

**The University of New South Wales
School of Aviation**

AVIA5018 – Aviation Human Factors

Semester 2, 2016 Course Outline

Course Staff

The course facilitator is Dr Peter Murphy of the School of Aviation. Peter can be contacted via e-mail at peter.murphy@unsw.edu.au.

About the Author/Facilitator

Peter served as a full-time military psychologist prior to working as a consulting psychologist. He currently works in the Department of Foreign Affairs and Trade. He is a registered psychologist, a Fellow of the Australian Psychological Society, and is an Adjunct Associate Professor at the University of New South Wales. He continues to support the Australian Defence Force as an Army Reserve Colonel consultant.

Peter's professional interests include applied human factors and aviation psychology (including accident investigation); fatigue, performance and safety management in high-reliability occupations; organisational climate assessment and interventions; strategic human resource management; the design and implementation of selection and assessment centre techniques; psychological resilience and recovery from critical incidents (such as unlawful captivity); cross-cultural competence, and human sciences research in real-world settings.

In terms of aviation-related experience, Peter was the senior human factors specialist within Australian Army Aviation for four years. During that period, he was a member of several accident investigation teams, including the 2005 Royal Australian Navy Sea King accident on the island of Nias in Indonesia. Peter edited and contributed to the 2005 publication *'Focus on Human Factors in Aviation'* which was awarded the Royal Aeronautical Society (Australian Division) Field Award for Flying Safety. Peter has consulted for the Civil Aviation Safety Authority in relation to non-technical skills and fatigue risk management systems. He has an extensive applied research background, which has included research positions with the Canadian Forces and the Defence Science and Technology Organisation, and membership of international collaborative research panels, including one devoted to military aviation human factors. Peter has been part of the editorial team of the relatively new Aviation Psychology and Applied Human Factors journal. He also supports the Directorate of Defence Aviation and Air Force Safety through his work as a Reservist.

Peter's formal qualifications span the areas of psychology, defence studies, international relations, human resource management, aviation human factors and accident investigation. He has over 60 publications, mainly in the human performance and human resources domains.

Approach: The challenges for human factors in aviation

On 2 April 2005 a Royal Australian Navy Sea King helicopter Shark 02 crashed on the island of Nias, Indonesia, while participating in an Australian Defence Force (ADF) humanitarian aid Operation Sumatra Assist II. This accident resulted in the tragic deaths of nine ADF members and serious injuries to a further two.

The Maritime Commander Australia appointed a Board of Inquiry to determine the factors contributing to the accident and make recommendations for preventing a similar tragedy. The Board consisted of five people with expertise in ADF operations, aviation, engineering and psychology.

The Inquiry considered 44 Terms of Reference and was conducted in an open and transparent manner with public hearings and the hearing transcript published on the Internet. The Board deliberated for almost 20 months, considered evidence from more than 160 witnesses, reviewed 560 exhibits, conducted hearings over 111 days and produced approximately 10,000 pages of transcript.

The Board's Report was submitted on 18 December 2006. It is approximately 1,700 pages long and consists of 759 Findings and 256 Recommendations for improving aviation safety.

Navy accepts that the accident should not have happened and takes full responsibility. Navy and Defence will fix the safety problems identified in the Report by implementing all of the Board's recommendations in full.

By improving aviation safety, Navy and Defence will demonstrate that it has learnt from this tragedy.

Extracted from: http://www.defence.gov.au/sea_king_boi/board_of_inquiry.htm

The extract above, from a Defence website reviewing the Sea King accident Board of Inquiry, reveals several of the main learning points of this course: a. aviation accidents can be prevented; b. aviation accidents are high profile and complex events, and c. understanding the contributory and causal factors of aviation accidents requires a multidisciplinary and multi-level or systems approach, along with a willingness to learn and to be immersed in intricate detail.

This course overview could have been prefaced with a case study of another Australian aviation accident from the same year: the crash of a Fairchild Swearingen Metroliner commuter aircraft on 7 May 2005 near Lockhart River in Northern Australia. That accident claimed the lives of all fifteen on board and, in terms of fatalities, was the worst air crash in Australia in 36 years. (Refer to: http://www.atsb.gov.au/publications/investigation_reports/2005/AAIR/air200501977.aspx)

Humans in general have a preference for simplicity, and this is exemplified in how most of the media portray the news. Both the Sea King and the Metroliner accidents were reported as resulting from ‘human error’ – error in maintenance personnel in the case of Shark 02 and error in aircrew in the case of SA227-DC Metro 23. As I review these notes, there continues to be speculation about the reasons for the disappearance of Malaysia Airlines Flight 370 on 8 March 2014, with the notion of a ‘rogue pilot’ gaining media prominence. The search for the aircraft and its 239 passengers and crew has reputedly cost over 180 million dollars (though there is no agreed methodology for costing such search activities). Such a figure reflects, in part, the importance placed on aviation safety. If you have an interest in this matter, see: <http://www.abc.net.au/news/2016-06-05/push-to-continue-the-search-for-mh370/7464674> and <http://www.atsb.gov.au/mh370.aspx>.

The Aviation Safety Network has announced that during 2015 there were 16 fatal airliner accidents, resulting in 560 fatalities. While this made 2015 the safest year ever by number of fatal accidents and the 5th safest year ever in terms of fatalities, only three previous years (1988, 1983, 1985) showed a higher death toll of accidents attributed to sabotage, shoot downs and pilot suicide. Two out of 16 accident airplanes were operated by airlines on the E.U. “black list.”



Figure 1. Airliner Accident Statistics 2015

Source: <http://news.aviation-safety.net/2016/01/01/despite-high-profile-accidents-2015-was-the-safest-year-ever-according-to-asn-data/>

The 2014 listing included the missing Flight 370, a shoot-down, a hijacking, crashes of both commercial and military cargo transportation, a medical transport, and two helicopters, including a media rotary wing, a military-civil mid-air, and a crash that

killed several senior political figures, including a deputy prime minister. It is clear that aviation exposes its operators to many complex, diverse and, at times, terrible challenges and situations. Safety in aviation remains vital.

One of the themes of this course is that by reducing the complexity of aviation safety events, and by resorting to blame and punishment (another strong human tendency), the ability of people and organisations to learn from the rich tapestry of experience that such events can weave is undermined.

The field of 'Human Factors' refers to the study of human capabilities, limitations and tendencies in the workplace. There is general consensus that the major catalyst of the human factors discipline was the abundance of challenges to human performance posed by the Second World War, when the operation of increasingly complex systems, especially aircraft systems, caused tremendous problems.

For example, a study of aerial (turret) gunnery during World War II concluded the role was so complex that its component tasks were carried out largely independent of the perceptual situation. The attention of the gunner was so occupied by the tasks of tracking and ranging that he could not make a clear and discriminating choice of the moment at which to fire. In its complexity, turret gunnery taxed the limits of human ability. Strange then, that the defensive system in the *Millennium Falcon* in *Star Wars* harked back to the era of the B-17 and the Avro Lancaster – it seems that even in a galaxy far, far away, technology neglected the human factor.

The broad goal of human factors is to develop an understanding of human performance within work environments. Human factors attempts to facilitate an optimal relationship between humans and the demands and characteristics of the workplace. Because all humans have different and inconsistent performance capabilities, and because workplaces are constantly changing, this is a challenging and complex task indeed.

Within the aviation industry, there are perhaps two broad goals of aviation human factors. One goal is to enhance operational effectiveness through improved individual, team and system performance. The second goal is to enhance safety so as to better preserve the reputation and capability of the industry. Both goals depend upon the effective transfer of human factors knowledge and techniques to the operational aviation community. This course, generally undertaken by working members of the aviation industry, is a means of enhancing that awareness.

As noted above, human factors is a field that combines the knowledge and skills of multiple disciplines. These disciplines include engineering, computing, artificial intelligence, ergonomics, physiology, optometry, medicine, psychology, training development, sociology and management science.

The reader should be able to perceive a dimension running through these disciplines from the 'hard' disciplines of engineering and computer science, for example, to the 'soft' disciplines of sociology and management science. It should be noted that, in terms of complexity, many of the 'softer' sciences are, in my opinion, more taxing than the so-called 'hard' sciences. Unlike physics or chemistry, there are no

immutable 'laws' governing human behaviour. Humans are complex creatures and our workplaces are very complex socio-technical systems.

This course will travel along much of this conceptualised continuum, but will focus largely on the 'softer' side of human factors. This is partly because an attempt to cover the entire spectrum of human factors knowledge is beyond the scope of a single tertiary course; and partly because my interests and expertise are decidedly in the arena of the behavioural sciences.

The course will endeavour to stay true to the multidimensionality of the aviation workforce. There are units devoted to maintenance, air traffic control, technology, training and evaluation, and, of course, flight operations. In the more generic units, case studies will be drawn from different occupations within aviation. There will also be a balance between academic/technical readings, and readings drawn from the 'popular' professional literature, regulatory sources and formal accident investigations.

I trust you will find the course engaging and challenging. I look forward to embarking on a journey of mutual learning with you.

Aims

The aim of this 6 UoC course is to introduce students to human factors as an applied discipline and its role in support of civil and military aviation. Theoretical and applied perspectives will be explored. Students will be required to consider ways that human factors principles can be applied to improve system safety and resilience and to enhance performance at multiple levels of the organisation, i.e., in individuals, operational teams, and management teams. Emerging challenges and opportunities related to the human dimension of operational safety and effectiveness will be examined. The course will also consider how senior management can be effectively engaged with respect to the application of human factors.

Learning Outcomes

On completion of this course students should have:

- an understanding of aspects of the historical development of aviation human factors,
- an awareness of contemporary contributions made by the field of human factors in support of aviation operations,
- an appreciation of reigning models of human error, safety management systems, and organisational resilience,
- a considered perspective on emerging theories and issues related to human and organisational performance in the aviation workplace,

- insight into the human challenges pertaining to a range of aviation industry occupations,
- conceptual and applied knowledge with respect to nontechnical skills, and
- a critical appreciation of the academic and professional resources available in the field of aviation human factors.

Timing and Location

This course runs for the duration of Semester 2.

The course is delivered electronically via UNSW websites, on a distance-learning basis. The core component of delivery is the course manual. The AVIA5018 course manual was written by the current course facilitator. The course manual approach allows students to study at their own pace, in accordance with their particular work schedules and locations. The course manual provides considerable choice with regard to what articles and case studies the student can absorb. Academic review and feedback is delivered via e-mail or Moodle, an online learning and teaching platform.

Learning and Teaching Philosophy

This course is designed for mature students undertaking study at the Masters level with either a first degree or substantial industry experience. It builds upon existing knowledge about the aviation industry or a related discipline to provide an interesting yet challenging learning environment. Although students study individually via distance learning, interaction with the course facilitator and other students is encouraged through the UNSW Moodle. Students are encouraged to manage their time effectively. The course caters for a range of learning styles. Assessment tasks are designed to be rewarding educational experiences with formative feedback in time for preparation for the final examination.

Integration into Overall Program

The course relates to several other courses offered as part of the MScTech in Aviation Management, that relate to risk and safety management, aircraft operations, accident investigation and aviation security. This course focuses on human performance issues as they affect the individual and organisations.

Internet

Online content and study materials can be accessed via UNSW Moodle;
<https://moodle.telt.unsw.edu.au>.

Course Schedule and Outline

The course comprises of 12 units to match the course duration of 12 weeks.

Unit 1	History and Basic Concepts
Unit 2	Foundations of Human Performance
Unit 3	Human Performance Enhancement
Unit 4	Safety and the Organisation
Unit 5	Non-technical Skills
Unit 6	Training and Evaluation
Unit 7	Flight Operations
Unit 8	Air Traffic Control
Unit 9	Maintenance
Unit 10	Technology
Unit 11	Investigation
Unit 12	Trends and Controversies

The twelve units of the course are designed to develop a broad knowledge of applied human factors.

Unit one - history and basic concepts – defines human factors, places aviation human factors in its development context and lays the conceptual foundations for the course. The scope of this unit will include the history of aviation human factors and an introduction to human error, systems theory, and safety management systems.

Unit two - human performance foundation concepts – provides ‘bread and butter’ information about the human operator in the complex socio-technical system that is modern aviation. Topics will include visual perception, memory, information processing, skill erosion, and the impacts of age on work performance. Some fundamental aviation medicine topics will be reviewed. The unit focuses on the human operator and represents a ‘bottom-up’ approach.

Unit three examines applied and theoretical aspects of human performance by introducing the essence of human factors – enhancing human performance within high-reliability/high-consequence organisations.

Unit four adopts a ‘top-down’ approach by examining safety and the organisation. Characteristics of high-reliability/high-consequence industries and occupations will be explored, along with organisational culture and safety climate, the ‘dark side’ of organisational behaviour, organisational approaches to fostering safety, and the developing field of resilience engineering.

Unit five concentrates on the non-technical skills associated with safe and effective aviation operations. Aviation was the birthplace of nontechnical skills training, often under names such as Crew Resource Management, Threat and Error Management, and Maintenance Team Management. Other high-reliability industries have followed aviation's lead and are adopting nontechnical skills training in settings such as operating theatres and ship's bridges. Topics will include the history of non-technical skills, communication; situation awareness; naturalistic decision making, cognitive effectiveness, emergency response, workload management and resilience.

Unit six - on training and evaluation - provides a bridge from the earlier conceptual units to the units that examine how human factors concepts and principles are applied in specific occupational roles in aviation. Topics will include; identifying nontechnical skill training needs, developing nontechnical skill training content; simulation, competency-based training, the training trilogy of awareness, knowledge and skills, and approaches to assessment and evaluation.

Units seven through nine concentrate on three main occupational streams within aviation. 'Flight operations' will examine ground and flight crew roles via topics such as teamwork, common hazards and errors, and effective controls. The unique challenges associated with air traffic control will be studied via topics such as attention and working memory, mental workload, and distributed decision-making. The contribution of maintenance error to the aviation accident record appears to have been on the increase, for reasons that will be explored in the course. Maintenance human factors topics will include the unique errors of this occupation, the hazards of shiftwork, drivers of noncompliance and a 'practical drift' case study.

Unit ten focuses on issues of technology, such as human-centred design, displays, automation, simulation, and the human factors challenges of unmanned aerial vehicle operations.

Unit eleven adopts a case study approach with a focus on the role of the human factors specialist in accident and incident investigation. The topic will double as a means to review the course content in an applied way.

The **final unit** will examine current trends and controversies in aviation human factors. Security, 'just culture', blame and punishment, night operations and emerging technologies and regulatory approaches will be canvassed.

Readings

Previous student feedback about the course has noted the large number of provided readings. It is acknowledged that most students would be unable to read all the reading materials in the time they are prepared to devote to study. As a result, the provided readings are divided into three levels of priority, to assist you in arranging your study time:

- *essential* readings are those all students are expected to read,

- *recommended* readings are those that students are encouraged to read, and
- *optional* readings are those that some students with particular interests or occupational backgrounds might find interesting or useful.

The provision of a wide range of readings is an attempt to cater to the typically wide and diverse interests of students who undertake this course.

The readings can be accessed via the UNSW online library, and some are also available on the internet. Some students have trouble working out how to use the online library. If you have such trouble, please liaise with library staff rather than the course facilitator or the School of Aviation administrator.

Research skills

All students should become acquainted with the UNSW online library if they have not already done so. A basic competency of any postgraduate student should be the ability to search for recent and relevant academic books and peer-reviewed journal articles using the online search capabilities. Too many AVIA5018 students in past courses have relied on Google and non-academic references in their assignment work. Reliance on such material will not result in a good result for this course.

Academic writing skills

Similarly, some past students have not delivered assignments that met basic academic writing standards, particularly for the essay assignment. It is appreciated that some students have not undertaken tertiary studies for many years, and that some may have been admitted to this program without a formal undergraduate degree. Nevertheless, it is your responsibility to develop your academic writing skills. There are numerous relevant resources available online, particularly through the UNSW Library website; for example: <http://subjectguides.library.unsw.edu.au/elise/writing>

All assignments should be submitted electronically in Word, Rich-text or Acrobat format to the School of Aviation submitted through the Assignment Submission Box on the UNSW Moodle site.

If you are not clear about what is required of you then it is your responsibility to contact the course facilitator as soon as possible – and certainly well before the due date for an assessment task.

Normally, extensions for assignments are not provided after the due date.

Normally, any agreed extensions will be limited to a maximum of seven days.

Final Course Result

All final course marks are scaled by the School and reviewed/moderated by the Faculty. Therefore, students are cautioned not to 'predict' their final grading for the course directly from a summation of each assessment mark. The final approved course result will be officially released on myUNSW in December (for Semester 2).

Academic Honesty and Plagiarism

Plagiarism is the presentation of the thoughts or work of another as one's own¹. Examples include:

- direct duplication of the thoughts or work of another, including by copying work, or knowingly permitting it to be copied. This includes copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement;
- paraphrasing another person's work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and,

¹ Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle.

- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.²

Submitting an assessment item that has already been submitted for academic credit elsewhere is also considered to be plagiarism.

The inclusion of the thoughts or work of another with appropriate attribution does not amount to plagiarism.

Students are reminded of their Rights and Responsibilities in respect of plagiarism, as set out in the University Undergraduate and Postgraduate Handbooks, and are encouraged to seek advice from academic staff whenever necessary to ensure they avoid plagiarism in all its forms.

The Learning Centre website is the central University online resource for staff and student information on plagiarism and academic honesty. It can be located at:

<https://student.unsw.edu.au/plagiarism>

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

1. *correct referencing practices*;
2. paraphrasing, summarising, essay writing, and time management;
3. appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor allocation of time. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

² Adapted with kind permission from the University of Melbourne.

References and Resources

Text Books

Prescribed: There are no prescribed (compulsory) textbooks to purchase for this course.

Recommended: Three texts are recommended as particularly useful for this course and for students with an enduring, professional interest in aviation human factors:

- Flin, R., O'Connor, P., & Crichton, M. (2008). *Safety at the sharp end: A guide to non-technical skills*. Aldershot, Hampshire: Ashgate. E-book available via UNSW Library at <http://er.library.unsw.edu.au/er/cgi-bin/eraccess.cgi?url=http://www.unsw.ebib.com.wwwproxy0.library.unsw.edu.au/patron/FullRecord.aspx?p=1207018>
- Harris, D. (2011). *Human performance on the flight deck*. Aldershot, Hampshire: Ashgate.
- Salas, E., & Maurino, D. (Eds.). (2010). *Human factors in aviation* (2nd ed.). New York: Academic Press.

Suggested: Other suggested texts, which you may wish to borrow or purchase, include:

- Dekker, S. W. A. (2005). *Ten questions about human error: A new view of human factors and system safety*. London: Lawrence Erlbaum Associates.
- Dekker, S. W. A. (2014). *The field guide to understanding 'human error' (3rd ed.)*. Aldershot: Ashgate.
- Dekker, S. W. A. (2011). *Drift into failure*. Aldershot: Ashgate.
- Ebermann, H., & Scheiderer, J. (Eds.). (2013). *Human factors on the flight deck: Safe piloting behaviour in practice*. Berlin: Springer.
- Griffin, T. G. C., Young, M. S., & Stanton, N. A. (2015). *Human factors models for aviation accident analysis and prevention*. Aldershot: Ashgate.
- Harris, D., & Li, W. (Eds.). (2015). *Decision making in aviation*. Aldershot: Ashgate.
- Kern, T. (2009). *Blue threat: Why to err is inhuman*. Pygmy Books.
- Marcellin, J. D. (2014). *The pilot factor: A fresh look into Crew Resource Management*. CreateSpace Independent Publishing Platform.
- Martinussen, M., & Hunter, D. R. (2010). *Aviation psychology and human factors*. Boca Raton: CRC Press.

- Reason, J. (2013). *A life in error: From little slips to big disasters*. Aldershot: Ashgate.
- Reason, J., & Hobbs, A. (2003). *Managing maintenance error: A practical guide*. Aldershot: Ashgate.
- Stolzer, A. J., Halford, C. D., & Goglia, J. J. (Eds.). (2013). *Implementing Safety Management Systems in Aviation*. Aldershot: Ashgate.
- Wiegmann, D. A., & Shappell, S. A. (2003). *A Human Error Approach to Aviation Accident Analysis: The Human Factors Analysis and Classification System*. Aldershot, Hampshire: Ashgate Publishing.
- Wise, J. A., Hopkin, V. D., & Garland, D. J. (Eds.). (2010). *Handbook of aviation human factors* (2nd ed.). Boca Raton: CRC Press.

Journals and Magazines

Journals / magazines that you are encouraged to become acquainted with include:

- Aviation Psychology and Applied Human Factors – <http://www.hogrefe.com/journals/apahf>
- Aviation, Space, & Environmental Medicine - <http://www.asma.org/publications/asem-journal>
- International Journal of Aviation Psychology - <http://www.tandfonline.com/toc/hiap20/current>
- AeroSafety World Magazine - <http://flightsafety.org/>

You should be able to access these journals via the UNSW online library.

Training Resources

The Civil Aviation Safety Authority (CASA) has developed a training resource *Safety Behaviours: Human Factors for Pilots* designed for the General Aviation and Low Capacity Regular Public Transport sectors. The package contains a comprehensive resource guide for ten nontechnical skills areas, including fatigue, stress, alcohol and other drugs, communication, teamwork and airmanship. At the time of writing, copies could be ordered from the human factors section within CASA: humanfactors@casa.gov.au

A companion resource, *Safety Behaviours: Human Factors for Engineers* resource kit, for aircraft maintenance engineers and small to medium-sized maintenance organisations has also been released by CASA. Larger organisations may also find the resource a useful supplement to existing human factors programs or a basis on which to build an appropriate program. Components of this kit can be downloaded

from CASA: http://www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_100999

Internet Resources

Extensive human factors-related online resources are available. A brief selection is provided below (links were working at the time of this revision). Further websites may be promulgated during the course. Students are encouraged to share web-based resources that they are aware of, or that they discover during the course.

- The Australian Transport Safety Bureau - www.atsb.gov.au
- Civil Aviation Safety Authority (Australia): <http://www.casa.gov.au/>
- Flight Safety Foundation - <http://flightsafety.org/>
- The Civil Aviation Authority (UK) has perhaps the most up-to-date source of human factors publications from a regulatory perspective. Their publications website is at: <http://www.caa.co.uk/application.aspx?catid=33&pagetype=65&appid=11>
- Skybrary's human factors portal - http://www.skybrary.aero/index.php/Portal:Human_Factors
- CRM Developers' Forum - <http://www.crm-devel.org/index.htm>
- Conference proceedings of the European Association for Aviation Psychology - <http://www.eaap.net/library.html>

Continual Course Improvement - Your Feedback to Us

UNSW is committed to excellence in education and regularly seeks feedback from students, employers and staff. Student evaluative feedback on each course is gathered each semester, using among other means, UNSW's Course and Teaching Evaluation and Improvement (CATEI) Process. Students are strongly encouraged to complete the surveys, which are routinely administered electronically towards the end of the semester. The feedback is anonymous and provides the School with evidence of what aspects of each course that students are satisfied with, as well as areas for improvement. Student feedback is taken seriously, and continual improvements are made to the course based in part on your feedback.

Administrative Matters

Students should be familiar with the information contained in <https://my.unsw.edu.au> regarding the university's expectations of students, enrolment, fees and other policies that affect you. Also, students should be familiar with the information provided in the Postgraduate Aviation Student Guide. This essential document can be obtained from the School of Aviation and is available on UNSW Moodle. Please contact Jamie Lim at aviam@ad.unsw.edu.au for any administrative enquiries.