

## **History of Inspection and Auditing in Aviation**

### **Craftsmanship**

In researching this subject it was readily evident how little historical information had been kept concerning the history of this important facet of aviation industry safety. Sandwiched between the exacting work of designing aircraft and the excitement of actually flying aircraft the sphere of the inspection and auditing has not been well recognized or documented.

As the first real flyers, the Wright brothers were bicycle enthusiasts and their early designing and engineering work to develop a flying machine reflected this influence. The framework for their early prototypes was constructed of bicycle piping and silk fabric. Their role as designers and technicians is also reflected in the fact that they made a number of modifications to their flying machines to allow them to fly safely. No one was checking their work, they depended on their own and other craftsman's skills.

The first mechanic to apply his skills to aviation was Charles E. Taylor, an American mechanic, who went to work for the Wright Brothers in June 1901. He was paid \$18.00 per week and was a real leader in the field. He helped to build wind tunnels, airplane engines, gliders and entire aircraft. When one of his early engines failed Taylor completed the first aircraft maintenance task. Despite his early successes he was found penniless in 1955. The American aviation industry, in recognition of his great contribution to the early roots of aviation, raised funds and installed him in a private senior's home. When he died on January 30, 1956 at the age of 88 he had no family so he was buried in Folded Wing Mausoleum dedicated to aviators. Today the Federal Aviation Administration (FAA) has a special award named in his honour.

The first licensed Air Engineer in Canada was Robert McCombie who received License No. 1 on April 20, 1920. He worked very closely with Roland J. Groome who held Canada's first Commercial Pilot's License. Both McCombie and Groome were working in Regina, Saskatchewan at the time.

Those times were the time of craftsmanship. Both these individuals expressed it. It was expected that each mechanic/technician was a skilled craftsman who

inspected and thereby certified his own work. This tradition of self inspection carried on until the advent of the First World War. The demands for parts interchangeability and mass manufacturing lead to the first organized inspection systems.

### **Inspection**

Technicians found jobs as aircraft and component inspectors in the military production systems. Airworthiness Inspection delegates were created, a tradition that carried on over the Second World War. Inspectors had discrete tasks to accomplish; measure parts, inspect for workmanship and so on. The technology in both aircraft manufacturing was changing as was the complexity of the aircraft systems.

The effect of the Second World War on aircraft maintenance safety was felt into the nineteen seventies. When I joined the Ministry of Transport (later renamed Transport Canada) in 1975, we still had maintenance inspectors working there that had been Airworthiness Inspection Division Inspectors during the war at aircraft and component manufacturing facilities. The regulatory system in civil aviation manufacturing and maintenance was very much continued on from the 1940-1945 period. Resident government inspectors at facilities were still commonly employed doing the same sort of job they did in over the last 30 years. Much regulatory compliance was simply accomplished by the fact everyone seemed to know everyone else in the industry and workmanship pride was the watch word. However, a general move was being made away from personal skill and responsibility to a systems approach. This went too far as I will explain later in my conclusions.

At this time, flight safety was still very much considered to be related to pilot capability, depending on a pilot's skill to overcome equipment failures and operational challenges. Accident investigators blamed pilot error when no other cause could be found. But some people began to think in terms of preventing accidents rather than finding a cause and apportioning blame after the fact. This thinking began to be applied to the maintenance work world as well.

In both military and civilian aviation in the '60s and '70s we had lots of manuals and procedures. I remember taking only one very short course about a maintenance control manual and then it was back to work. We all knew we had to

complete logbooks, snag sheets, etc. but our safety-system knowledge was sparse at the working level. The addition of new trades based on the electronics revolution meant that many old time aviation personnel were being replaced by newcomers without the intensive background previous technicians had. This was aggravated by the more complex jet powered aircraft that had arrived and overtook the aviation business. Therefore, management systems were needed to ensure the new generation of technicians understood the entire system. This led to applying the newly developing quality control philosophy to aviation maintenance work.

### **Quality Control and Quality Assurance**

By the late nineteen fifties industrial managers searching for more reliability and durability came to develop the organized principles of quality control. Courses were developed and taught in colleges and universities. The general principle was that detailed manuals of procedures supported by direct inspection and statistical analysis of problems would lead to better products. It did, but of course soon led to a more mature system called Quality Assurance which relied more on systems and procedures rather than inspection. This led to much more regulatory effort on maintenance control systems, inspections and audits by industry and the government. It was obvious by the '80s that a different approach to aviation safety was needed, an even more complete systems approach. This became known as Quality Assurance whereby the top manuals committed the organization to a basic set of principles of how to manage quality and regulatory compliance. It was still to be backed up by quality control procedures and direct inspection.

### **Human Factors**

One of the greatest advances was the introduction of the human factors approach to understanding human error. Applied first among flight crews it certainly has added to safety in maintenance operations. It has also helped to save many technicians from being disciplined to show that some action was taken after an incident. Thankfully those events are less frequent now.

People in aviation came to realize that safety could be improved by the understanding of human factors, sharing data and perhaps most surprising, moving away from a punishment attitude toward mistakes made to one of

learning from that mistake. With the advent of almost instant global news reporting, aviation accidents around the world added to the safety worries of the public and helped drive further changes in aviation safety culture

Due to the increasing number of aircraft flying and steady increase in passenger traffic, many advanced aviation country safety regulators were looking for new ways to decrease the accident rate. The number of accidents were low but increased size of aircraft made aviation accidents news worthy and a major concern to politicians responsible for air safety.

### **Safety Management Systems (SMS)**

By the 1990s, Quality Assurance became firmly established as the model used by aviation maintenance to assure safety. This model was also being applied to flight operations as well as maintenance activities around the world.

Still accidents continued to happen and with increasing global aviation traffic, another move was needed. Senior aviation managers and regulatory managers were concerned that the current systems were unable to bring the accident numbers down. Tying this to projected traffic growth around the world lead them to SMS to affect a future decrease. The accepted solution was to be SMS. A system well proven in the petroleum and nuclear industries.

SMS, a concept of managing safety first was developed by the energy companies due to them having to deal with so many safety hazards. Canada, among others, soon began promoting a safety culture that started with the Chief Executive Officer and moved on down. Laws were changed to make senior managers more accountable than before. It had been noted that many failures found under the older Quality Systems could be tied back to lack of senior executive support on the resourcing side.

Human Factors took on a life of its own as well. It was soon recognized that SMS needed a non punitive enforcement system which could only be based on the new field of human factors. So the two grew together. One fault of earlier systems was that an organization could escape retribution by punishing someone lower down the food chain and calling the problem solved. SMS made that a last step only to be used in serious personal action to deliberately circumvent the rules and systems. Human error was to be corrected by other means.

The work on SMS really began in earnest in aviation in the early years of the 21<sup>st</sup> century and is now widespread, especially among the larger operations. As an aside, it has now been brought into the medical field. I just completed a knee operation where the surgeons told me they got the handoff procedures from aviation SMS. Nice.

### **Conclusion**

My take away from witnessing all of these changes; from direct inspection, into Quality Control, Quality Assurance and then SMS is that the fundamentals used in the early years are still very valid. I will not try and argue that the new systems approach is not working or are wrong. My background and experience has shown that you need highly skilled craftsmen and women working in a well managed safety system.

There has been one troubling idea that developed as we transitioned through these changes is the idea that personal accountability and technical skills are not that important anymore. Some Individuals were so taken in by the quality assurance advances back in the early nineteen eighties they actually proposed eliminating government certification of technicians. Fortunately, that was defeated and personal certification, integrity, training and accountability still under pin the aviation maintenance safety system. In addition, non certified trades now have national standards.

In closing, maintenance professionals must be careful that this attitude does not creep back in. Safety is first and foremost based on individual skill, integrity, education and a high standard of personal dedication to airmanship.