Current aircraft types that have reached the end of their economic lives are being dismantled and recycled at an increasing rate, with an estimated 1,800 aircraft facing end-of-life harvesting for parts and raw material extraction over the next three years. There has been a push for quality and control over this part of the aviation industry market, however, instigated by the OEMs themselves.

End-of-life aircraft value extraction: dismantling & recycling

Extraction of value from ageing aircraft entails several stages and processes. The aircraft is broken into usable and non-usable components and materials that can enter the aftermarket, be recycled, or relegated to a landfill.

An aircraft's value is not only in the airframe and engines, but also in its associated maintenance records, without which the only value remaining would be materials for recycling.

There is a push for greater environmental protection and industrial safety in the process of dismantling. Organisations, such as the Aircraft Fleet Recycling Association (AFRA), are a driving force behind this movement. There is the development of best management practices (BMP) containing guidelines to assist businesses in efficient, revenue-building, and environmentally-sound methods for aircraft disposal.

AFRA's goals and the correct processing of end-of-life aircraft are detailed below with insight from some of the key developers in this part of the aviation industry market.

AFRA

AFRA was founded in 2006 following original equipment manufacturer (OEM) requests to existing aircraft dismantling companies to assist the aviation industry by developing a degree of control over the disassembly, part-out, and recycling of end-of-life aircraft. Circulation of unapproved parts, combined with uncontrolled dismantling practices, was causing safety concerns that needed to be addressed.

AFRA is a membership-based global collaboration of 70 companies from 18 countries. Its goals are to elevate the performance of the industry through compliance with all applicable laws and regulations, while at the same time promoting higher standards of ethics and integrity throughout the dismantling and recycling processes.

To achieve this, AFRA's BMP provides advisory standards on minimum levels required of aircraft disassembly and recycling companies to ensure sustainable and safe management of end-of-life aircraft.

Recognised compliance with BMP through the AFRA accreditation programme also assists airlines and aircraft owners to make knowledgeable decisions about where to place their aircraft for final asset-value extraction.

Storage – transitional maintenance

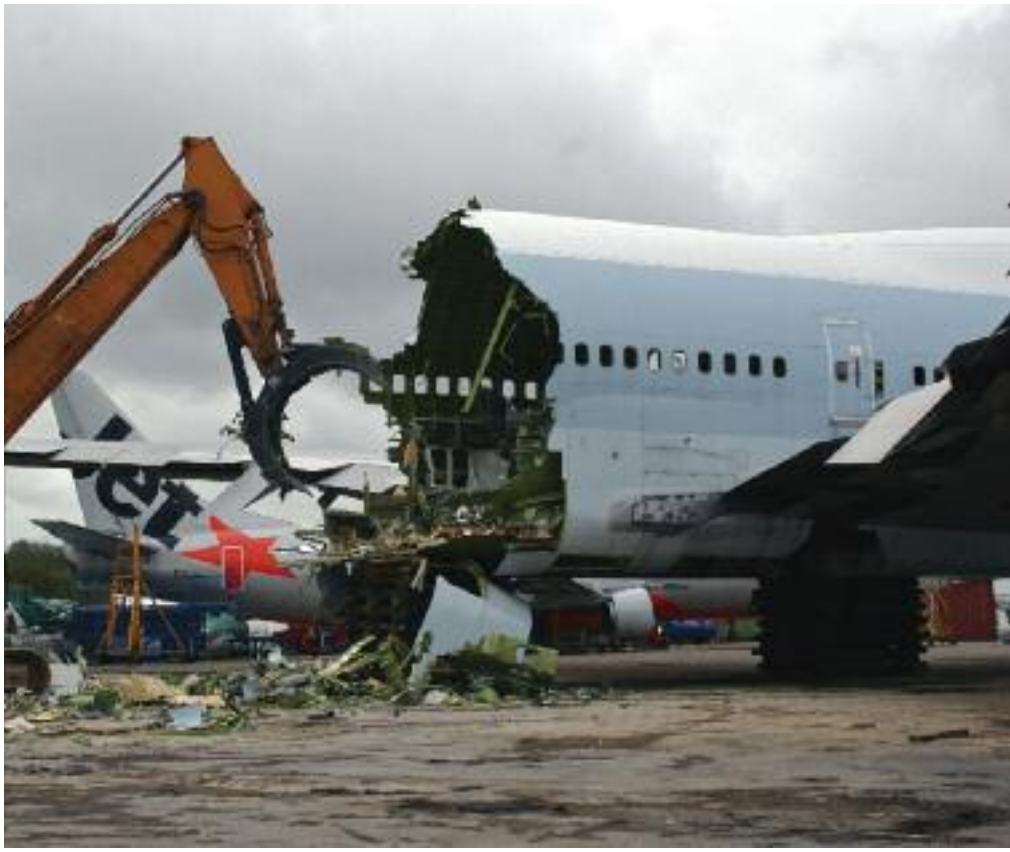
For aircraft not in operation but which may return to service, parking care and maintenance is required while their future is being decided. This transition period of maintenance will keep the aircraft serviceable for ease of relocation when needed, and to ensure better parts condition when removed for re-sale.

Additionally, storage of aircraft at dismantling facilities is also used by operators to maintain access to parts before an aircraft's disposal. "GJD provides certified storage maintenance to maintain an aircraft's current airworthiness review certificate (ARC)," explains Gary Spoors, accountable manager at GJD AeroTech. "This is an opportunity to harvest serviceable parts and provide a logistics lifeline for remaining aircraft in the fleet. While this may seem costly in the short term, it only takes one unavailable part with a manufacturer's lead time of months, to make this a cost-effective solution.

"As part of a customer's fleet extension utilisation programme, when the next aircraft is phased out and delivered into storage, the previous aircraft will be parted out and scrapped," continues Spoors. "The new aircraft will go on to a certified care and maintenance programme until the next aircraft arrives. This fleet extension programme proved very successful when GJD disposed of the British Royal Air Force's (RAF's) VC10 fleet over a five-year period. Parts were provided to keep the 50-year-old aircraft flying, and in the long term saved the UK taxpayer tens of millions of pounds in re-manufacture and overhaul costs."

A manufacturer's instructions for parking, storing and mooring aircraft will be detailed in an aircraft maintenance manual (AMM). In general, however, once an aircraft has been on the ground continuously for seven days, and is not considered to be on scheduled maintenance, such as a 'C' check, some form of care and maintenance is required to preserve the aircraft and its systems.

These preservation procedures can vary in depth, depending on the length of time an aircraft is anticipated to be on the ground. For some aircraft types, if they are going to be grounded for no more than 15 days, for example, short-term parking repeat inspection tasks can be available to retain 'flight ready' condition. In some instances, this can be carried out twice consecutively before the aircraft must be put into storage or flown to renew the process.



Once the harvesting of parts from an airframe is complete, the remaining airframe material will be condensed down to a transportable size for the recycling and disposal steps to begin.

When an aircraft is known to be on the ground with no immediate release, deeper storage requirements need to be met. Different tasks have to be carried out depending on whether an aircraft is being put into storage, held in short- or long-term storage, or coming out of storage to return to service. Repeat interval inspection requirements at weekly and monthly intervals outlined by the manufacturer will provide regular condition checks of the aircraft structure and aircraft systems.

In terms of the cost of parking and storing an aircraft, putting an A320 aircraft into preservation, for example, will cost about $15,000. This will include preservation of exposed metals, protection of interior soft furnishings, and installation of humidity controllers. Once an aircraft is considered to be 'in storage,' repeat interval checks at every seven days, 15 days, 30 days and higher intervals are cycled through. These smaller checks can cost $525, $1,100, and $2,500 respectively. Inspections at this stage will include tasks, such as rotating tyres, and operational checks of aircraft hydraulic, electrical, and air conditioning systems. Cabin humidity checks will also be needed, together with exterior aircraft surface condition inspections for any impact damage or paint deterioration. As an aircraft is stored longer, additional requirements will include further re-protection and/or external cleaning.

Reactivation of an aircraft for ferry flight or return to service is also carried out, subject to AMM instructions. For an A320, this process would cost about $21,000, plus relocation costs. Usually this maintenance would be carried out with a 'C 'check, but for an aircraft only being flown for dismantling, the required work will be kept to a minimum to meet the conditions of its permit to fly.

The cited sample costs do not make allowances for defect rectification, which, if required, would be set at the local industry man-hour (MH) rate. Also, any materials or components required for defect rectification would be charged at cost, plus a handling charge.

Storing engines at maintenance facilities can be done off-wing while the fate of the aircraft is decided, or if the engines have been removed due to onward lease requirements. The general price of storage will be affected by the services requested, which may include monitoring the engines in accordance with applicable engine manuals, transport requirements, and customs clearances. Charges can be $1,300-2,600 per month per engine.

As the costs of storing an out-of-service aircraft can accumulate quite quickly, dismantling it shortly after its last flight may be the best option if the aircraft has no further use.

Teardown evaluation

Prior to dismantling an aircraft, the teardown evaluation process involves a series of sales forecasts and aircraft technical records reviews to establish the asset's value. Since engines have the highest value of any component, options for green-time leasing or even restoration will be considered in addition to any part-out evaluations. Green-time leasing is the use of any remaining engine flight hours (EFH) and engine flight cycles (EFC) left before overhaul or teardown is required.

Although aircraft type, condition and age have a part to play in the overall evaluation of the aircraft, the value of components that can be removed from an aircraft is directly affected by the availability and condition of its records.

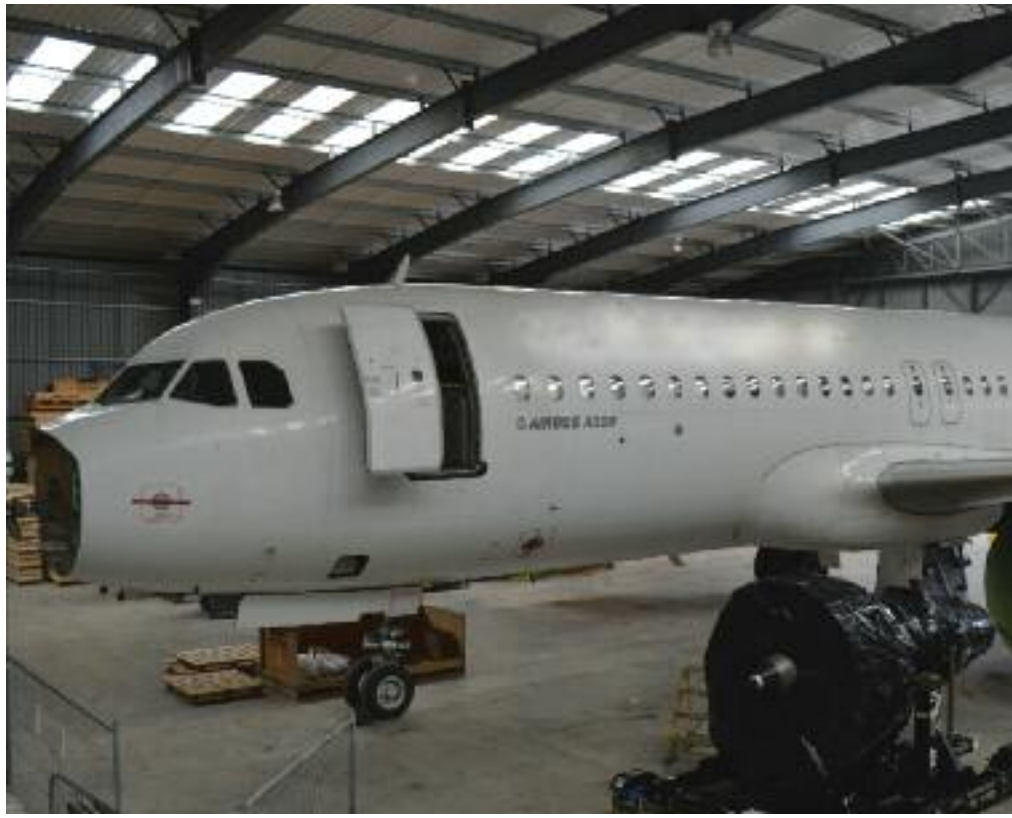
Technical records contain the history of all scheduled and unscheduled maintenance activities. Up to date records are critical for full asset-value extraction in the dismantling process. For some components, these records need to begin at point of manufacture.

"To give you an idea, a 737 parked at an airport with no records only has value left in the metal," explains Derk-Jan van Heerden, general manager at Aircraft End-of-Life Solutions (AELS), based in the Netherlands. "Due to labour costs, I would have to ask the owner to pay me to recycle it. There is a positive in the value of the metals, but there is a negative in the hazardous materials and non-metals that need to be disposed of."

Component value also depends on where an aircraft model is in its life cycle, and size of the market. At a certain point suppliers will stop producing specific parts for the major original equipment manufacturer (OEM) production lines. This might happen soon for the 737NG or the A320ceo (current engine option) because the component manufacturers will switch to newer models, such as the 737MAX or the A320neo (new engine option). This will generate a shortage of available spare parts for the older types over time, affecting the prices of remaining stock and, therefore, increasing the potential teardown evaluation.

Similarly, if 60-70% of a fleet type has already been disassembled, a substantial supply of materials and components is already on the market, reducing teardown value.

For engines, teardown values can vary in direct relation to their remaining EFC on the LLPs. Other engine components, such as compressor blades and stators, are monitored on an 'on-condition' basis, and will also have an effect on the used serviceable materials (USM) retrieved from an engine for part-out or recycling.



Prior to disassembly, aircraft are treated as being 'in maintenance' until all parts requested have been removed and returned to the supply chain.

A CFM56-7B, for example, could have a teardown value ranging from $3.7 million to $4.5 million, while an engine such as the CFM56-3, used on 737-300/-400/-500 aircraft, will have a lower evaluation due to the large availability of engines on the market and steady decline of operational aircraft needing those engines. A CFM56-3's teardown value ranges from $80,000 to $1.25 million.

Dismantling

Aircraft are dismantled, not just because they have reached the natural end of economic life. An aircraft could be damaged beyond repair, be involved in a bankruptcy situation, or be used to support the parts supply of the worldwide fleet. The non-airworthiness of aircraft can make it impossible to fly to a location for disassembly and dismantling, so many dismantling companies are capable of relocating to an aircraft's final position.

Mark Gregory, managing director at UK-based Air Salvage International (ASI), explains the approach to parts removal once an aircraft is ready for dismantling. "The quantity of parts removed depends on the aircraft type, and the specific requirement of the owner or designated parts company involved. You would be removing 200-600 parts from an old 737 Classic, but upwards of 1,200 parts from a 737NG -700 or -800. It is down to market needs and value of the items being removed. As not many NGs are being broken, the value of their parts is high."

As more of a specific aircraft are broken, more parts are placed in the market, which devalues those parts. Also, the more of one type of aircraft that is removed from service, the less there is to support. It is a balancing act between owners, operators and market needs.

"The A320 has the same story," continues Gregory. "Those aircraft with manufacturer serial numbers (MSNs) 1,000 and below (built before 2000), typically have 400-700 parts removed, while we are removing 1,200-plus parts from post-MSN 1,000 aircraft."

During the parts removal process, an AFRA-accredited disassembly company will treat an aircraft as if it is under maintenance until all parts to be returned to the supply chain are removed. Job cards will be created with reference to the relevant AMM and illustrated parts catalogue (IPC), and if possible, operational checks will also be carried out to determine condition.

"When the aircraft come in, right up to the point where the last part is removed that is going back into the supply chain, it will be handled in the same way as it would be on maintenance check," explains Gregory. "That could be anything from four weeks to 12 months. With regard to the newer aircraft that we are dismantling, we may try to keep them longer. If you consider the process to be in three phases, then as many parts as possible are removed in phase one. During phase two we hold the airframe for any odd or unusual requests to remove certain parts. This phase may last up to a year if that is the only aircraft of that type being broken. Finally, phase three would constitute asset disposal."

Once the remains of an aircraft are at the disposal stage, the owner of the asset will need to sign-off the aircraft to state that there are no further parts required.

Gregory adds: "The aircraft is owned by the operator, bank, leasing company, or parts company that has instigated the dismantling until it is signed off. Once the aircraft is signed off, this is where our function changes and we come under the disposal part of the process. We are now looking for avenues to maximise return on unwanted material. The reason that as many as 55-60 aircraft go through our facilities each year is that we are constantly working with customers to get the best return on unwanted material. If we can sell the front section to a training school, we will work openly with the owners to get them more money than they would have received from just scrapping the metal."

Stating exact timeframes for dismantling is difficult, due to varying circumstances of parts to be removed, aircraft and engine ownership, and aircraft type. In general, the quickest dismantling process will take 15-40 days with a fixed or mobile team.

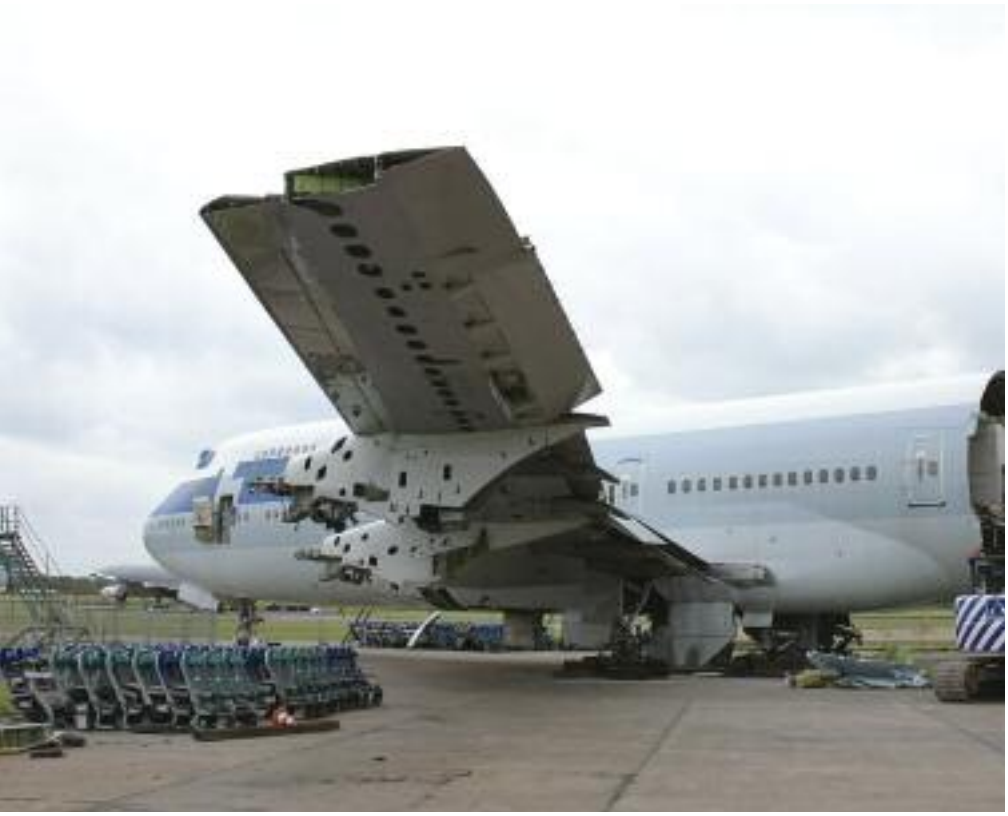
Once parts harvesting is complete, the remaining airframe material will be condensed to a transportable size for the start of recycling and disposal.

Importing aircraft

When an aircraft enters a disassembly facility it turns into a package of parts to be sent to several locations, although some components will stay behind. Adherence to import and export requirements is part of the process.

One of the biggest challenges is frequent change of ownership prior to aircraft arrival. Up to 80-90% of aircraft switch owners before they are disassembled. Change of ownership can bring change of registration, and, therefore, a change of regulatory authority rules that require compliance. Aircraft arriving from alternate trade zones can entail customs duties.

This can be more challenging in Europe than in the US, because aircraft arrive from outside Europe's smaller geographical boundaries from owners, for example, that may be based in the US, the Asia Pacific, or Africa. One way to circumvent this problem is through the use of a free trade zone.



The quantity of parts that can be removed from an end-of-life aircraft can vary greatly, depending on aircraft type, age and the availability of maintenance records.

A free trade zone is defined as a set geographic area in which goods, such as aircraft, can be processed and re-exported without customs intervention.

In Europe, the Shannon Free Zone (SFZ), a 2.43 square kilometre (600 acres) international business park situated next to Shannon Airport in Ireland, is often used to import aircraft. Businesses located in the SFZ enjoy tax incentives. Aviation companies that have invested at Shannon include GE Capital and Lufthansa Technik.

Gregory explains further: "If the aircraft has come in from outside the European Union (EU), we have to import it. We have our own import/export personnel who look after each aircraft. Alternatively, we work with customers to clear customs in the free trade zone at Shannon. Once aircraft leave Shannon, they are in free circulation.

"Otherwise, we bring them in by our own inward processing relief (IPR), but an owner will be limited to the amount of time an aircraft can spend at our facility. This is normally 12 months," continues Gregory. "Additionally, parts removed from an aircraft have to be exported within a certain time frame. This does not, however, usually cause a problem, because within six months the dismantling and part-out process is normally complete, and the goods are either components or waste products and have been re-exported."

Permits

Companies that dismantle and recycle aircraft are required to follow rules and regulations established by a local governing authority to obtain the correct permits and licences. There are, however, clear distinctions between dismantling and recycling. These can differ between countries, and also within the EU.

Gregory explains: "Aircraft coming into ASI are doing so under maintenance. A dismantling company is a maintenance company that dismantles an asset to release the premium from the parts. They only go into the permitting requirement where a licence to 'handle and treat waste' is needed once an aircraft has been signed off as waste for recycling or disposition. Although we may be able to sell a section of an aircraft, it is still classified as a waste product because it is unwanted and no other bits are fit for the purpose for which they were made."

Part-out

Many aircraft dismantlers will not act as component brokers, although they may sell components removed from the aircraft they have purchased and dismantled. Alternatively, components removed from aircraft can be consigned to independent parts brokers or parties acting in a joint venture with dismantlers or other businesses.

For an airline operating older aircraft types, dismantled aircraft can be a valuable parts supply.

The process of re-certifying parts can be complicated, however, and the process varies depending on the part involved, its paperwork history, condition, and also where the part is re-entering the market. If the part is remaining in the same airline, sometimes known as sister-to-sister transfer, the process differs from that involved in crossing aviation authority boundaries. If a disassembly facility issues a disassembly tag that is an approval for return to service, the facility would be required to conform to standards of practice that are acceptable to local aviation authorities and OEM instructions. This can be a natural advantage to dismantling companies that also hold Part 145 repair station approval, allowing for aircraft repair and overhaul. Usually Part 145 operations are supported by in-house capabilities, including back shops to carry out component recertification for aircraft on site for standard scheduled maintenance.

Gregory adds: "The main components removed as serviceable are engines. They often make up to 80% of the value of an aircraft. Operators are able to take advantage of the aircraft as a test bed for the engines while carrying out borescope checks along with maximum power assurance (MPA) engine runs that are needed before engine removal. 90% of the aircraft that come through our facilities require these checks to prove the engine is within the correct operating parameters and is serviceable. The engine is then released as 'serviceable,' subject to trace paperwork. Back-to-birth records, including FH, FC, previous modifications and repairs, will always be required for engines. Components other than engines are sent to specific workshops for testing before being sold as being in serviceable or overhauled condition."

For airframe parts, the value of a part is generally always more with an OEM serviceable tag on it. Van Heerden adds: "At AELS we sell parts as 'on-removed' condition and also as 'serviceable' condition. A part that is labelled 'as-removed' means the buyer or one of the next owners needs to recertify it before it is installed on another aircraft. We also send components out for recertification ourselves, and they can be overhauled, repaired and upgraded in some cases."

Spoors adds: "As an approved aircraft maintenance organisation, we target airlines that are looking to extend fleet utilisation by sacrificing some older aircraft that are due heavy checks. Through a system of historical parts use and forecasting, the number of parts needed to support the remaining fleet can

be determined. From this, a fairly detailed and comprehensive list of probable parts required can be drawn up. GJD can then remove most of these parts with the appropriate checks, issue a Form 1, and they can then go straight back into a customer's stores system to support the remaining fleet."

The volume of parts removed from end-of-life aircraft can vary greatly, depending on aircraft type, age and maintenance records availability.

Levels of part-out

There are different statistics on the percentage of an aircraft that can be successfully parted out or recycled, although many companies estimate this to be 85-95%. It is difficult to establish what percentage is disassembled and recycled, unless it is directly compared to an in-service 'complete' aircraft.

"If we say 85% of an aircraft is recycled, then we must state what the original 100% is," says van Heerden. "Is 100% the weight of the aircraft when it arrived, and does this include or exclude fuel? Or is it the weight of the aircraft after the components have been removed, for example? Nobody really has a calculation method for that. So if you remove all the interior plastics for re-use, which happens on occasion, you end up sending to the recycling facility a hull that is quite clean and therefore constitutes a high percentage of the original weight of the aircraft. If the aircraft interior cannot be re-homed, or was not installed on arrival, the statistics would be different."

Destruction of parts

Waste materials treated through the recycling process must be documented with a traceable certificate of destruction, issued by the recycling facility and conforming to regulatory guidelines.

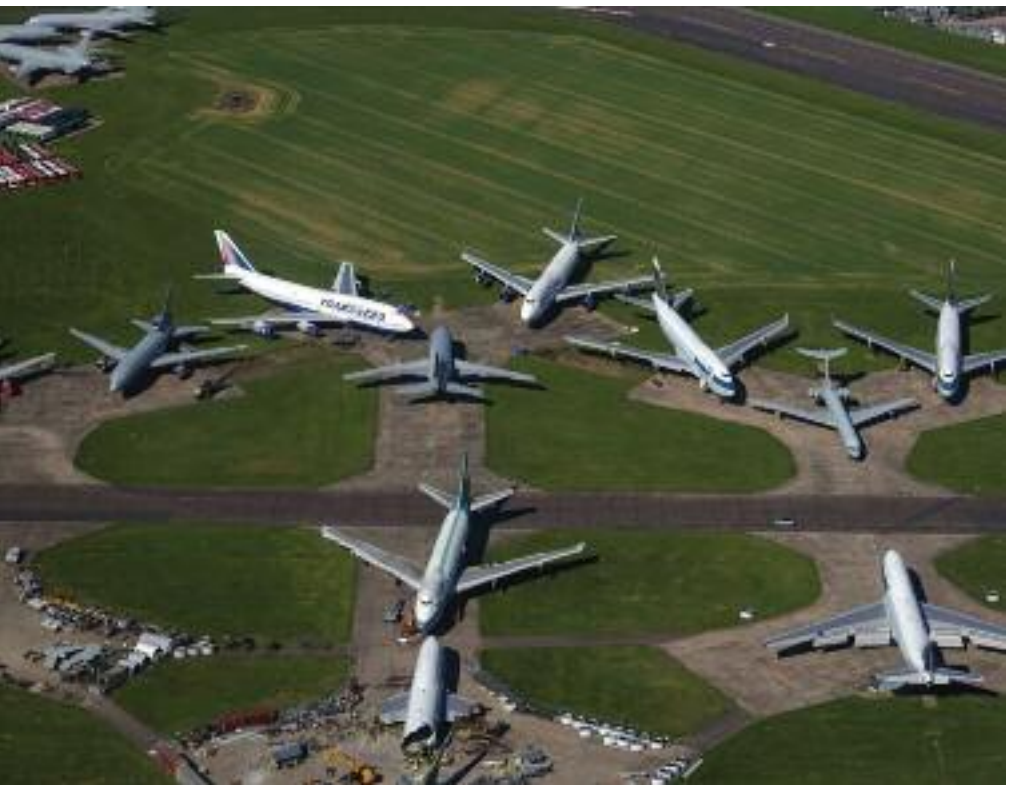
What can't be accounted for during dismantling are components with incomplete certification; missing, manipulated or altered identification plates; or suspicious appearance that may lead to authenticity being questioned.

"A questionable part with an unclear history and trace will have a potential impact on the re-sale of the part and serviceability of any future aircraft it is used on," explains van Heerden. "A removed part without a paperwork trail will have to be recertified at a repair station that does all the checks. Owners and component brokers should always expect to pay for recertifying removed components, unless they have come from a serviceable aircraft that is in the right environment, where airworthiness regulations are met. This would allow the dismantler to give an EASA and/or FAA (or equivalent authority) serviceable form directly. These forms are known as EASA Form 1 or FAA 8130-3.

Recycling

Once all required components and usable parts from an aircraft have been removed, remaining waste material is either recycled and returned to the supply chain as raw material, or disposed of in a landfill. Typical materials used for aircraft fuselages and wings, which then become the major content of waste products, are 2000 series aluminium alloys, 7000 series aluminium alloys, titanium alloys, glass or carbon reinforced polymer composites, magnesium and stainless steel.

The term 'waste streams' is often used to define different groups of waste products for recycling. These waste streams will contain a mix of materials from aircraft fuselage and wing structures that will need to be further analysed before the final recycling stage. Mixed aluminium, for example, has a lower weight value than segregated aluminium. So if 2000 series and 7000 series aluminium can be separated, both types can be sold for a higher value.



Storage of end-of-life aircraft for parts supply can be a logistics lifeline for some operators.

All alloys and precious metals can be segregated using an XRF (X-ray fluorescence) analyser. This handheld device acts as a portable lab that allows technicians to identify with confidence the type of material at hand for recycling.

Chris Calam, sales and marketing manager in Europe for Thermo Fisher, which manufactures Thermo Scientific XRF analysers, explains: "Thermo Scientific XRF analysers determine an alloy's chemistry, and display an alloy grade, often within just a few seconds. The device uses an x-ray tube to excite the sample. In turn this generates secondary x-rays that can be analysed by an in-built detector. Because every alloying element in the metal being tested has a unique energy, the XRF analyser differentiates and counts the number of signals occurring at that particular energy. Once the analyser has the elemental composition, it is referenced to the on-board library to give specific information about the sample, such as the alloy grade.

"For aluminium, there are generally two different alloy types of large quantities that tend to be sorted. These are distinguished by contributing alloying elements," Calam continues. "For the 2000 aluminium series, the main alloying element is copper at 2-6%. The key alloying elements for the 7000 aluminium series are zinc at 4-7%, magnesium at 1-3%, and copper at 1-2 %." The metals can be segregated for more precise recycling paths by using XRF analysers.

Using tools, such as analysers, results in improved efficiencies by reducing the time taken to handle the material, as well as minimising waste cross-contamination for greater revenue extraction.

"I think the aviation industry is generally unaware that the value of the remaining airframe, once stripped of components and interior furnishings, is not very high," says van Heerden. "It is actually very low, especially compared to the value of the components, which could be worth $1-3 million per aircraft. To add to this, there is a decreasing amount of metal available as a result of increasing quantities of composite materials being used in aircraft construction. Composite materials do not sell easily on the recycling side, and sometimes not at all. The only value in an aircraft after component removal is in the metal."

"An aircraft's material prices, after parts removal, are EUR500-600 per metric tonne," continues van Heerden. "That is the value of the mix that arrives at a recycling facility. The cost of transporting it to the recycling facility or bringing in the equipment to cut the aircraft into transportable size is extra. For an aircraft the size of an A320 or 737, transportation could cost EUR5,000-10,000. If you only retrieve 20-25 metric tonnes of material from the dismantling process, with a value of EUR15,000, you are not left with much after deducting expenses."

Of course the quality of the end product required from the recycled material will affect the extent of processes used and the amount of segregation needed. If metal alloys, for example, are melted into virgin material that enters the market at the beginning of a supply chain, they need to be of high aviation grade standard. This is difficult to achieve because recycled aluminium is more likely to be only 95% pure due to the remnants of paint, sealant, fasteners and coatings applied to the metal during original construction of an aircraft. The growing use of recycled material when possible, rather than the difficult and more costly extraction of natural raw materials, is assisting the sustainability of the product.

Environmental issues

Environmental issues relating to end-of-life aircraft waste material may initially focus on the immediate physical area surrounding the dismantled aircraft. On a larger scale there is a need to develop improved processes to lower the environmental impact of aircraft waste entering landfill sites by moving as much as possible through the recycling industry.

While greater volumes of material will in turn increase revenue, developing techniques and finding a market for the material comes at a cost.

Airlines and aircraft owners disposing of aircraft are responsible for environmental protection compliance. Not all end-of-service aircraft owners consider environmental performance when looking for a provider or are aware of the risks that end-of-service aircraft can have for aviation safety and environmental protection.

Market potential

To develop greater end-of-life aircraft asset value release, would-be acquirers are eyeing aircraft with only several years of remaining operational service.

This may involve targeting an aircraft with limited time left on a current lease to disassemble the asset on lease expiry.

Prime candidates would be suitable 18-22 year-old aircraft; there is little risk as the value of the aircraft parts exceeds the value of the aircraft as a whole.

This supply is readily available. To raise money in the capital markets, major aircraft lessors and financial institutions aim to keep the average age of aircraft in their portfolios as low as possible.

GCAP, an Aviation Partners joint venture that includes CGAM, for Part 145 maintenance and leasing aspects; ASI, for disassembly; and Skyline Aero for parts handling, is currently looking into this approach for end-of-life aircraft.

Once purchased, on lease expiry, an assessment would be made on whether to take the engines and APU off an aircraft for re-lease, disassemble the aircraft, or hold the aircraft intact and for further short-term leasing. Disassembly could be carried out when all other avenues of value extraction have been utilised.

Bill Cumberlidge, chairman and chief commercial officer of Aviation Partners, explains: "If we look at the pure trading side of the business, this is where people who know the assets can make a great deal of money. The mature end-of-life section of the aircraft market can be a manageable side of the industry because the overall exposure is not great. If you have paid $6 million for a run-out 18-year-old 737-700, whose engines are worth $2 million each, that leaves you only $2 million to reclaim from the aircraft to start to be in-profit. This could easily be achieved by parting out the landing gear, or burn time off the APU."

"But there are limitations and you cannot go out and raise large amounts of capital because the banks do not see the market in the same light," continues Cumberlidge. "The risks of this end of the market can be controlled and mitigated throughout the bidding process and, of course, you would not enter a transaction without clear access to aircraft records. Evaluation of each aircraft prior to purchase will involve looking into the net present value of the lease stream, and looking at lease return conditions to see if you can mitigate any of them. In addition, where there are maintenance reserves, you need to know exactly where the account is in terms of how much is held and any obligations/drawdowns before lease termination. Finally, an estimate needs to be made of how much has to be spent on an aircraft up until a lease terminates."

This process suits some lessors and banks selling off old aircraft. Some major leasing companies have in-house units to support end-of-aircraft leasing. In general, it is easier to sell an aircraft that has a few years remaining on a lease to release the asset's value early, and not have to deal with lease return problems.

Cumberlidge adds: "If return conditions of an aircraft outline that there must be a minimum of 4,000 FC on the engines, for example, then the lessee could forgo the maintenance reserves, and we will have the engines in an 'as-is' condition and located on a 'where-is' basis. If we are going to dispose of an aircraft, it is an easy option. In this respect an equivalent pay-out figure is probably what you want, including any cancellation fees on the return conditions. So you end up with a pot of money, and an aircraft ready to dismantle and recycle.

Summary

Dismantling aircraft and returning parts to the distribution network is an asset-value extraction process that is mainly for aircraft owners. Dismantling and recycling of end-of-life aircraft provides a lifeline to other aircraft still in service through crucial parts harvesting, and it is also a path for environmental protection through the re-distribution of raw materials back into industries.

There is a need to find new ways to improve the value of end-of-life aircraft waste materials by recycling certain non-metal materials, as well as finding a market for materials for which there is currently limited demand. A constant, and if possible, predictable quantity of aircraft needs to be available to do this.

What aircraft will be available in the future can be determined by analysing the number of a specific aircraft type that was dismantled, compared to when the same type ceased production, and/or was replaced by a newer type. Peaks in aircraft dismantling are also driven by fuel prices, global industry events and the cost of finance. AC