THE AIRCRAFT LIFE-CYCLE: "REDUCE, RE-USE, RECYCLE"

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In October 1987, the World Commission on Environment and Development, also known as the Brundtland Commission, released a report aimed at providing "a global agenda for change". This report, *Our Common Future*[1] gave life to and provided a definition for "sustainable development", integrating environment and development under one umbrella, stating that "Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs." Since, sustainable development has become central to the activities of the United Nations, and reached its culmination in September 2015 with the adoption of the UN Sustainable Development Goals.

A number of sectors have embraced the concept of sustainable development, deploying the socio-economic benefits of their products and services, while striving to minimize their impact on the environment. This "clean production" approach has increasingly expanded to goods' and services' entire life-cycle and issues such as waste reduction, energy and water efficiency, water quality and eco-design are fundamental to an environmentally sustainable and economically sound production chain. The linear approach to manufacturing "take, make, dispose" is evolving toward greater consideration for the origin of the input material, the impact of the manufacturing process on the environment and the treatment of end-of-life products. Aviation is no exception and the environmentally-sound management of the aircraft life-cycle is gaining traction, leading to the multiplication of partnerships and best practices in the sector, as illustrated in this chapter.

For aviation, such considerations are of greater relevance now, as an increasing number of aircraft are expected to leave service. Some studies show that some 17,000 commercial aircraft will be retired from service by 2030.

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Environmental Sustainability Across the Aircraft Life-Cycle

Between the inception of an aircraft research programme and the aircraft's actual entry into service, some of the most forward-looking innovations can be embedded into new aircraft designs. Indeed, aircraft manufacturers are continually bringing new products to the market that would decrease the environmental footprint of aircraft operations. Today's innovations, such as advanced materials or 3-D printing, can be real game changers for the sector.

The use of leading-edge technologies and advanced materials have a significant CO_2 emissions reductions potential. For example, aircraft weight reduction measures enable Bombardier's C Series aircraft to deliver over 20% fuel burn benefit, which can reduce CO_2 emissions to 6,000 tonnes annually. In a similar vein, Airbus considers that in the long-term, 3D printing can reduce aircraft weight by more than 1,000 kg per aircraft. It is anticipated that 3D printing on a large-scale could be in place by 2018.

Aircraft manufacturers are also reducing the environmental impact of their manufacturing process. This strategy includes better control of waste material and a decrease in energy consumption at their manufacturing facilities.

Again, 3D printing appears to have significant potential. For a single spare part, the time, cost and waste savings linked to the use of 3-D printing are considerable, and can bring about reductions in raw material waste as high as 95%. Aircraft parts are not directly cut in raw material sheets, which would create scrap material, but stem from the conglomeration of the exact amount of raw material needed to manufacture the piece.

The use of new technology is also associated with new challenges, and this is when recycling and aircraft end-of-life management come into play. While waste savings are important, the ability of the sector to re-use and recycle aircraft parts and to adapt these practices to the new materials used in aircraft manufacturing, such as composite materials, are equally as valuable.

The Aircraft Fleet Recycling Association (AFRA) has announced that 400 to 600 aircraft will be dismantled each year until 2017 and it is expected that the entry into force the new ICAO CO_2 standard for aircraft will intensify this trend. The objective of AFRA is to ensure that this process is carried out in compliance with state-of-the-art practices (see related article page 196). However, important challenges lie ahead, beginning with the lack of awareness on environmental best practices in this area.

The Way Forward

A paradigm shift is needed to conceive of the life-cycle of the aircraft in its entirety and to extend the concept of environmental sustainability beyond the production and utilization of aircraft.

ICAO and its partners will aim to support this paradigm shift and to provide best practices on the use of material, as well as information on environmental risks during the dismantling and recycling process. The ICAO Committee on Aviation Environmental Protection (CAEP) will establish a first diagnosis of the issues connected to aircraft end-of-life to make sure that they are addressed by the relevant bodies, including safety and security. This should contribute to strengthening the full life-cycle approach to aircraft manufacturing.

From cradle-to-grave and to cradle-to-cradle, a case is being built on a daily basis by those who work hard to limit the aircraft environmental impacts, after those aircraft have completed their service in the development of international aviation.

Of course, to address emerging issues such as aircraft recycling and dismantling, it is imperative that ICAO establishes relevant partnerships with the experts in the field. By the time of publication of this report, ICAO and AFRA should have formalized their willingness to strengthen their cooperation.

Sustainable Development Goals

References

1. World Commission on Environment and Development (1987). Our Common Future http://www.un-documents.net/wced-ocf.htm