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21ST CENTURY AVIATION MAINTENANCE TRAINING

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THE FUTURE OF AVIATION MAINTENANCE TECHNICIAN SCHOOL CURRICULUM

A university education is provided to students based upon a variety of challenging requirements, ranging from academic accreditation to cost per credit hour. When the requirements for training aviation maintenance technicians in accordance with Federal Aviation Regulation Part 147 are added to the traditional academic requirements, a total of 1900 (student clock) hours must be integrated and the challenge becomes even greater. Training aviation maintenance students is an extremely complex process, and programs should include transportable "soft skills" such as the four "C's" presented in this paper.

Historical Perspective

An ideal formula for establishing an aviation maintenance curriculum would be to develop it based upon what the Federal Aviation Regulations (FARs) require, and what industry needs. Although the FARs provide general subject matter topics, and specify a level of proficiency which the student must possess upon completion, they were last revised over 20 years ago. They lag significantly behind the current aviation technology. The following quote from Raymond E. Thompson, Chair, ARAC Part 147 Working Group sums it up by saying:

> The CFR Part 147 training curriculum was approved in 1970. Minor revision of the curriculum took place in 1992. With the curriculum subjects and topics embedded with Part 147, curriculum change (i.e. rule change) is difficult and has occurred once in the 38 years since initial rule implementation. The Part 147 curriculum has not evolved to match fundamental changes in aircraft technology. (1)

It should also be remembered that aviation regulations specify only minimum requirements, so a training institution can always provide more courses than are necessary, just not less. Therefore, a more detailed look at what the aviation maintenance industry actually is, may provide a better understanding of what should be incorporated in the college curriculum. Some of the areas to consider are:

- U.S. Civil aviation fleet data
- Aircraft complexity
- Types of maintenance provider

U.S. Civil aviation fleet data

There are over 200,000 civilian aircraft in the United States aircraft registry. These include: 9,100 turboprop airplanes, 10,000 helicopters, 11,300 jet powered airplanes, 16,600 commercial/cargo and 157,100 piston powered airplanes. (2)

All of these aircraft need to be maintained and inspected by either an individual Federal Aviation Administration (FAA) certificated mechanic, or an FAA designated maintenance facility which employs properly trained technicians. The above list categorizes the great diversity in aircraft complexity, and this diversity can be easily seen by comparing the following two aircraft. The

Figure 1 Piper J-3 "CUB"

Piper J-3 (Figure 1) was built prior to WWII, carried two people and was powered by a 65 horsepower four cylinder, air cooled piston engine. The Airbus A-380 (Figure 2) was first flown in 2005 and has four Pratt and Whitney jet engines. It can carry a maximum of 850 passengers and has a range of 9600 miles. Both are on the US civilian aviation registry, and require maintenance in accordance with FAA standards.

Figure 2 Airbus A-380

Aircraft complexity

The older style aircraft, of which the Cub is at least partially representative, were fabricated either with riveted aluminum or fabric material over steel tubes. The newer aircraft use large amounts of composite (non-metallic) material. The Airbus contains approximately 25% composite material construction. Others, like the new Learjet 85 have the entire fuselage manufactured using composites. Historically, the flight controls of small aircraft were controlled by cable connections, or push-pull tubes. Larger aircraft use hydraulic power to move their ailerons, elevator and rudder. Current technology aircraft have been designed and delivered with "Fly-by-wire" electrical controls which transmit the pilot commands through wires to an electronic motor controller. Cockpit instrumentation, which had been designed with individual gauges, now use flat panel technology, with both primary flight displays (PFDs) and multi-function displays (MFDs) that are similar to a flat screen TV. The pilot can scroll thru menu selections ranging from engine monitoring information to airport approach flight information.

Types of maintenance provider

A student graduating from a Part 147 school could possibly work on either of the above aircraft, or become a specialist in any one of the subsystems. For smaller aircraft, the technician conducting maintenance will often be self employed, and will have the responsibility for signing

“Return to Service” in the aircraft maintenance records. Larger aircraft are frequently maintained by FAA Certificated Repair Stations. When these aircraft are “Returned to Service” it will be by an authorized inspector in the repair station, who signs in the aircraft maintenance records for the repair station.

Summary Statement

The U.S. fleet is diverse, with a broad range in technology and maintenance providers.

Current Status

Although some schools develop an area of focus or specialization, in addition to meeting the requirements established in Part 147, no aviation maintenance training institution can possibly train its students to be fully prepared in all technical areas of both historic and modern aircraft. The school’s specialization is often accomplished because instructors at the school come as Subject Matter Experts with a particular area of expertise gained by working years in industry in a specific technical area. This allows the school to develop that specific area, and usually includes developing relationships with industry contacts associated with that area. Examples of this type of specialization are schools that excel in teaching composite materials, avionics, or rotorcraft maintenance. Today’s aviation maintenance training programs are complex environments.

Future Considerations

Programs that incorporate the four C’s can provide transportable skills to their students so that each graduate will have a greater chance of becoming successful.

- **C**ritical Thinking

A short definition of “Airworthy” is that the item “conforms to approved type design, and is in condition for safe operation.” (3) The first part of that definition is objective, and the second part is subjective. Since aviation maintenance is primarily based upon following procedures established by the manufacturer of the product, most laboratory projects tend to be objective in nature. The student either accomplishes the task in accordance with the maintenance instructions provided by the manufacturer or not. Although this effort is partially based upon the FAA specified levels of proficiency, projects should also include grey areas where the student must inspect and analyze a condition, and determine whether or not the product can be “Returned to Service” with no additional effort. This would exercise the subjective side of airworthy and improve the student/employee critical thinking process.

- **C**oncern for Integrity

This skill really follows directly behind the preceding one since the decision made in the critical thinking step must be entered in the aircrafts logbook. There are times in industry when there is intense pressure to “release the aircraft” from maintenance so a revenue flight can be conducted. The student/employee must be able to discern the aircraft condition and decide the proper action.

Quality instruction must be provided in all classes, and this should include activities where the simulated maintenance action is not ready for release. A common saying in aviation is that "Companies come and go, but your signature lasts a lifetime!" Integrity in decision making is an extremely challenging competency to teach, and is probably best modeled by the aviation maintenance instructor, as he/she conducts the course activities and projects.

- **C**lear Ability to Communicate

Maintenance students often are under the impression that since they like the "hands on" experience that comes from being a technician, then as long as they can do the technical aspects of their job, that's all they need to know. Today's workforce is often team based and requires significant ability to communicate, with peers, supervisors, upper management and sometimes customers. Although a speech class is a required course in many four year university curriculums, the students need many more opportunities to prepare and present technical information. Virtually every technical course provided by the maintenance training school should incorporate at least one such student presentation in the class.

- **C**omprehension of the Effects of Human Factors

This is the most important of the four "C"s and figure 3 reflects that nearly 80% of current aviation related accidents are caused by Human Error. (4)

CAUSAL FACTORS OF AVIATION ACCIDENTS

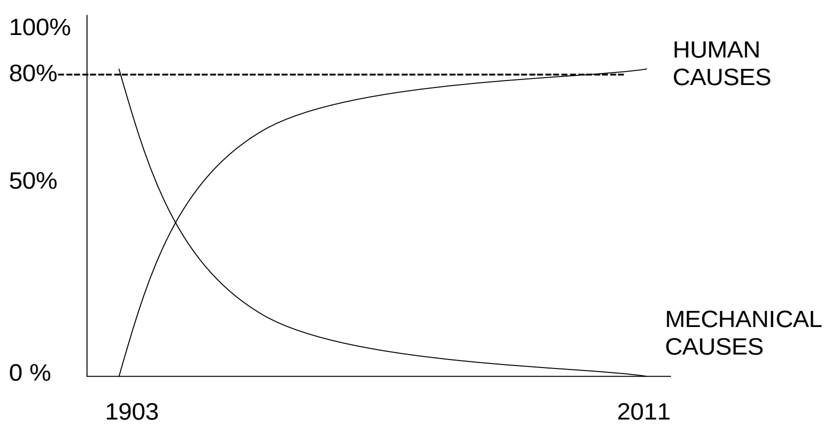

Figure 3

As industry has improved the quality of the product over the last hundred years, the percentage of mechanical causes for aircraft accidents has diminished significantly and the percentage of accidents related to human factors has increased. Although there is neither a singular definition of Human Factors, nor a singular approach to explaining it, there is a definition that captures the essence of human factors:

> "Human Factors is the interaction between: People and People, People and Machines, People and Procedures, and People and their Environment." (5)

Understanding this definition can best be accomplished by understanding that an accident is caused by a variety of contributing factors that interfere with good judgment. This permits a series of events to develop eventually resulting in damage to property and harm to people.

Therefore, the greatest impact in aviation safety will not come from improving the technology. Rather, it will be from educating the student or technician to recognize those factors that allow for human factors and do all they can to prevent them.

Conclusion:

Training the aviation maintenance student today, for future employment is a unique challenge. University responsibilities combined with FAA regulations must be integrated with industry expectations and requirements. Therefore a program should incorporate transportable skills that will enable the student to become a successful employee regardless of his/her specific area of work. The "Four C's" are one way to accomplish that instruction.

- **C**ritical Thinking
- **C**oncern for Integrity
- **C**lear Ability to Communicate
- **C**omprehension of the Effects of Human Factors

Assessment Practices

Successful implementation of the "Four C" concepts should allow the student to:

- Determine the difference between airworthy and unairworthy conditions on a variety of laboratory projects.
- Recognize when undue pressure is being placed on the technician to release an aircraft
- Explain technical problems in a coherent manner, providing clear choices for solutions
- Distinguish factors that may be negatively affecting him/her or someone on their maintenance team, and provide positive alternatives.

(1) Source: Final Report, Part 147 Aviation Maintenance Technician Schools Curriculum and Operating Requirements Working Group, Submission to the Aviation Rule Advisory Committee – Executive Committee December 5, 2008
(2) Source: FAA Administrator's fact book, March 2011
(3) Source: Title 14CFR Part 3, Paragraph 3.5 (a)
(4) Source: FAA Maintenance Human Factors Presentation, May 2008
(5) Source: FAA Advisory Circular 120-72, September 8, 2000