Qualcon 2005

One hundred plus four years of motorized flight: From Gustave WHITEHEAD to A380, the world's biggest Aero People Mover (APM).

Lou (A.P). MAGRITZER, Acn.-IAQ
Principal Consultant & AS 9100 AE Lead Auditor
AQAC International
Box 115, Merrylands, (Sydney), NSW, 2160, Australia
Tel / Fax + 61 + 2 + 9760-0315
Email: amagritz@bigpond.net.au
Web: www.aoqnsw.com.au/consultants

ABSTRACT

*The motorized Aerospace Industry had its birth in 1901, the same year the Australian Federal Government was established. It took a 104 year long journey to progress from the first motorized flight to the recent test flight in the world's biggest Aero People Mover (APM). From the American-built twin-engine single-seat monoplane named "Dove 21" by its designer and pilot, Gustave WHITEHEAD, to the present European-built A380 Airbus, seating 555 passengers.

*No ordinary air traveler could imagine even a decade ago that in the year 2005 a much bigger APM, other then the well known Boeing 747, would trans-travel our globe. This fantastic technical advance in the Aerospace industry, is largely due to the high quality, safety and reliability of its hardware and software, skilled People and QMS Systems.

*And almost since the beginning of flights with passengers , it has been necessary, to ensure ongoing flight safety and controls. Therefore, National and International Civil Aviation Authorities and Standard bodies, had to introduce the necessary regulations and standards for product, process and management systems.

Keywords: Aero People Mover, Flight Safety, ISO 9001, AS9100, Human error defects, Human factors, Bogus parts, SUP, FAI, Whitehead, Airbus, Boeing,

INTRODUCTION

*The early civil aviation history appeared to be relatively simple as far as product ,procedures and regulations were concerned. For example, in 1928, a "Technical Memorandum" issued by the Commonwealth of Australia titled "Repairs to Civil Aircraft" consisted of three separate requirements defined in three sentences. This simplistic situation certainly changed in the second half of the 20th century with an explosion of National, Federal and Joint Aviation Regulations and standard requirements.

.

*It took also more than a century for the world-wide (civil and military) aerospace industry to agree on and issue a common industry-specific Quality Management System (QMS) standard, namely the ISO 9001 based SAE-AS 9100 family of management and audit standards.

*The author proposes that all the elements of the AS (Aerospace Standard) could be employed by most other transport or safety-critical industries, in order to further reduce risks of potential man-made disasters, business failures /disappointments, use of bogus parts and human errors in general.

SUMMARY

This paper focuses on four key aspects associated with motorised flight:
(1) Aerospace history - the earliest aviation pioneers and the latest space heroes ,
(2) Risks and some catastrophic outcomes associated with flying and flying machines,
(3) the development of Regulatory requirements and
(4) Standards (focusing on the new SAE-AS 9100B family of QMS)

1 AVIATION PIONEERS AND SPACE HEROES

1.1 Whitehead and the Wright Brothers

*Nowadays there should be no longer any doubt at all, particularly in the global aviation industry, that piloted motorized flights really began about 2 ½ years before the legendary WRIGHT brothers flight in 1904. Actually all began in the USA with four flights on 14 August 1901, piloted by a hands-on mechanical engineering genius, named Gustave WHITEHEAD.

* A couple of American newspaper reporters described in words and picture what they witnessed on that historic northern summer's day in Bridgeport, Connecticut. The pilot was a GBA (German-Born-American) by the name of Gustav WEISSKOPF (1864-1927), known in the USA as Gustave WHITEHEAD who migrated to the US a few years earlier.. WHITEHEAD reportedly achieved this historic flight with his 21st home-built twin-engine aircraft, he affectionately named "Taube" in German, meaning "Dove" in English.

*The German magazine 'Neue Revue'(Nr 18, dated 30-4-1998, page 62/63), features a story about WHITEHEAD and his achievements, titled:
"Luftfahrt-Sensation, Jetzt bewiesen: Ein Deutscher hat das Flugzeug erfunden".
Roughly translated it means: "Aviation sensation: Now proven: A German discovered the Flying machine (Aeroplane)."

*This Neue Review article reported by Jochen DERSCH also describes a successful motorized flight, almost a hundred years later, on 18 February 1998. Horst PHILLIP, ex Luftwaffe Test pilot flew an exact copy of the aircraft, the 'Taube / Dove" with its two light-oil engines. All components were rebuilt to the original specifications by the Whitehead-Fans from the Research Society WHITEHEAD (Forschungsgemeinschaft WEISSKOPF).

* By contrast, global Television networks showed on 17 December 2003 (in the presence of USA President George BUSH) the re-enactment of the WRIGHT Brothers' historic flight, in an exact replica plane as the original displayed in the Smithsonian museum in New York. Unfortunately for the promoters, they could not get it off the ground, before it crashed in a ditch, for all the world to see. I am sure, the President was never advised, about the real first successful powered flight in 1901 by the German born American (GBA) aviation pioneer, WHITEHEAD..

*The author of this QUALCON 2005 paper is proud to have been able to reflect on WHITEHEAD's fantastic achievements and celebrate the 2001 Centenary of man's first powered flight, in the Zhengzhou Institute of Aeronautics (ZIA), during the 2001 SKICO Conference. This was largely due, thanks to the efforts by the VP of ZIA, Prof. XU Jichao, who is a Boeing trained Advanced Quality System expert and a Chinese leader in Six Sigma applications. Zhengzhou is the capital city of Henan, China's largest of its 33 provinces , with a population of some 100 million people.

*The US Smithsonian Institute is reportedly still "investigating" today, WHITEHEADS's historic flight. No doubt they are carefully assessing the impact of the contract requirements entered into with the WRIGHT brothers, in case they have now to recognize WHITEHEAD (WEISSKOPF) with achieving the World's first motorized flight, in the first year of the 20th Century.

*A Google search at the time of writing this section of the QUALCON paper (on 9th Aug 2005) scored for “Gustave WHITEHEAD” about 64,100 search results and under “Gustav WEISSKOPF” another 5,240 articles. It is however no guarantee that when WHITEHEAD gets the due recognition this pioneer deserves, that he will soon equal the 2,5 Million Google articles currently credited to the WRIGHT Brothers. I recommend to anybody interested in the truth of early aviation history to visit the following two knowledge-rich web sites : www.deepsky.com/~first flight and www.weisskopf.de

1.2 Space heroes

*Hundreds of other noteworthy pilots, from the global aerospace sector, made their names in the history books in the last 104 years, since WHITEHEAD’s historic first flight. Space does not allow me to mention many others except the first and the most recent achievers.

* In 2003 a sole Astronaut to return safely from outer space was Lt.Col. YANG Liwei from China. Although not being a private operator, as WHITEHEAD and the WRIGHT Brothers were, Liwei YANG nevertheless deserves a medal for risking his life for his country: just as the world’s first Space hero, Yuri Gagarin did for the Soviet Union and the glorious Team that made the journey to the Moon and back for the USA. China now goes into the aerospace history as the third Nation in the world, having conquered outer space in a race against the almighty technological advanced Europeans.
Stop press: In late Oct 2005 China launched its second manned space flight.

2 AVIATION RISKS AND SOME CATASTROPHIC OUTCOMES

*The technological progress made on the aviation hardware, as used by WHITEHEAD and the WRIGHT brothers’ single-seaters, right up to the world’s largest civilian Aero People Movers (APM) is just enormous. Advancing in one Century from the small “Dove” to the likes of the Jumbo jets , the largest APM’s of Boeing 747 and the new Airbus A380 is a testament of what mankind can achieve. This progress ranges from wooden airframes used by the early pioneers in their single-seaters right up to the latest aluminum and composite structures of the A380, which was test flown in 2005 to carry 555 people.

*All this had been accomplished despite the interruptions by two world wars and a few other localized contests for world power, which resulted in catastrophic outcomes for most participants. There is no doubt that this rate of technological advance was also spurred on by the quest for world supremacy, commencing in a big way with the planning phase for the second world war.

*As to the Software and electronic avionics, there is hardly a comparison possible, as they just did not exist in those early pioneering days. Furthermore, the author, with over 40 years association in the aerospace industry dares to say that, without the sophisticated technology of electronics and software in computer-aided devices, none of those giant AMPs would be flying today.

*With the pursuit of faster and larger aircraft of all types, the inherent hazards and risks of flying must be considered in all associated activities. Relevant safety efforts must be adhered to by all concerned, at all times throughout the life cycle of the aircraft from

design to maintenance and operations. Hazards apply, regardless whether it is an Ultra-light plane or the latest wide-body APM, as the law of Gravity applies equally to all heavier-than-air objects, no matter, whether the problem is caused by bad weather, by human failure or by equipment error etc.

*During the month of August 2005, I read in several Australian daily newspapers, reports about a number of aircraft crashes / incidents around the world.. The majority resulted in catastrophic loss of life and / or equipment. The media's chosen headlines and details (as well as the printed pictures) are certainly helping to remind all readers of the inherent risks associated with flying and therefore sound aircraft design and conformance are paramount at all times.
****See Table 1.**

*Despite these reported losses, flying is still considered to be the safest and fastest mode of mass travel and its Industry's safety performance is almost approaching six Sigma levels in the modern Quality measures. This means that there are about three errors in a million activities, for example in processes such as flights, take-offs, landings, etc.

*Paying attention to risk avoidance and / or minimization of critical errors in particular, is a necessary ingredient in everything one does in the aerospace industry. Despite all available and practiced countermeasures, errors caused by humans or other parts of the system can and do occur quite frequently. These errors are usually found and reported by concerned maintenance engineering personnel to the appropriate Civil Aviation Regulators for collation and periodic publishing for the purpose of Continual Improvement (CI).

*This author carried out an extensive **human factor research** study on Errors / Defects reported over a four year period (covering 1993 to 1996) by Australian aircraft maintenance organisations to its Regulator , the Civil Aviation Safety Authority (CASA). An analysis of this data revealed some interesting statistical trends in the Human Error category ie. of the 7,262 All Reported defects , some 17 % (1,224) , were classified by the author as most likely Human Error defects. The other 83 % reported defects were not caused directly by the maintenance personnel; they comprised findings such as fatigue cracks, corrosion and design related issues etc.

*Of the nine Human error / defect categories researched, the most frequent and / or flight safety critical types include:
(1) Incorrect Assembly Operations
(2) Incorrect parts fitted and
(3) use of Bogus parts.
Studies by the author covering later years, continued to support the above findings.

**** See Table 2** for the graphic results of an analysis by type and relative frequency of reported Human Error defects.

*While all errors reported deserve appropriate attention in a timely manner, the most worrying trend in the author's opinion, is the proliferation and use of Suspect Unapproved Parts (SUPs), commonly known a Bogus Parts. SUPs may range from new fake parts of prominent Brand names to some of the most dangerous of all, re-claimed parts of a critical nature such as life-expired Helicopter rotor blades or Rotor

mast. These bogus parts were most likely scrapped at a previous routine maintenance task as specified by the aircraft manufacturer.

* No wonder when the International Aerospace Quality Group (IAQG) created the new AS 9100 B Quality Management Systems (QMS) standard, they did not overlook this problem. AS 9100 now requires to consider the Risks involved in all areas of the global supply chain of aerospace manufacture, maintenance, distribution and operational activities. Such risk factors are heavily reflected in the new SAE-AS standard's Purchasing requirements clause 7.4 and the First Article Inspection (FIA) requirements of AS 9102. These requirements include appropriate part traceability throughout its life cycle, supplier approval throughout the global supply chain and first, second and third party auditing to ISO 9001 and/or AS 9100 standards by qualified / registered auditors.

3 REGULATORY REQUIREMENTS

3.1 Early days

*The early aerospace pioneers did not have the worries that Regulators and Standard bodies can and do impose upon their activities. Nor did they realize the benefits National and Regional Legislators and Regulators can bring. In the new millennium, pilots , operators, manufacturers and maintenance organizations / personnel can have these benefits instantly available via the Internet.

*Going from no regulations and standards at all in 1901, to a global abundance of regulations and standards, information, requirements and associated paperwork (and e-work) would have been rather hard to comprehend by earlier generations.
Some people in the industry still find it hard to accept all these regulatory requirements but their use in the manner intended has been proven over and over again to enhance and control flight safety.

* In 1928, some 27 years after the Commonwealth of Australia was founded, the Department of Defence (DOD) was still responsible for the young Nation's Civil Aviation affairs. The then Controller of Civil Aviation , H. C. BRINSMEAD , issued on 27th March 1928 from his Melbourne Office, a signed Technical Memorandum, No 56, simply titled " Repairs to Civil Aircraft".

**Table 3, shows these particular 1928 Regulatory requirements in full , consisting merely of three paragraphs / thirteen lines / 115 words.

* The above example shows that Rules and Regulations in the Australian aviation industry, a quarter century after WHITEHEAD's historic flight, were still rather uncomplicated and expressed in relative simplistic terms.

3.2 CASA- Civil Aviation Safety Authority-Australia

*By contrast to the 1928 simplicity, the author's paper (published in the AOQ-QUALCON 1994 Book of Proceedings, page 327, Exhibit 4) shows the relatively complicated structure of an Australian Civil Aviation Regulation ie. CAR 42CZ, issued in 1994. If you want to read its 30 or so sub-regulations and associated sub-sub regulations you need to follow this cumbersome thread to get there: CAR Part IV-

Airworthiness Requirements / Part IVA-Maintenance / Division 5- Who may carry out maintenance / Maintenance on Australian Aircraft in Australian Territory / Regulation 42 CZ / Sub-regulation ….only now you can start reading whatever sub-clause is of interest to you.

*Typing just two words, namely “CASA & Civil Aviation Safety Authority” into the Google search page brings up almost instantly 219,000 matches. Its first entry states CASA’s mission, ie. ”CASA has the primary responsibility for the maintenance, enhancement and promotion of the safety of civil aviation in Australia”. This is in line with CASA’s very appropriate vision “ Safe skies for all”.

*It is apparent that CASA has come a long way in the last decade , since the author submitted some recommendations for reform, to the Australian Government’s “Plane Safe Inquiry” in Dec 1995. The web site www.casa.gov.au provides a lot of evidence with regards of CASA’s general Continual Improvement (CI) in customer service, communication and automated e-mail services for Airworthiness Directives (AD) etc. etc.

*However, one specific input by the author to the Plane Safe Inquiry a decade ago is still to be realized, namely that all sectors / sites /offices and functions of CASA (and all CASA approved organizations) should upgrade their existing QMS to comply with the latest version of the ISO 9000 family of standards. As far as the author is concerned he could see no visible evidence that this has actually happened.

*CASA and their other “two legs” in the Australian tri-partite safety structure ie. the Australian Transport Safety Bureau (ATSB) and Air Services Australia (ASA) could no doubt afford to walk-the-talk as a fully certified ISO 9001 organisation. This would provide a good example to all their CASA approved organizations that are now giving airworthiness services for the 12,400 Australian registered aircraft.

*NASA , FAA and others are reportedly strengthening their Management systems and are providing a lead role as national Regulators by implementing ISO 9001 QMS standards. Some of the Australian Aircraft companies are now going a step further by up-grading their ISO 9001 QMS to the globally recognized SAE-AS 9100 family of Aerospace QMS standards.

*If Australian Regulators wish to follow their American counterparts, the author suggests that perhaps CASA’s internal Aviation Safety Forum (ASF) might look at this opportunity. The ASF could be the right instrument to promote, train , implement and internally audit CASA-wide a QMS to ISO 9001:2000 and / or AS 9100 B, as appropriate, and lead them to external certification within the next 12 month or sooner.

* Following this initial effort, CASA’s ASF group could additionally embark upon an Integrated Management System (IMS) to include OHS/Safety and Environmental Management Systems (EMS) over the second 12 month period. Following third party certification , the CASA Board, its management and staff, including all Auditors (Technical , Administrative / Financial) could then proudly ”walk-the -talk” and earn the full respect of all Government sectors, all CASA clients and all its peers.

*Also credit is due to CASA for issuing a timely media release on the extreme danger of hypoxia (due to lack of pressurized air) as experienced just three days earlier on the aircraft that crashed near Athens on 15th Aug 2005.

**** See Table 4.**

*As an example of the need for relentless vigilance on safety and quality in the aircraft industry the author will remind the readers of a cover story in the latest Flight Safety Australia magazine (July-August 2005, Page 28 to 33, authored by Macarthur JOB and CASA's Steve SWIFT, titled: "JAL123: August 12, 1985, 520 LOST. It is 20 years since the world's biggest single Airliner accident."

*The first part describes the last flight of Japan Airline's Boeing 747 SR, registration JA 8119, from Tokio's Haneda Airport to Osaka. The crash investigators revealed that this airplane worked hard, accumulating 25,000 flight hours since new. The crash was reportedly caused by a rear pressure bulkhead failure. It was found to be damaged seven years earlier during a nose-high landing and "wrongly" repaired by the airline with the help of Boeing engineers.
This botched repair job resulted in excessive loading on one of the two rows of rivets.

*To improve its "Fail Safety" approach Boeing subsequently strengthened this portion of the aircraft, increased the testing regime and intensified the ongoing search for fatigue cracks. This failed repair job would be counted in this author's study as a Human Error defect and captured in Table 2 , under Category 1) Incorrect Assembly Operations.

*In response to this accident the FAA, CASA and other Regulators now require all Airlines to comply with Airworthiness Directive AD / General / 82 Amdt 1 (10/2003) Guidelines for Repair Assessment of pressurized fuselages. Also an FAA Advisory Circular AC120-73 is available to help establish an inspection program to detect damage in repaired areas of all affected aircraft.

* What else is new? A new systematic inspection approach called Diamond Standard Maintenance (DSM). DSM is a systematic analysis of fatigue cracks says Steve SWIFT. DMS consists of five elements: Sight / Scenario / Detectable / Dangerous / Duration. The DSM info was imported into Australia in June 2005, by Steve SWIFT from a Hamburg Conference. It is a new way of describing / depicting the "damage tolerance" rules for managing structural design. For a "Rough Diamond" copy and reports on structural fatigue, visit CASA's website.

*See also CASA website <casa.gov.au/fsa/2005/aug/21-23.pdf> article titled "Black out" on page 21 to 23. CASA also produced a video "Oxygen first" That explains how to recognize the symptoms of hypoxia and survive. Online order at <casa.jsm.emillan.com.au>.

3.3 FAA-Federal Aviation Administration-USA

3.3.1 General

*A Google search for "FAA & Federal Aviation Administration " revealed 988,000 matches and no doubt most of them would be very interesting to any person with an aviation or quality background. The first click on the "FAA News Topics" button covers the latest natural disaster in the US, titled "Operation Air Care evacuates thousands from New Orleans".

*FAA and the aviation industry needs to be commended upon their ongoing relief operations, from its Louis ARMSTRONG New Orleans International Airport to assist the unfortunate people trapped in this city. With only two major runways open the FAA air traffic controllers are reportedly still landing 15 large aircraft an hour, that is in addition to 125 to 175 helicopter flights an hour.

*A Testimony statement by Jon JORDAN, M.D., Federal Air Surgeon, FAA, (dated 6 April 2005) discusses the efforts to prevent contagious deceases eg pandemics by air travel caused from the SARS outbreak and lacking Air Quality; simply to help the traveling public and cabin crews.

3.3.2 'Human factor' issues- SUPs or Bogus Parts

*According to the FAA there is a growing requirement for "human factor" research, as accidents and incidents are more likely to be caused by the actions of humans in Aviation maintenance and inspection, then by mechanical or other factors. It pays for interested readers to visit www.hfskyway.faa.gov/HFAMI/ and hfskyway.faa.gov/document.htm for more related information on this subject.

*FAA's SUP-Program Office- Suspect Unapproved Parts Notification website is well worth visiting on www.faa.gov/avr/sups/upn.cfn to get a deeper insight into the global SUP / Bogus Part problem. The above office reportedly makes also available, for free, a training video CD named "SUPs-What can you do?"

*Another good source (and a proponent of Quality), on prevention of SUP / Bogus Part use is the Aviation Supplier Association (ASA) register –EAA-AC-00-56 Accredited Companies. ASA represents companies that supply and sell aircraft parts. Visit www.aviationsuppliers.org/AC_0056/List_accrediteddistributers.htm

*The tool which is now more commonly used by FAA approved organizations to control parts distribution (in the USA and for export) and maintenance work is the FAA Form 8130-3 (Authorized Release Certificate - Airworthiness Approval Certificate)

*Both the FAA Form 8130-3 and its European counterpart, the new EASA form One (which supersedes the old JAA-Form One) are basically standardized traceability documents. They are very important tools to control the proliferation and use of SUPs and because of the importance of human factors in aircraft maintenance Quality systems. These two forms are considered to be rather effective weapons in the fight against the global trade by SUP-dealers.

* The recently established European Aviation Safety Agency (EASA) is harmonizing Aviation Safety Regulations throughout the European Community. This includes the common regulations, known as "Part 145" which requires that all European Aviation Maintenance Organisations can only accept airworthy components released on an "EASA Form One" or equivalent eg. for exported parts from the USA on an FAA 8130-3 tag, issued by a DAR (Designated Airworthiness Rep.)

*A DAR may issue 8130-3 Tags for parts held by a distributor, as long as long as two conditions are met ie
(1) the product or parts must have positive traceability to a Production Approval Holder through acceptable documentation or part markings and

(2) the distributor must be accredited under the FAA's Voluntary Industry Distributor Accreditation Program (VIDAP) per FAA Advisory Circular AC-00-56.

*The 2002 ASA survey revealed that "a full 50%" of the parts held by accredited distributors have no Airworthiness Approval Tag of any kind, thus reportedly impeding export from the USA into Europe since June 2003.

* The Director General of IATA (International Air Transport Association) Giovani Bisignani (G.B) summarized in the 2003 Airbus publication "Flying into the Future" that since the formation of the civil aviation industry on 1 Jan. 1914, quote " Now, as then, our first priority is to carry each passenger safely and aviation remains one of the safest mode of transportation" and "from the first recorded scheduled air service in 1914 with one passenger, to the 500 passengers currently and 650 passengers in the next decade, we have come long way".

*The Boeing "Frontiers" magazine (Dec 2003/ Jan 2004) features a cover story titled "Century of Technology" by Michael Lombardi. It illustrates the contribution the Boeing company has made to the history of flight since William Boeing flew his first airplane (about 15 years after Whitehead's historic first flight) and founded his airplane company.

*In the same edition of Frontiers there was a special section on engineering and technology that covers many "Engineering gifts to the world". Followed by two other interesting articles titled "Lessons learned" and "Saving endangered knowledge" a knowledge management subject. It describes the noble way Boeing is capturing the wisdom of their current 80,000 employees before they all retire, so that the future generations can learn from its forbears.

3.4 JAA-Joint Aviation Authorities-Europe & EASA–European Aviation Safety Agency

*A recent Google search for "JAA + Joint Aviation Authorities" revealed 87,000 matches and for "EASA & European Aviation Safety Agency " another 57,100 matches.

*One of the first websites on the list www.easa.eu.int/home/events_en.html is a really informative aviation source of what's going on in Europe and how EASA relates to the rest of the global aviation industry.

* It outlined the official opening ceremony of EASA, on 13 Dec 2004, at its new Head offices in Cologne, Germany, followed by presentations in each of the 25 European Union (EU) member States.

*EASA also held a Maintenance Road Show in the USA in Dec. 2004 to elaborate on AESA's main objectives and on its Missions.

* AESA's objectives are: To establish and maintain a high uniform level of civil aviation safety in Europe (for passengers, crews and third parties)

*AESA's Missions are:
a) Certification (Airworthiness and Environmental protection) of aeronautical product, design, production and maintenance organizations and

b) to outline the impact of EASA has on US Repair stations, which are subject to BASA (Bilateral Aviation Safety Agreement) and MIP (Maintenance Implementation Procedure).

*MIP amendments for Europe are EASA Part-145 and for the USA FAR145 Amdt Jan. 2004. No doubt smooth transition from JAA to EASA is a challenge.
A regulatory comparison to review and amend the existing Special Conditions (SC) means the following:
-In USA: FAR 145 + EASA SC = EASA Part 145
-In Europe : EASA Part 145 + FAA SC = FAR 145

*The EASA-Wikipedia, a free encyclopedia on the internet, covers human factors and pilot errors, which is now quoted as the most common factor in Aviation crashes.

4 AEROSPACE QUALITY SYSTEM STANDARDS.

4.1 General

* The Aerospace industry around the world relied through the second half of the 20th century on an assortment of Quality Systems Standards. These consisted in the main of two types
- Quality Inspection and Test (QIT) Systems and
- Quality Management Systems (QMS)

* QIT Systems include the now obsolete standards MIL-I-45208A, and ISO 9003 and the current SAE-AS9003:2001 created by America's Aerospace Quality Group.

* The QMS standards range from the obsolete MIL-Q-9858A and ISO 9002 to the latest generic ISO 9001:2000 standard and the international Aerospace-specific SAE-AS9100B, AS9110 and AS9120 range of standards.

* The registration / certification process for both standards, the AS 9003 QIT system and the AS-QMS series are within the juristiction of the Registrar Accreditation Committee (RAC). RAC includes representative from the Accreditation Bodies and Registrars such as RABQSA and IRCA. They are both prominent as international certification / registration bodies for Aerospace Auditors as defined in AIR 5359B- Requirements for Certification / Registration of Aerospace Quality Management Systems (AS-QMS).
Note: Not to be confused with AS, the Australian Standards.

* AIR 5359B defines the registration / certification process for the Society Automotive Engineers – Aerospace System (SAE-AS). It also covers the training + certification needs of its professional aerospace auditors to ensure global industry expectations are met at all times.

4.2 ISO 9001 and AS 9100

4.2.1 General

*Three of the earliest ISO–based industry-specific QMS standards apply to the following key industries:
-Automotive Industry –QS9000 and ISO / TS16949
-Aerospace Industry – AS 9100 family

-Telecom Industry – TL 9000 series

4.2.2 AS9100 Aerospace QMS family

* The current ISO 9001:2000 based SAE-AS9100 family consists of some seven documents. ****See table 5.**

* Clause 4 to 8 of AS 9100B is based on all ISO9001:2000 requirements plus many Aerospace-specific requirements. An analysis of AS9100B, clause 4 to 8, by Australian Quality Assurance Consultants International (AQACI) revealed a total of 720 Lines of Text (LOT), specifically 430 LOT for ISO, plus 290 LOT for AS-specific add-ons.

* In terms of “shall word ” requirements, some 60 % (129) were found to apply to the ISO text and about 40 % (63) apply to the additional aerospace-specific section..

* Most of the 63 aerospace-specific “shall” words are applicable to clause 7 - Product Realisation with (37) “shall” words and clause 8. Measurement Analysis & Improvement has (18).
* The other 8 “shall” requirements apply to clause 4, QMS and clause 5, Management Responsibility (1). While clause 6, Resource Management only consists of basic ISO requirements.

4.2.3 SAE-AS 9101

*The Aerospace Standard SAE-AS 9101 (Rev B, 2003-3) is a QMS Assessment package . It consists of a Quality System Assessment Report (QSAR) and Appendix A , that contains a QS Questionnaire from page 13 to 47. The purpose of AS 9101 is to define the content and presentation of the QSAR of its primary standard AS 9100. This QSAR package allows global uniformity of the Assessment Report across all audited and certified / registered organizations.

*AS 9101 can also be used as an ideal self-assessment tool to test readiness or ongoing compliance of the QMS in a single organization and / or across its different plants / divisions located anywhere in the world. Further, compliance with the appropriate parts of AS 9100 and internal assessment using AS 9101 would also help most non-aerospace manufacturing organizations in their journey towards sustainable Six Sigma Quality and / or Excellence award status.

4.2.4 AS 9102

*AS 9102 Aerospace First Article Inspection (FAI) Requirements Standard , issued in Aug. 2000 is a 20 page “shall word” document prepared by the SAE Committee AAQG for the Quality Group (IAQG) that was established in Dec. 1998. The purpose of IAQG is to achieve significant improvement in quality as well as reduction in cost throughout the aerospace industry value stream. It establishes documentation requirements for FAI performed on a new part that is representative of the initial production run.

*This FAI procedure applies to assemblies and all levels of parts within an assembly, including castings and forgings. Procured standard parts such as nuts, bolts and washers etc., are excluded. This FAI standard basically consists of 14 definitions and 11 ‘shall’ as well as “must” mandatory requirements.

*The aerospace industry's FAI concept in general and its FAI and AS 9100 requirement standard are in the author's opinion the best risk management tool currently available for the global aerospace industry (and / or any other .manufacturing organization). . Full compliance with these requirements will no doubt make the FAI process a truly effective risk terminator and a major contributor towards achieving higher Six Sigma performance levels.

4.2.5 AS 9103

*SAE-AS 9103 (Oct 2001) is titled – Variation Management (VM) of Key Characteristics (KC). It establishes variation management requirements for KCs and it provides a process to achieve these requirements. The primary goal of this standard is to control and minimize variation in defined KCs through a thorough assessment of the part production process.

*The standard specifically mandates for understanding process elements that affect KCs. by following these three stages of the VM process/es ie.1) Determine - 2) Control & Assess – 3) Document

1) Disciplined determination of process KCs (using appropriate analysis tools for variation)
2) Control & Capability assessment (to ensure variation is well understood)
3) Process Control Documentation (that defines specific control of KCs and Manufacturing Process Parameters)

*This standard can also be used for other than production Key Characteristics eg characteristics that affect cost and delivery. For that reason it can be considered an ideal tool in any Six Sigma performance improvement program.
All the above and many more "how to do" documents are available and usually adaptable to support any certified or non-certified business/organization.

*The above together with Handbooks and quality literature from well known Management gurus such as Shewhart, Juran , Deming, Crosby, Feigenbaum, Ishikawa, Taguchi, Masing, Harrington, Harry and others form the basis of all quality initiatives from the 1920s up to and including the latest Six Sigma improvement tools

*Aircraft companies such as Boeing also make available their own proven KC and VM control methods, training procedures and AQS (Advanced Quality System) standards for the benefit of all their employees and suppliers.

5 SUMMARY

"Quality drives Choice" is an article by Pierre Condom in the book "Flying into the Future" .He states "There are many reasons why airlines choose the aircraft they do – and not all of them revolve around the original purchase price". He concludes as follows: "It is healthy to maintain stimulating competition between the manufacturers". "However it is clear that everything starts with well-designed high-quality aircraft produced by financially strong manufacturers".
In this author's opinion, backed by decades of industry experience, the best known way to reduce the cost of goods is to do things right the first time and if the cost of poor

quality within the whole supply or value chain is zero Dollars / Euro etc, then the purchase cost and maintenance costs for an aircraft could be from 20 to 40% cheaper. Good management of the QMS and the economics of quality of all organizations within the entire supply chain will help keep the waste or cost of poor Quality down.

Everything in this world is subject to variation and associated with risks, therefore methods and tools have been presented in this paper to help minimize excessive variation and risks in all we do or make. Everyone knows that not even the best-in-class can do all things right the first time, much less doing it right every time.

But the ones dedicated to excellence, safety, performance, and Six Sigma quality levels are using such tools as the ISO 9001 and AS 9100 family of Standards, the Aerospace industry's latest Risk Terminator. After that climb on the maturity ladder they are likely to move on to Integrated Management Systems and perhaps end up with Six Sigma performance improvement strategies to get as close as possible to "doing it right first time and every time" and truly comply with all customer and regulatory requirements. Flight safety and economic survival from the days of WHITEHEAD to the latest Aero People Movers and beyond depends on Quality in everything we have done and will do within the aerospace industry.

7 REFERENCES

[1] Magritzer, L. [2000]. "Management In The 21st Century –Management By Standards", AOQ-QUALCON 2000, Sydney, Feb.

[2] Magritzer, L. [2000]. "Achieving Six Sigma Through Foundation of ISO 9000" IPQC Conference, Sydney, May.

[3] Magritzer, L. [2000]. "The New Family of ISO & Industry Sector-Specific Management System Standards", Zhengzhou Institute of Aeronautics, China, Jul.

[4] Magritzer, L. [2000]. "Six Sigma Seminar Shanghai", SQCA, China. 7/2000.

[5] Magritzer, L. [2000]. "Understanding the Strategic Importance of ISO & Six Sigma to Drive Business Excellence", IQPC Convention, Kuala Lumpur, Malaysia, Sept.

[6] Magritzer, L. [2000]. "Continual Improvement Through The Application Of ISO & Six Sigma", IQPC Convention, Beijing, China, Sept.

[7] Magritzer, L. [2001]. "Integration of Quality, Safety & Environmental Management Systems", SKICQ2001, Zhengzhou, Henan, China July.

[8] Magritzer, L. [2001]. "Developing the Right Foundation for Achieving Six Sigma", IPQC-Six Sigma Summit, Sydney, Australia, Aug.

[9] Magritzer, L. [2001]. "The implementation of a modern Integrated Management System - An Australian case study", Shanghai, SISQ-4, Nov.

[10] Magritzer, L. [2002]. "Some pragmatic & some theoretical solutions for performance improvement", Service Six Sigma, IQPC & Hongkong Productivity Council, Mar.

[11] Magritzer, L., Burt, R. M., XU, J. [2002]. "Standards as drivers of quality and safety (a historical perspective from biblical times to the six sigma era)", AOQ-QUALCON, Perth, WA , Australia, Oct.

[12] Magritzer, L. [2002]. "Six Sigma and the Cost Of Poor Quality", SIF-4 Six Sigma 2002 Proceedings, SAQ, Shanghai, China, Nov.

[13] Magritzer, L., Burt, R. M., XU, J. [2003]. "Standards as drivers of quality and safety", IAQ Book series Volume 14, The Best on Quality by International Academy for Quality & ASQ, May.

[14] Magritzer, L. [2003]. " Standards & Quality", EOQ/EFQM 2003 Congress, IAQ Forum, The Hague, Holland, June.

[15] Magritzer, L. [1994]. “Aircraft Safety and ISO 9000”, AOQ-QALCON 1994, Book of Proceedings, Melbourne, Australia, Page 311 to 329, Nov.
[16] SAE-AS 9100 [2001-08].Rev. A, SAE International Aerospace Standard, Quality Systems-Aerospace-Model for Quality Assurance in Design, Development, Production, Installation and Servicing, Page 1 to 37.
[17] SAE-AS 9101 [2003-03].Rev. B, SAE International Aerospace Standard, Quality Management Systems Assessment, Page 1 to 47.
[18] SAE-AS 9102 [2000-08]. SAE International Aerospace Standard, Aerospace First Article Inspection Requirement, Page 1 to 20.
[19] SAE-AS 9103 [2001-10]. SAE International Aerospace Standard, Variation Management of Key
[37] Flying in the Future [2003] Airbus Book, ISBN 1 901641 57 0
[38] Setting the Standards [2003-07] From Airbus The 21sth Century Family Brochure, Ref. CVM310.0115, Issue 4
[39] Boeing, Frontiers, [2003-12/2004-01] volume 2, Issue 8, Century of Technology by Michael Lombardi, Page 12 to 21, (www.boeing.com/frontiers)
[40] Boeing, Challenge {2003-12], “Engineering gifts to the world”.,“Lessons learned” and “Saving endangered knowledge”
[41] Boeing AQS-D1-9000-1, Table of Contents
[42] German magazine “Neue Review”, No 18, 30 April 1998, page 62/63.Whitehead story
[43] “Gustave Whitehead” stories. website <www.deepsky.com>
[44] Magritzer, L. [1997]. “Aircraft Safety and ISO/AS 9000-An Australian Update”, IQCC’97, Beijing, China, 31Aug-2Sep.
[45] Magritzer, L. [1997]. “Aircraft Safety and TQM-An Australian Version”, Quality Management and Economic Development conference, Zhengzhou Institute of Aeronautics, Henan, China, 8-10 Sep.
[46] Magritzer, L. [1997].”Application of ISO/QS 9000 and its relationship with ISO/AS9000”, European Quality week in Hungary, Budapest HNC for EOQ, Nov..
[47] Magritzer, L. [1998], “SAE-AS 9000: A new Hybrid Standard to improve Aircraft Safety “, 8th World Congress on Total Quality, WCTQ’98, Mumbai, India 12-14 Feb.
[48] Magritzer, L. [1998], “Auditing for Business Improvement-A practical Approach”, SISQ-3, Shanghai, China, 5-7 Oct.
[49] Magritzer, L. [1998], “A dream come true-ISO 9001 for AOQ”, AOQ-QUALCON ’98, Brisbane ,Australia.11-14 Oct.
[50] Magritzer, L. [1998]. “AS 9000, The new Aerospace Standard-Fit for the 21st Century” Third China Aviation Summit-Management and Development, Zhuhai, Guandong Province, China, 16-18 Nov..
[51] Magritzer, L. [1999], “Good Management Systems today more effective Management Systems for tomorrow’, IASMC-Aviation Safety Conference, pp 113-126, CASA, Perth, WA, Australia, 17-21 Oct.

16. DISCLAIMER OF LIABILITY

The author shall not be liable for any action or results, arising from the use of data, information, opinions, suggestions and recommendations pertaining to this paper.

1.1- "Jet burst into flames but everyone lived'
(TDT, 4 Aug 2005, Pg 25, Air France A340, Reported loss of life: Nil, Survivors: 309, Crashed in Toronto Airport, Canada) &
1.2-"Escape from inferno-Pilot and crew praised for saving passengers"
(TDT,(The Daily Telegraph) 5 Aug 2005, Pg 31, re as above)

2-"Stowaway dead in jet"
(TDT, 5 Aug 2005, Pg 31, Air France, Reported Loss of life: One and Royal Air Maroc , Reported Loss of life: One)

3.1- "Pilot has turned blue-121 die as jet crashes after pressure failure"
(TDT, 15 Aug 2005, Pg 18, re Cypriot Helios Airways , B737,Reported loss of life: 121, Survivors: Nil) &
3.2-"Pilot blue in face before crash-Passenger's text message"
(SMH, 15 Aug 2005, Pg 1, re as above) and
3.3-"Aussies fly to scene of air disaster-Family's painful mission"
(Herald Sun, 17 Aug 2005,, Pg 11, re as above)

4.1-" Jungle crash inferno-52 escape blazing jet wreckage"
(TDT, 25 Aug 2005, Pg40, re Peruvian Airline TANS B 737 , Reported loss of life: 39, Survivors: 59, Crashed near Pucallpa Airport, Peru) &
4.2-"From this scene of wreckage…Miracle baby is found alive"
(TDT, 26 Aug 2005, Pg 11, re as above)

5- "Backfire in the sky-Reports of flames as jet aborts landing"
(TDT, 26 Aug 2005, Pg. 15, re QANTAS 737-400, Reported loss of life: Nil, Landed safely in Sydney Airport, Australia)

6-"Stunt plane wreckage salvaged'
(TDT, 29 Aug 2005, Pg 7, re Nanchang CJ-6A Aerobatics, Reported loss of life:
One, Crashed into the Ocean near Narrabeen, NSW, Australia)
……
7- "Ill-faded helicopter flew with worn part"
(TDT, 7 Sep 2005, Pg. 14, re Sea King Australian Navy Helicopter, Reported loss of life: Not reported. Survivors: 2. Crashed on 2 April 2005 near Nias, Indonesia, while on a Tsunami relief operation)
……..
8-"Horror of jet crash survivors- Mother saves baby but sees son burn to death"
(TDT, 7 Sep 2005, Pg. 33, re Jet type & Airline not reported, Crashed on take-off at Medan airport, Indonesia, Reported loss of life: At least 150 on plane & on ground, Survived: 14
……
9-"Plane comes off second best in crash"
(TDT,12 Sep 2005, Pg. 2, re Cesna crashed on take off , at Bankstown Airport, Sydney, Australia, Reported loss of life: Nil, Survived: 3

Table 1-Some reported Air crashes/Incidents-Aug / Sep 2005-
Source: Australian daily newspapers

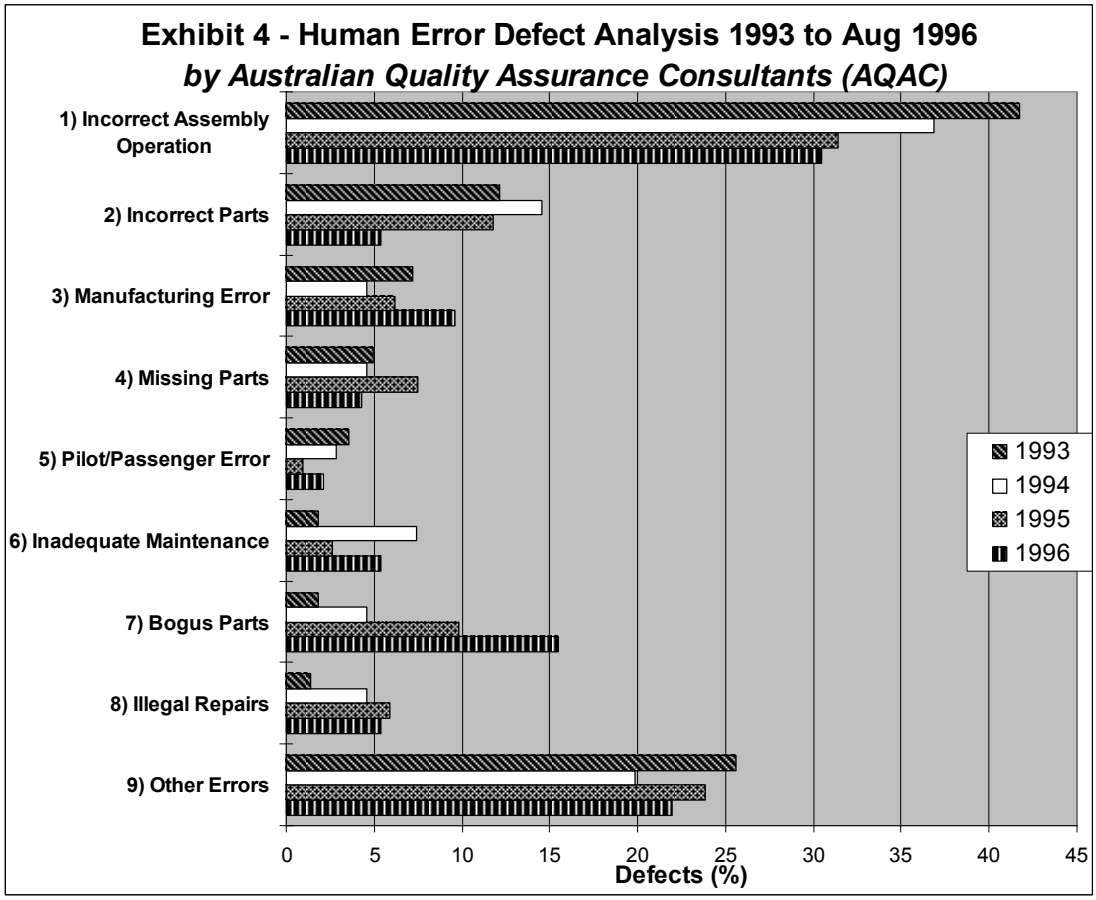

Table 2- Human Error Defects-1993-1996, Source: CASA & AQACI

COMMONWEALTH OF AUSTRALIA- DEPARTMENT OF DEFENCE

Technical Memorandum No. 56, Repairs to Civil Aircraft

It is hereby notified-

1. Ground Engineers are reminded that repairs to aircraft or engines they are permitted to carry out are limited to repairs which do not involve any modification of the detail design of the approved type of aircraft or engine.

2. Repairs which do alter the detail design of the approved type must be regarded as modifications for which prior approval must be obtained from the Controller of Civil Aviation.

3. Ground Engineers licensed in Categories A and B should satisfy themselves that this design approval has, in fact, been obtained before they certify repairs of this description, and should include a reference to the authority received in the aircraft or engine logbook entry.

Melbourne 29th March 1928 Signed H. C. Brinsmead Controller of Civil Aviation. P.713.

Table 3 - Repairs to Civil Aircraft, TM # 56, Source: QUALCON 94, Page 326

"Australian pilots are being given a timely reminder about the dangers of hypoxia. People on board an aircraft which suffer a loss of pressure when flying above 10,000ft will suffer hypoxia. This is a condition where the body is starved of enough oxygen to function normally and will lead to death. At a typical cruising altitude for a large passenger aircraft of 30,000ft, a loss of cabin pressure leaves pilots, cabin crew and passengers with only 1 to 3 minutes of useful consciousness. During this time reasoning and judgement is impaired, speaking becomes difficult, coordination is lost and visual information is not processed normally".

Table 4- CASA Media Release - Thurs, 18 August 2005 , New warning about hypoxia

AS9100	QMS based on ISO 9001
AS9110	QMS based on ISO 9001
AS9120	QMS based on ISO 9001
AS9003	QMS based on ISO 9002/3
AS9101	AS 9100 Assessment tool
AS9102	FAI tool
AS9103	Variation Control tool

Table 5-The SAE-AS9100 family of International Aerospace Standards