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# Introduction



Design and Development of Aircraft Systems 3rd edition by Allan Seabridge and Ian Moir covers this material in a single chapter as a series of brief tables. This handbook is intended to provide more detailed information and some historical information about the development of each system and also to indicate how the systems will develop in the future. The reason for this is to give information to people working on heritage or older aircraft still in use, to span current types in operation and to provide assistance to those looking at future projects. The intention is to provide a full set of information for all aircraft systems in one single volume which complements other books in this field and is suitable for suitable for practitioners, students, graduates, and apprentices in aerospace.

People in the aircraft industry will expect to work on aircraft on all types and ages in their career. As a result they will be exposed to different technologies, different design methods, and different certification procedures. Typical aircraft will include

- Aircraft on display in museums
- Flying aircraft in heritage fleets
- Aircraft in private ownership
- Aircraft in routine operation by state owned airlines
- Aircraft in operation with commercial business organisations
- Aircraft in military air force operations
- Aircraft close to end of life
- Newly developed aircraft about to enter into service

The life span of aircraft in these classifications ranges from over a hundred years to a few years and spans many technologies. Some aircraft have a relatively low utilisation rate, whereas others are in operation on a daily basis. Their daily flight may be uncomplicated and stress free, or they may be consuming structural life. This means that the wear and tear of system components will vary and that many

*Aircraft Systems Classifications: A Handbook of Characteristics and Design Guidelines*, First Edition. Allan Seabridge and Mohammad Radaei.

aircraft will be subject to routine maintenance and repairs. Knowledge of these scenarios is important to anyone engaged in support of the aircraft.

This book is to provide information for people researching or working with heritage aircraft, current in-service aircraft and future projects and to provide a broad but brief description of each of the aircraft systems likely to be encountered. There are references to enable the reader to find more detailed information, suggestions for further reading to expand their horizons, and naturally there is always Google to rely on – other search engines are available.

Each chapter of this book contains the following information for each aircraft system:

- Key characteristics of all aircraft systems
- Clear descriptions with diagrams where appropriate
- Full glossary and bibliography

Readers preferably will require knowledge of the aircraft industry and its products at introduction level with sufficient links to encourage reading to seek more detailed information. The book is intended to help people who do not have that knowledge but need to know more in certain areas.

The content is intended to be of interest to people intending to join or already working in

- Organisations directly involved in the design, development, and manufacture of manned and unmanned, fixed-wing and rotary-wing aircraft – both military and commercial.
- Systems and equipment supply companies involved in providing services, sub-systems, equipment, and components to the manufacturers of aviation products.
- Organisations involved in the repair, maintenance, and overhaul of aircraft for their own use or on behalf of commercial or military operators.
- Commercial Airlines and armed forces operating their own or leased aircraft on a daily basis.
- Organisations involved in the training of personnel to work on aircraft.

The book is also aimed at educational establishments involved in the teaching of systems engineering, aerospace engineering, or specialist branches of the topic such as avionics or equipment engineering at high school, university undergraduate, or postgraduate level. It is also suitable for short courses intended for the professional development of industry professionals and practitioners. It will be useful for those who do not work directly in engineering, but have a role to play in the industry. Examples include the following:

- Support departments in the aerospace industry such as commercial, contracts, procurement, legal, training, communications, and public relations.

- Supply chain company staff
- Colleges, training academies, universities.
- Journalists, aerospace magazine/journal writers
- Practitioners in the aerospace industry – prime contractors and suppliers
- Graduates and apprentices in the aerospace industry – prime contractors and suppliers
- Undergraduates and postgraduates at universities offering aerospace related courses

These are the sort of people who will be found in the broad range of stakeholders in complex aerospace projects, illustrated in Figure 2.5. This gives an example of the aviation system and some of the people and groups affected by the systems or directly affecting the system. This diagram has been developed to illustrate the stakeholders in the development of a particular aircraft solution as an example to show that each specific project and indeed each system will have its own specific set of stakeholders.

The intention of this book is to provide a basic understanding of the principles of practical systems engineering, not to justify or to recommend specific processes or tools. Examples will be used to illustrate the principles; however, it is important to note that there is not one single "right" approach to an engineering process –nor need there be. As long as there is consistency of approach in the partners in a project, and as long as the process works, then that is the correct approach for that project. This understanding will be particularly useful to engineers designing systems or equipment and will provide essential background information for engineers or technicians using or maintaining the systems.

What this book aspires to do is to create an open-minded approach so that systems engineers feel comfortable that the process they have chosen will produce a safe and successful result. It will also serve to introduce people to the language, jargon, and terms used in industry. Hence, there are no solutions in this book, no definitive architectures. One reason for this is that such architectures go out of date quickly, and they are usually proprietary information so they will be sharply focused on the aims of the company designing the aircraft from which the solution is taken. Another reason is that it is not always good design practice to be overly influenced by previous designs. This book provides an opportunity for readers to understand their system and its requirements and ensure that the system is not only fit for purpose in its own right but also fits into other systems in the total aircraft architecture.

Exercises have been included at the end of most chapters to encourage readers to develop their reading of the chapter. There are no answers given; in many cases, there are no 'right answers', but doing the work, alone or in groups, will help to develop the skills of understanding a system and developing it to a firm solution.

Many references and suggestions for further reading have been provided to assist in this process, and the Internet serves as a source of further information.

**Chapter 2** addresses the general nature of an aircraft system and leads to a definition of such systems in the context of a physical application. Some characteristics of systems and their environments will be introduced to encourage the reader to adopt a behavioural skill of broad systems thinking when addressing the analysis and design of systems. This description will include the associated ground systems such as those required for the support and logistics organisations to analyse fault and prognostic information, as well as the systems required to operate and analyse the information collected by Unmanned Air Systems for real-time operations.

**Chapter 3** presents the key characteristics of all aircraft systems providing a brief summary of what each system is and to providing references to source material for further detailed descriptions.

**Chapter 4** presents the key characteristics of all avionic systems providing a brief summary of what each system is and to providing references to source material for further detailed descriptions.

**Chapter 5** presents the key characteristics of all mission systems providing a brief summary of what each system is and to providing references to source material for further detailed descriptions.

**Chapter 6** briefly describes some of the ground-based systems which link directly to the operation of the aircraft. Interfaces with these systems must be considered in the design of the airborne system. Some of the functions of ground-based systems will be found in the system diagrams in Chapters 4, 5, and 6.

**Chapter 7** provides a literature review of research in progress to provide a mechanism for modeling complex system architectures in order to find an optimum solution. A recently developed model is described in detail using proprietary modeling tools.

**Chapter 8** presents a summary of the book, some discussion and poses some questions for the future.

## Further Reading

Marais, K., Wolfe, P.J., and Waitz, L.A. (2016). *Air Transport and the Environment* (ed. P. Belobaba, A. Odone and C. Barnhardt). The Global Airline Industry. Wiley.

Mitkoff, A., Hansome, J., and Reynolds, T.G. (2016). *Airline Flight Operations* (ed. P. Belobaba, A. Odone and C. Barnhardt). The Global Airline Industry. Wiley.

Odoni, A. (2016). *The International Institutional and Regulatory Environment* (ed. P. Belobaba, A. Odone and C. Barnhardt). The Global Airline Industry. Wiley.