transportation research and innovation to increase the capabilities of the personnel to be able to perform the task. As mentioned above, MRO is an industry with a tendency to generate income, and the government has pushed a lot to make Thailand as Aviation hub. So, MRO is service of Thialnd's future industry that government will be support.

2. BACKGROUND

2.1 Knowledge and Skills for Aviation MRO

Aircraft maintenance need specialized knowledge and skill beyond the basic engineering and maintenance knowledge. Also, aircraft maintenance requires specialized staff for each area of the aircraft maintenance service. It is not possible to use unlicensed repair technicians in that field to maintain aircraft because the aviation industry is very safety-focused.

ICAO Doc.7192 AN / 857 Part D-1 is training manual of Aircraft Maintenance Engineering (AMEs) that cover both knowledge and skill requirements outlined in Annex 1 – Personal Licensing and Annex 6 – Operation of Aircraft. This manual is the minimum requirements used in the training of Aircraft Maintenance (Technician/Engineering/Mechanic) or personnel.

Table 1. Knowledge and skills of aviation maintenance

Occupation	Knowledge and skills		
	Standard	**Foreign MRO**	**Literature review**
Airframe Maintenance	Chapter 5 in ICAO Doc.7192 AN / 857 Part D-1	- Aerodynamics - Aircraft Propulsion Systems - Aircraft Structure and System - Flight Mechanics - Aerospace Manufacturing Processes, Materials and Structures - Aircraft Electrical Systems	- Aicraft Assembly - Rigging - Fabric Covering - Metal Structure Repair - Welding - Wood and Structural Repair - Advance Composite Materials - Painting and Finishing - Electrical System - Hydraulic and

Occupation	Knowledge and skills		
	Standard	**Foreign MRO**	**Literature review**
			Pneumatic Power Systems - Landing Gear System - Fuel System - Ice and Rain Protection - Fire Protection System - Aerodyanmic - Corrosion Control
Engine/Component Maintenance	Chapter 6 in ICAO Doc.7192 AN / 857 Part D-1	- Gas Turbine Engine - Propeller	- Aircraft Engines - Engine Fuel and Fuel Metering Systems - Exhaust Systems - Ignition Systems - Starting Systems - Lubrication Systems - Cooling Systems - Propeller - Removal and Replacement - Fire Protection Systems - Induction Systems
Avionics Maintenance	Chapter 7 in ICAO Doc.7192 AN / 857 Part D-1	- Digital Technique - Aircraft Avionic Systems - Radio Communications - Aircraft Communication & Navigation Systems - Wireless Communications and Signal Processing - Aircraft Instrument Systems	- Communication and Navigation - Flight Control - Instrument Systems

2.2 Current Aviation Training Courses in Thailand

Thailand has opened the aviation industry and aircraft training courses for a total amount of 25 universities/institutes 60 courses both in Bachelor Degree, Master Degree, Diploma Vocational Certificate, and various training courses. Aviation courses in Thailand divide into two parts: Management and Operational (Technical, Engineering and Pilot).

In Thailand, aviation management and flight operation courses offered in many universities. They emphasise on teaching in both theory and practice both parts of the ground service (Ground Attendant) and providing services on board (Flight Attendant) including Air Cargo Management and Airport Management. Moreover, operational aviation courses (Technical, Engineering and Pilot) in Thailand has a lot fewer institutions offering this course than aviation management courses. Most of them focus on providing training courses on commercial pilots. For the aircraft maintenance

course (technician and engineering), very few institutions offer this course, such as Civil Aviation Training Center (Thailand), Chulalongkorn University, Kasetsart University and Assumption University of Thailand etc.

Table 2. Current aviation maintenance knowledge and skills of Thailand

Occupation	Knowledge and skills (Thailand)
Airframe Maintenance	- Aircraft Material and Structure - Aircraft Electrical Systems - Aircraft Propulsion - Aircraft Hydraulics and Pneumatics
Engine/Component Maintenance	- Gas Turbine Engines - Aircraft Propellers
Avionics Maintenance	- Aircraft Instruments - Communications Maintenance - Navigation Systems - Signals and Systems - Digital Techniques

2.3 Gap Analysis

Andreja (2007) suggested that the gap analys is carried out in many contexts for various purposes and to understand and study gaps that express a mismatch between issues of consideration. In the understanding of this research, gaps may refer to an issue of specific knowledge and skills of MRO between the workforce demand for specific knowledge and skills complied with the MRO industry regulations and the current supply.

In this research, we use Gap Analysis to compare knowledge and skills between ICAO the standard from Doc.7192 AN / 857 Part D-1, the literature review and MRO's courses from other countries with the current MRO curriculum offered in Thailand. To find knowledge and skills that Thailand does not meet standard.

3. METHODOLOGY

The research data will be collected from various databases, formatted appropriately, and then analysed using appropriate statistical techniques. This research uses previous documents data to study the difference and gap between the workforce demand for skills current curriculum offer to develop aviation MRO curriculum structure.

In this research, the methodology consists of five steps to answer the objectives. They can explain as follow in Figure 1.

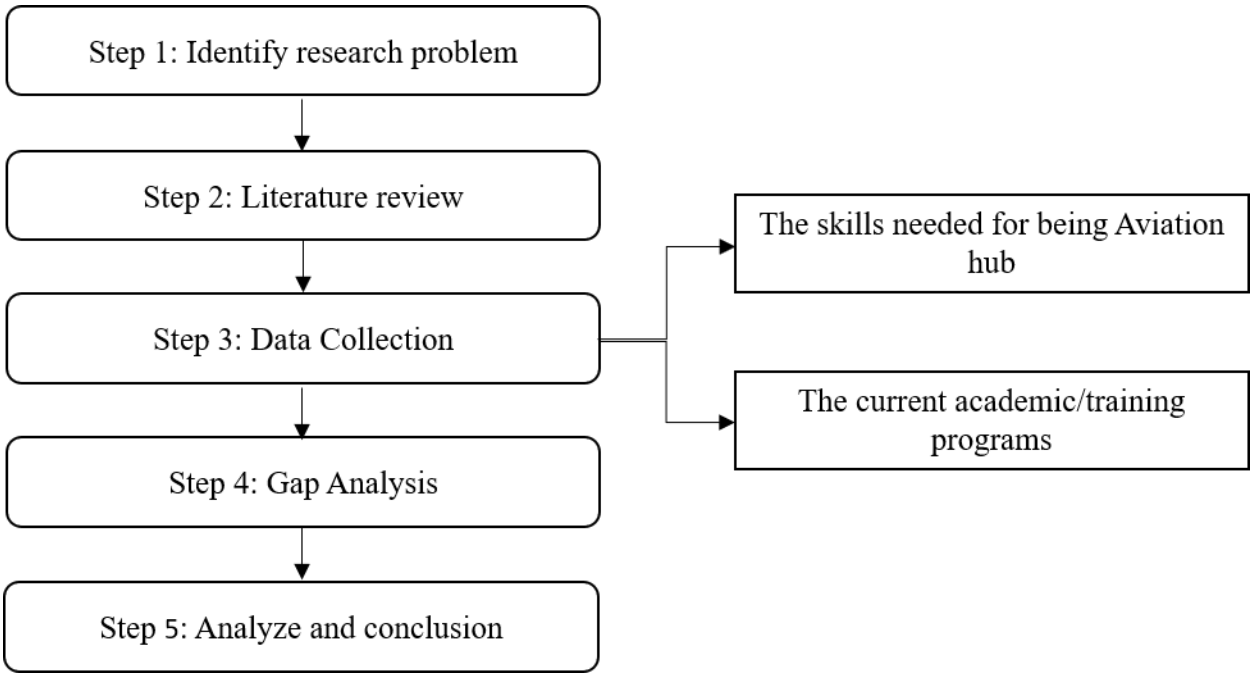

Figure 1. Five Steps to do this research

Step 1: To identify problems, the problem is the new workforces that graduate from an aviation institute do not have skill and knowledge that suitable with their job or field and some course of aviation doesn't appropriate with the position in the aviation industry.

Step 2: To review the previous studies about workforce in the aviation industry.

Step 3: To collect the data from four aviation career groups (80 positions) and 25 university/institute (56 academic courses) and 52 training courses.

Step 4: To analyses the gap between the current aviation MRO curriculum and international standard of MRO.

Step 5: To analyse and summarise a process to obtain which action plan to improve aircraft maintenance course.

4. FINDING AND ANALYSIS

The collected data were compared with the Thailand MRO course by Gap analysis. The results of comparative analysis of MRO curriculum are divided into 3 sections: (1) Airframe Maintenance, (2) Engine/Component Maintenance and (3) Avionics Maintenance according to table 3, 4 and 5 as follow:

Table 3. Comparative analysis results of Airframe Maintenance

Airframe Maintenance	Standard	Foreign MRO	Literature review	Thailand
Aicraft Assembly	○	○	○	○
Rigging			○	
Fabric Covering			○	
Metal Structure Repair	○		○	○
Welding	○		○	
Wood and Structural Repair			○	
Advance Composite Materials			○	
Painting and Finishing			○	
Electrical System	○	○	○	○
Hydraulic and Pneumatic Power Systems	○	○	○	○
Landing Gear System	○	○	○	○
Fuel System			○	
Ice and Rain Protection	○		○	
Fire Protection System	○		○	
Corrosion Control	○			
Aerodynamics	○	○	○	○
Aircraft Propulsion Systems		○		
Flight Mechanics		○		
Aerospace Manufacturing Processes, Materials and Structures	○	○	○	

Table 3 shows the results of the comparison of the Airframe Maintenance course from the literature review, standard from ICAO and MRO's courses from other countries with the current MRO curriculum offered in Thailand. This research found that the current MRO curriculum still lacks in terms of Rigging, Fabric Covering, Welding, Wood and Structural Repair, Advanced Composite Materials, Painting and Finishing, Fuel System, Ice and Rain Protection, Fire Protection System, Corrosion Control, Aircraft Propulsion Systems, Flight Mechanics and Aerospace Manufacturing Processes, Materials and Structures.

Table 4. Comparative analysis results of Engine/Component Maintenance

Engine/Component Maintenance	Standard	Foreign MRO	Literature review	Thailand
Aircraft Engines	○	○	○	○
Engine Fuel and Fuel Metering Systems	○		○	
Exhaust Systems	○		○	
Ignition Systems	○		○	
Starting Systems			○	
Lubrication Systems	○		○	
Cooling Systems	○		○	
Propeller	○	○	○	○
Removal and Replacement			○	
Fire Protection Systems			○	
Induction Systems	○			
Gas Turbine Engine	○	○		○

Table 4 shows the results of the comparison of the Engine/Component Maintenance course from the literature review, standard from ICAO and MRO's courses from other countries with the current MRO curriculum offered in Thailand. This research found that the current curriculum still lacks in terms of Engine Fuel and Fuel Metering Systems, Exhaust Systems, Ignition Systems, Starting Systems, Lubrication Systems, Cooling Systems, Propeller, Fire Protection Systems and Induction Systems.

Table 5. Comparative analysis results of Avioics Maintenance

Avionics Maintenance	Standard	Foreign MRO	Literature review	Thailand
Communication and Navigation	○		○	○
Digital Technique	○	○		○
Aircraft Avionic Systems		○		○
Radio Communications		○		
Wireless Communications and Signal Processing	○	○		○
Flight Control	○		○	○
Instrument Systems	○	○	○	○
Autopilots	○	○		
Full Authority Digital Electronic Controller			○	
Electronic engine controller (EEC)			○	

Table 5 shows the results of the comparison of the Avionics Maintenance course from the literature review, standard from ICAO and MRO's courses from other countries with the current MRO curriculum offered in Thailand. It is found that Thailand still lacks in terms of Aircraft Avionic Systems and Radio Communications.

5. RESULTS

In this research focus on gaps between the workforce demand for specific aviation maintenance knowledge and skills with the MRO industry regulations and the current supply, which are the courses offerings in Thailand. The courses that Thailand lacked and need to develop to improve aviation workforce to cover all aspects of aircraft maintenance consisting of 3 groups consisting of (1) Airframe maintenance (2) Engine/Component maintenance and (3) Avionics Maintenance.

The airframe maintenance are consisting of interior group (Fabric Covering, Wood and Structural Repair and Painting and Finishing), protection group (Ice and Rain Protectiona and Fire Protection System) and structural group (Materials and Structures, Fuel System and Aircraft Propulsion Systems) etc. The course in engine/component maintenance that need to improve are Engine Fuel System and system that support engine fuel (Exhaust Systems, Ignition Systems, Starting Systems, Lubrication Systems, Cooling Systems Fire Protection Systems and Induction Systems) etc. The avionics maintenance that need to improve are Radio Communications, Autopilots, Full Authority Digital Electronic Controller and Electronic engine controller (EEC).

Therefore, Thailand need to develop the courses of aviation maintenance to meet the standard of ICAO for support the expansion of aircraft maintenance centres according to the plan of those involved.

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