Conference Paper

Aircraft Maintenance Engineering Higher Apprenticeship: Review and Challenges

Nithia Kumar Kasava

BTS Consulting and Training, Bina Tech Service (M), Bangi, Malaysia

Abstract

This article is a review paper to discuss the definition of apprenticeship and differentiation between apprenticeship scheme and school-based vocational education model for aircraft maintenance engineering. The author explores literature between years 2015 and 2017 related to apprenticeship. Besides academic literature, the author reviewed Australia, Malaysia, Indonesia and United Kingdom apprenticeship-related documents. This was to ensure that a rigor literature review was conducted prior further author's review discussion. The author used observation and secondary government document archival data in this article. The author discussed the flow of an aircraft engineering apprenticeship programs conducted by legacy air carriers. The future trend has shifted aircraft engineering apprenticeship program from purely work-based vocation training to mix school-based vocational education training. This paradigm shift were driven by business outsourcing model, reduction airline training cost, technological change, digitizing aircraft and reduction of basic training equipment purchase and syllabus standardization across the industry. In conclusion the author recommended future agile apprenticeship integrated school-based vocational conceptual model for aircraft maintenance engineering apprenticeship program. This conceptual model was to overcome the current challenges of digitization industry, standardization of syllabus and skill.

Keywords: apprenticeship, aircraft maintenance vocational education

Corresponding Author:
Nithia Kumar Kasava
nithia78@gmail.com

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1. Introduction

The apprenticeship system has been established for work-based skilled or craft training since 1563 in England [1]. There are many definitions derived for apprenticeships. The definition from *Meriam Webster* dictionary define an apprenticeship as:

> "One who is learning by practical experience under skilled workers a trade, art or calling".

Under the Ministry of Manpower and Transmigration's regulation No. 22/2009 of Indonesia the definition of an apprenticeship as follows:

> "A part of a training program that is conducted based on the combination of mentorship at training institution and guidance by senior employees (in the workplace) in the process of production of goods and services at companies with the goal to master certain set of skill" [2].

Apprenticeship started as an informal training for craft and trade to meet the industrial demand. Today the apprenticeship programed have evolved from informal shop floor orientated training to a formal vocational work-based education. The level of theory and practical ratio embedded in the apprenticeship program depending on the criticality and complexity of job designed knowledge needed. In this article, the author uses aircraft engineering apprenticeship. Hence this is a critical and high technology-based industry, which require a higher degree of knowledge and practical skilled need. Thus the apprenticeship training period commonly will last about four years. Aircraft engineering apprenticeship program also known as the higher apprenticeship scheme.

2. Review

2.1. Method and review

This article is a review paper involving aircraft maintenance engineering apprentice training. Hence, the author carried out literature review from academic journals to government policy documents for the latest body of knowledge in this area. The author uses airlines apprenticeship models to propose a conceptual model for aircraft engineering apprentice program. The literature reviewed from the year of 2015 to 2017. However the government policy documents were from Australia, Malaysia, Indonesia and United Kingdom. The author reviewed aircraft maintenance engineer licensing document with National Aviation Authority of United Kingdom.

The apprenticeship program is to train men and women in traditional and non-traditional scheme. The apprenticeship has been supporting the economic sector in manufacturing, construction and resources [3]. Figure 1 shows the stakeholders relationship in an apprenticeship system. The stakeholders are the sponsor or the employer whom funding the apprenticeship scheme. The number of sponsored apprentice are based on skilled manpower forecasted taken into consideration of the business expansion demand. The parents of the apprentices are entrusted the employer to groomed and welfare of their youth. Since apprentices are considered an

employee within the organization, therefore the union will be looking into their welfare and benefits. The training department in the organization is responsible to structure a standard apprentice training and examination quality assurance. The external accreditation board and government agency that will oversees the apprenticeship policy and governance. Finally the apprentices themselves are the selected by the sponsor in order to have high rate of successful completion the apprenticeship and be the designed employee in the future.

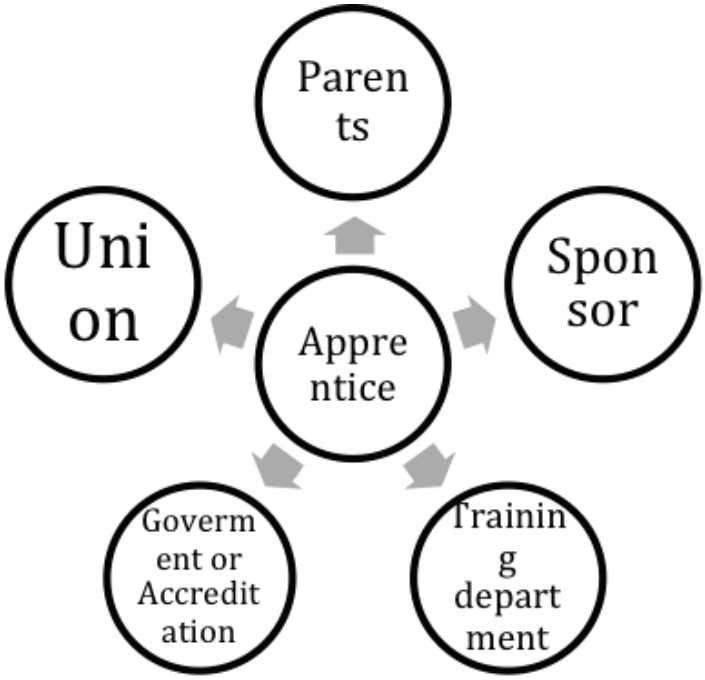

Figure 1: Apprenticeship stakeholder (Megan 2016) [3].

2.2. Aircraft maintenance engineering apprenticeship scheme

The aircraft maintenance engineering is a every growing industry. The term of growing here meant were that the aircraft technology evolution and the number of the aircraft demand. The aircraft need to be maintained in order to be airworthy and safe operation. The aircraft maintenance was carried out by a highly skilled engineers and technicians. The aircraft maintenance engineers and technicians are competent person whom being licensed by the National Aviation Authority. These licensed engineers and technicians were trained in an apprenticeship manner by the airlines or maintenance repair station or also known as MRO.

The aircraft engineering apprenticeship comprises 60 percent theory and 40 percent on-the-job training on aircraft and component maintenance level. Apprenticeship

trades skills were trained based on the airline aircraft type. Therefore, there will be trade skill different from airline to airline. In aircraft engineering the traditional trades skills were airframe technology, powerplant technology, electrical, instrumentation, radio and sheet metal. As the aircraft technology advances the need for trade skills changed. The modern aircraft engineering apprenticeship now have an integrated trade skill. The integrated trade skills are mechanical (combination of airframe and powerplant technology), avionics (combination of electrical, instrumentation and radio) and structural repairman (combination of sheet metal and advance composite repair). The aircraft maintenance engineering apprenticeship is known as higher apprenticeship program. The higher apprenticeship program leads to level five or higher qualification [1, 4]. In this case will be an Aircraft Maintenance Engineer License.

The apprentices under goes a sponsorship program with work-based vocational education with the training department of the airline and the syllabus was set by the licensing body. The licensing body in this case will be Aircraft Maintenance Engineer (AMEL) license granted by the National Aviation Authority. Traditionally the apprentice will do in house theory and practical on-job-training in the airline and when apprentice reach minimum licensing examination age, which was twenty one years old, the airline will schedule the apprentices for the licensing examination.

Once the apprentice passed the aircraft maintenance license then airline will promote the apprentice to the designed job as licensed aircraft maintenance engineer. See Figure 2 summary of the traditional aircraft maintenance engineer apprenticeship scheme as work-based vocational program.

3. Apprenticeship Benefits and Challenges

The work-based vocational apprenticeship scheme was a preferred method of acquiring highly skilled tradesman by legacy airline. This was because legacy airline had a total maintenance and engineering capabilities. Hence, training apprentice to suit their in house technical and technology capability was justified.

In other hand smaller airline and budget airlines had an outsourced business model and supply chain. In this case where school-based vocational education was preferred. The school-based vocational education for aircraft engineering syllabus requirement have been regulated by the National Aviation Authority. This was to balance the theory and practical learning in school based. Since there will be limited on-job-training for school-based vocational learning compared to work-based vocational apprenticeship.

Apprenticeship advantages in the perspective of candidate and parents are:

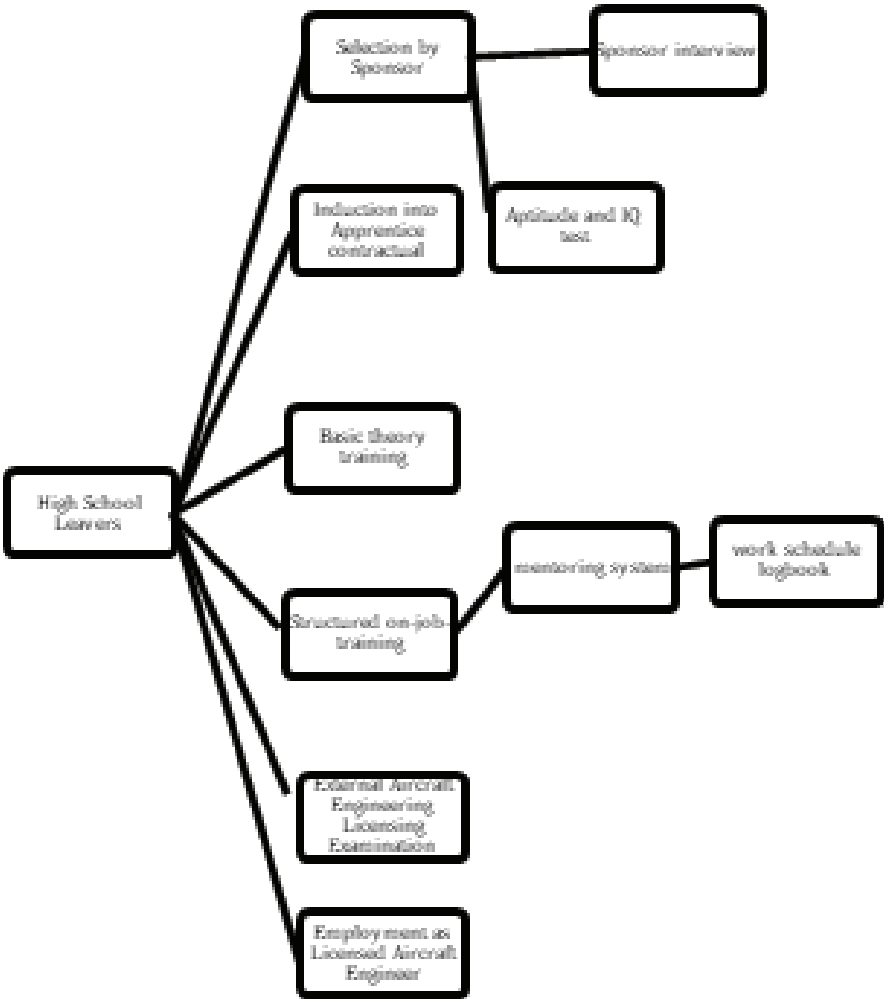

Figure 2: Figure of traditional work-based vocational apprenticeship scheme for aircraft maintenance engineering.

1. Sponsored skilled education
2. During apprenticeship financial allowance provided [5].
3. Employment guaranteed end of completion scheme.
4. Hand on experience on real aircraft operation.
5. Personally trained with mentoring system.
6. Apprentice considered an employee and work experience start at very young age.
7. All study material and tools are provided.
8. Health insurance provided and bound by labor law.
9. Able to grow with the company.

10. Apprentice contractual in the even the company change of ownership but apprenticeship will continue.

The significant difference between apprenticeship and traineeship is basically contractual terms and duration. Traineeship usually shorter terms training and contractual terms if company change ownership the contract will be terminated.

The benefit from the organization from the apprentice is skilled employee retention. This is possible because those from apprenticeship will have 'stayer' behavior compared to those from school-based vocational education graduate whom known as 'mover' [6].

National level apprenticeship reduces the unemployment rate by policy of school to work [7–9]. Apprentice trained have better employment opportunity compared to the school-based vocational education [7, 10].

The challenges that an apprenticeship program experience is funding for the program. Here in a list of challenges for apprenticeship:

1. Lack of funding
2. Decline of participants
3. Low competition
4. Poor reception
5. Digitizing economy
6. Higher training equipment cost
7. Syllabus changes with new authorities regulation
8. Limited sponsorships due to infrastructure capacity

4. Conceptual Future Agile Apprentice

Industry growth expansion need to train more apprentice in aircraft maintenance engineering have cause enormous skilled engineer and technician in the world see Figure 3 for details. Figure 3 shows a forecast of 679,000 new aircraft maintenance engineering need from 2016 to 2035.

The new outsourcing business model has driven for new apprenticeship programs. The legacy airline with vertically integrated supply chain has reduced lately. Therefore the author proposed for a mix model of apprentice vocation education. In this model

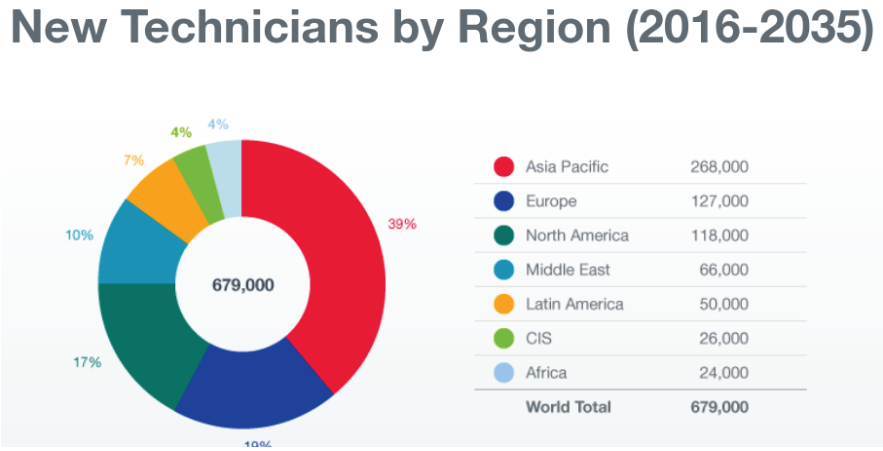

Figure 3: Chart of new technicians by region 2016–2035 (Source: Boeing Pilot and Technicians Outlook Forecast 2016) [11].

the author propose a cross training where by the school-based vocational education will teach the theory part of the learning. The on-job-training will be carried out at the sponsor premise and facilities. This concept will be able to reduce sponsor training capital cost and agile apprenticeship program. Figure 4 shows the digitalization training needs for future high technology aircraft, which demand in depth knowledge in information technology.

In agile higher apprenticeship conceptual model will balance out the theory teaching competency at school-based vocational training and hands on training will be balanced at work-based vocational training at sponsor premises. There is similar model being practiced in a university in Munich Germany and it was called dual system [12].

The difference between German dual program with the agile higher apprenticeship proposed model is that apprenticeship is the domain. Every candidate is being sponsored as an apprentice. This will be a structure program where the sponsor has full authority over the path of the apprentices. The agile higher apprenticeship conceptual model developed to meet 'industrial 4.0' of digitizing of economy. Industrial 4.0 is known as the fourth industrial revolution [13].

5. Conclusuion

The apprenticeship scheme for men and women in aircraft maintenance engineering need to constantly transform to meet the global changes in digitization of economy and work culture. In addition to that aircraft technology have revolutionized from mechanical, analogy, digital and now server-based technology. Hence the knowledge

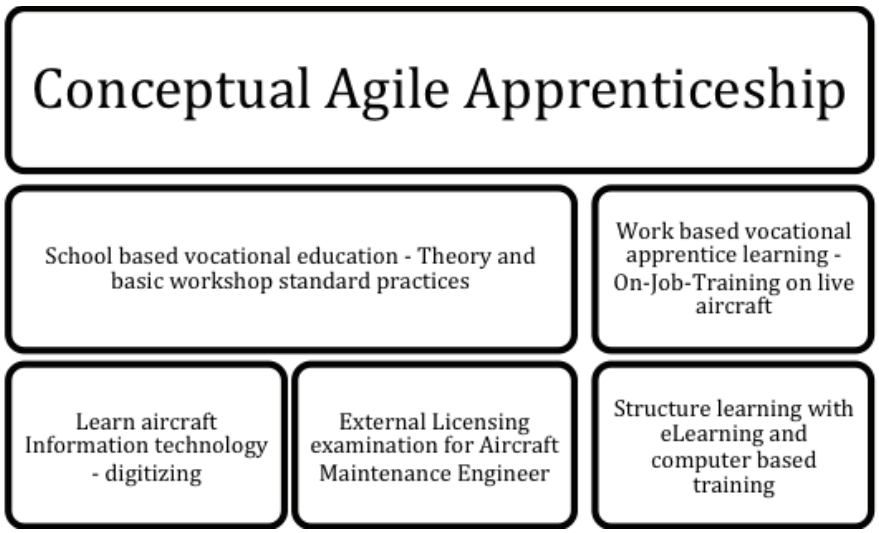

Figure 4: A conceptual agile apprenticeship for aircraft maintenance engineering program.

of modern aircraft maintenance engineering apprenticeship need to be inclined to avionics and information technology skills.

New airline business model where globalization and outsourcing has caused separation of training centers from main airline operation. Therefore traditional apprenticeship scheme became very costly training.

Hence the author proposed a conceptual agile higher apprenticeship model for aircraft maintenance engineering vocational training. This model proposed to meet the digitization of socio economy, core competency of vocational education and hands on on-job-training highest quality.

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