Economic Impact Assessment and Select Recommendations

Dissimilar Technical Regulatory Requirements Impacting Cross-Border Transfer of Aircraft

A study prepared for the Aviation Working Group by SGI Aviation

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A·W·G
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EXECUTIVE SUMMARY

Costs of regulatory overlap and inconsistency

Safety is a universal objective for the regulation of air transport. The means by which this critical objective is achieved vary between jurisdictions. This study estimates that dissimilar technical regulatory requirements between jurisdictions regarding the safe operation of commercial aircraft cost the aviation industry up to ***US$ 369 million per annum***. It further estimates that the projected cost over the next twenty years of such dissimilar requirements may be as much as ***US$ 7.286 billion***.

It would be beneficial to the aviation industry if some or all of these dissimilar requirements could be harmonised, and the costs associated with them avoided, provided always that doing so would not compromise the safe operation of aircraft. Harmonisation of such requirements may lead to an increase in the overall level of safety as a result of:

(i) increased multi-jurisdictional cooperation between aviation safety oversight organisations;
(ii) reduced duplication of work; and
(iii) a freeing up of limited global rulemaking resources to focus on critical areas.

Lower and more predictable costs of compliance with aviation safety regulations would increase the efficiency of the air transport system, with cost savings and economic benefits accruing to all involved in the system, including end users.

Consistent with overriding safety objectives, this study makes select recommendations which would materially contribute to the realisation of such cost savings and benefits. Moreover, the infrastructure is already in place to begin implementing some of the most important recommendations.

International standards to enhance the transfer process

In particular, this study argues that the Universal Safety Oversight Audit Program (***USOAP***) (established by the International Civil Aviation Organization (***ICAO***)), is a valuable tool which can be employed by states to determine whether to accept, without further action, certification by the state in which the aircraft has most recently been registered as evidence of the airworthiness of an aircraft.

In international civil aviation, safety is regulated by multilateral standards promulgated by ICAO. These universal standards are laid down in the Annexes to the Chicago Convention. The Chicago Convention itself requires, in Article 33, recognition *without further act* of certificates and licences in international civil aviation, provided that the standards of the Annexes are met.

Article 33 is primarily directed at day-to-day operations, when aircraft registered in one state temporarily enter the airspace of another state. However, a similar, albeit optional, provision applies to the international transfer of aircraft[1], allowing an importing state of an aircraft to accept the Certificate of Airworthiness (***CoA***) issued by an exporting state without further action. ICAO considers this multilateral recognition of certificates to be a basic foundation of international civil aviation,

[1] at paragraph 3.2.4 of Annex 8.

stating that this facilitates the free flow of states' exportables, such as aircraft, throughout the world. The organisation observes, however, that many states require the holders of such certificates to comply with separate, but similar, obligations and requirements that increase the administrative and financial burden of the certificate holder, without any positive impact on safety[2].

For the purposes of this study, a "transfer" consists of four elements:

1. ***deregistration*** of the aircraft from the aircraft register of the state of export;
2. ***aircraft modifications*** associated with the registration change;
3. ***registration*** by entering the aircraft into the register of the state of import;
4. ***certification***, resulting in the issue of a new CoA.

The rate of aircraft transfers has rapidly increased over the last 20 years, and that trend is likely to continue. The important role of leasing underlies and is reflected in Article 83bis of the Chicago Convention. Aircraft leasing companies now collectively own approximately 32% of the world's air transport fleet. The transfer of aircraft is at centre of the leasing business model: aircraft leases typically have durations materially shorter than the useful life of the aircraft, with transfers following the end of many leases.

In common with ICAO's observations, the experience of aircraft leasing companies is that CoAs issued by a state of export are often not accepted without further action. It is common for different requirements to be imposed as conditions to import. Such requirements are not restricted to issues of certification of individual aircraft by the importing state, but also affect technical requirements, such as different *type* certification requirements and operational requirements. Collectively, these different and additional requirements are referred to in this study as "***dissimilar requirements***".

The consequences of these dissimilar requirements include: (a) delays in the transfer process, causing unnecessary grounding of the aircraft prior to re-entering revenue service ("***downtime***"); and (b) additional costs incurred in connection with compliance with such dissimilar requirements, which often include aircraft modifications, records inspections and the recertification of components.

The present study analyses and quantifies data collected on the effects of such dissimilar requirements for consideration by policy makers in the areas of aviation safety rule making, application and interpretation. It also makes select recommendations to address the issues identified.

2 ICAO, High-Level Safety Conference 2010, Working Paper on Recognition and validation of approvals and certifications issued by other states, HLSC 2010-WP/9.

Data and methodology

The collation of data was conducted in two phases:

The first phase consisted of a questionnaire completed by members of the Aviation Working Group[3] (***AWG***) designed to identify instances where dissimilar requirements apply. This generated a list of 29 categories of identified dissimilar requirements.

The objective of the second phase was to quantify the effects of these 29 categories. This was achieved in respect of 25 of them (see Table 7 of the main report), with 4 categories proving difficult to quantify. Data on typical direct costs and downtime, and importantly, the frequency of occurrence of such events, was collected from a representative group of AWG members.

This data was used to calculate the annual direct costs for all transfers by AWG members and losses attributable to downtime. Subsequently, the total figure was extended to non-AWG members and non-lessors to reflect the annual costs for all international transfers. This extrapolation was based on available data for international transfers and on the assumption that the transfer experience of AWG members is representative of all transfers. On this basis, the total annual cost attributable to dissimilar requirements was estimated to be US$ 369 million, while the average total cost per transfer was US$ 386,000. The direct costs element amounts to US$ 251 million in total, with a total downtime loss element of US$ 118 million.

Projecting the total figure for the next 20 years (making assumptions in respect of fleet growth, shift in ratio between leased and owned aircraft, the cost of capital and cost per transfer), brings the total figure for the next 20 years to the vast sum of ***US$ 7.286 billion.***

Not all dissimilar requirements cover similar safety obligations. The ICAO standards are minimum standards that must be observed. Individual states have added additional and more detailed standards to cater for certain safety deficiencies that they have experienced or foresee going forward. This study presents an analysis of the contribution to safety standards achieved by the 25 quantified categories of dissimilar requirements. It concludes that in respect of the direct costs figure:

- 58% of the costs are attributable to states' dissimilar requirements that aim to comply with the same safety objective, thus indicating a need for further harmonisation of standards;
- 20% of the costs are attributable to circumstances where neither the requirement nor the safety objective differs, but where work is repeated for administrative reasons only, which suggests that the principle of mutual recognition is not followed;
- 15% of the costs are attributable to circumstances where there is not so much a similar or dissimilar safety requirement, but rather, where a different regulatory mechanism for ensuring the safe and efficient operation of aircraft is in use between the states, thus necessitating modifications to the aircraft upon transfer; and
- 7% of the costs relate to differing safety objectives between the states of export and the states of import.

[3] AWG is a not-for-profit legal entity whose purpose is to 'contribute to the development and acceptance of policies, laws, regulations, and rules that (i) facilitate advanced international aviation financing and leasing or (ii) address inefficiencies in aviation financing or leasing or that constrain those transactions'; see www.awg.aero.

Recommendations

Recommendations are included to harmonise those dissimilar requirements that do not increase safety standards. They are summarised in the following table and further detailed in chapter 10. Of the 23 recommendations, 19 relate either to the harmonisation of standards or to the improvement of the process of mutual recognition. The remaining recommendations relate to improvements in technical record-keeping and the creation of a registry of import requirements.

A recommendation of particular interest is that importing states should use the USOAP reports on the states of export. The ICAO audit programme has identified that the system of multilateral recognition cannot be relied upon as not all states properly fulfil their obligations pursuant to the Chicago Convention. This finding did not come as a surprise, and actually explains the proliferation of bilateral aviation safety agreements. When the USOAP (and its follow-up, the Continuous Monitoring Approach, offered to poorly scoring states) starts to bear fruit, it would perhaps be an appropriate time for the global aviation community to return to a system of multilateral recognition of certificates.

Table 1 - Summary of findings and recommendations

Dissimilar requirement	Report finding, with finding number from main report		Recommendation	Policy maker
Individual certificates • Export/import process • Test flight requirements	No globally harmonised standards (3, 5, 8, 10)	1	Develop standard process for export and import of aircraft	ICAO
		2	Introduce standard for the Export CoA	ICAO
		3	Develop format for authorised release certificate (Form 1)	ICAO
		4	Introduce global concept of airworthiness reviews upon import	ICAO
		5	Eliminate test flight requirements	ICAO
Individual certificates: • Maintenance checks • Recertification of components • Inspection of aircraft and records	Lack of mutual recognition by states (2, 6, 7, 9)	6	States to make use of USOAP results when determining inspection efforts for imported aircraft	States
		7	Encourage states to publish USOAP reports	ICAO
		8	Study the feasibility of transition from a system of bilaterals to a multilateral recognition system	States
Individual certificates – records	• Inadequate means of record control (4) • Confusing requirements for retention of records regarding life-limited components (4)	9	Formalise interpretation of 'back-to-birth traceability' and harmonise minimum retention periods for detailed maintenance records	EASA, FAA
		10	Accept aircraft and component records in electronic format	States
		11	Develop standard format for electronic recordkeeping of components	ICAO
Operational equipment	No globally harmonised standards for: • Applicability date (12) • Applicability range (12) • Technical specification (13)	12	Harmonise applicability dates, ranges and technical standards	ICAO

Design approval – validations	• Validation of designs is tedious (16) • More validations expected with emerging manufacturing states (14) • Bilateral linkage is missing (18)	13 Extend EU/US bilateral to include automatic recognition of basic STCs	EU, US
		14 Link bilateral agreements such that design approvals can be recognised through agreements with third states without further action	States
Design approval – airworthiness codes	• Differences remain in airworthiness codes, particularly regarding acceptable means of compliance (14) • Emerging manufacturing states may not be engaged in global harmonisation (14)	15 Continue airworthiness code harmonisation and expand to emerging manufacturing states	EASA, FAA, other states
		16 Expand harmonisation of airworthiness codes to include acceptable means of compliance	EASA, FAA, other states
Different airspace concepts	Different technical standards (18)	17 Facilitate harmonisation of technical standards of airborne airspace compatibility requirements	ICAO
Local language exit signs	States require text exit signs in native language (19)	18 Allow symbolic exits signs as an alternative to text exit signs	ICAO, states
Age limits upon import	States impose age limits upon import without airworthiness justification (20)	19 Recognise ageing aircraft programme from type certificate holder and/or state of design	States
		20 Discourage age limits upon import	ICAO
Article 83bis	Few states enter into 83bis arrangements (21)	21 Encourage use of 83bis arrangements	ICAO
Access to state import requirements	Many states do not publish their import requirements (22)	22 Create a registry for all import requirements	ICAO
		23 File all import requirements	States

Contents

1. INTRODUCTION AND SCOPE

1.1 Call for study

The aircraft financing and leasing community, as represented by AWG, has observed that there are costs associated with international transfers of air transport aircraft and their operation due to dissimilar national aviation safety requirements. These dissimilar requirements increase the time and cost of such transfers without measurable safety benefits. In order to quantify such costs and delays, the AWG called for a study:

> *‘that sets forth, analyses and quantifies the economic impact of*
> *(i) the lack of harmonisation among national aviation authority requirements;*
> *(ii) restrictive national rules; and*
> *(iii) the lack of easily accessible information,*
> *in each case relating to the international transfer (including through successive leases) and operation, maintenance, and repair of aircraft.*
>
> *This would include, without limitation, the costs and other economic impacts of resulting inefficiencies relating to:*
> *a) importing and exporting aircraft from one jurisdiction to another;*
> *b) operating and regulating the operation of aircraft in an international context;*
> *c) aircraft age or other technical restrictions affecting such import, export, or operation; and*
> *d) documentary requirements relating to the foregoing and the maintenance/repair of aircraft.*
>
> *The foregoing assessment shall presuppose maintenance of the highest aviation safety standards.’*

This study seeks to address the request made by AWG. It explores the dissimilar technical requirements, both in a qualitative and quantitative manner, and provides recommendations to harmonise differing requirements without reducing the level of safety that the various rules and regulations intend to achieve.

1.2 Reader’s guide

The structure of this study, shown with corresponding chapter numbers, is as follows:

1 **Introduction and scope:** sets out the motivation for this report and its terms of reference;
2 **Aircraft leasing:** introduces aircraft leasing and international transfers;
3 **Method:** explains the model used in this study;
4 **International legal framework:** gives an overview of the legal framework, focusing on the various stages of certification;
5 **Listing the dissimilar requirements:** explains the dissimilar requirements;
6 **Input data:** presents data on frequency, costs and downtime due to the dissimilar requirements, much of which has been provided specifically for this study by AWG members;
7 **Output data:** sets out the results obtained upon processing the data;
8 **Assessment:** analyses the results obtained;

9 **Summary of findings:** distils the assessment into a series of short conclusions; and

10 **Recommendations:** makes suggestions to the appropriate international bodies for addressing the issues raised in this report.

1.3 Scope

In consultation with AWG, the scope of this study was restricted to:

- transfers of used passenger aircraft from one state[4] to another (therefore excluding transfers within states);
- Western built jet passenger aircraft with 50 seats and above; and
- source data from the years 2007, 2008 and 2009.

Although AWG's focus is particularly on leased and financed aircraft, this study extends to transfers of all aircraft falling within the above parameters, as the issue of dissimilar requirements affects not only lessors and financiers, but the entire aviation industry.

[4] The word 'state' is used in this report to identify both sovereign states and other bodies that have an aviation authority. Examples of the latter include Bermuda (United Kingdom), Hong Kong (China) and Aruba (The Netherlands).

2. AIRCRAFT LEASING

2.1 The growth in aircraft leasing

When the air transportation industry was in its infancy, airlines owned all aircraft they operated. In the late 1960s, airlines began to use the services of financiers and leasing companies to acquire aircraft. Aircraft are high value assets; their acquisition requires substantial capital outlay, which leasing avoids while also frequently bringing tax benefits. In addition, leasing provides greater fleet flexibility than outright ownership. Air operators may obtain or return aircraft at relatively short notice in response to market demands and macro-economic trends. Indeed, for start-up operators, leasing may be the only way to source the aircraft necessary to commence operations.

Financiers and leasing companies acquire aviation assets, either directly from the manufacturer or second hand, and lease them to air operators. The operating formula consists of ownership residing with a financier or a leasing company (the lessor), with the air operator having operational control and responsibility for maintenance.

2.1.1 Finance leases and operating leases

Leases written by financiers and lessors can broadly be divided into two basic types. Under a finance lease, the operator becomes the owner of the aircraft upon expiry of the term of the lease. In contrast, under an operating lease, ownership remains vested in the lessor upon expiry of the lease. The typical duration of leases of both types is several years and generally a financier will sub-contract lease management functions to a third party for the life of the lease, whereas a leasing company will not.

For the purposes of this study, the operating lease is particularly important, as an aircraft is transferred from one operator to another following expiry of the lease. Often, the process will also involve a transfer of the aircraft from one state's registry to another.

2.1.2 Inter-operator leases

A third form of lease exists, whereby an aircraft is let by one operator to another. Such leases are normally of a shorter duration than operating leases from dedicated lessors of aircraft, ranging from a few days to one year or more. There are two basic forms of an inter-operator lease: Under a wet lease, the aircraft remains under the operational control of the lessor. Conversely, a dry lease involves the transfer of the aircraft so as to be included under the Air Operator Certificate of the lessee. The dry lease may entail a change to the state of registry of the aircraft.

2.1.3 Trends

The use of operating leases has grown significantly over the past 20 years, increasing by a factor of almost 5, as illustrated by Table 2. Currently, approximately 32% of the air transport fleet is subject to such lease agreements, making leasing companies important stakeholders in commercial aviation. Inter-operator letting remained stable at about 2% of the market.

Table 2 – Jet transport aircraft - growth in leasing

	Fleet total	Operating leases	Inter-operator leases
1989	8,915	7%	2%
1998	11,953	25%	2%
2009	19,604	32%	< 1%[5]

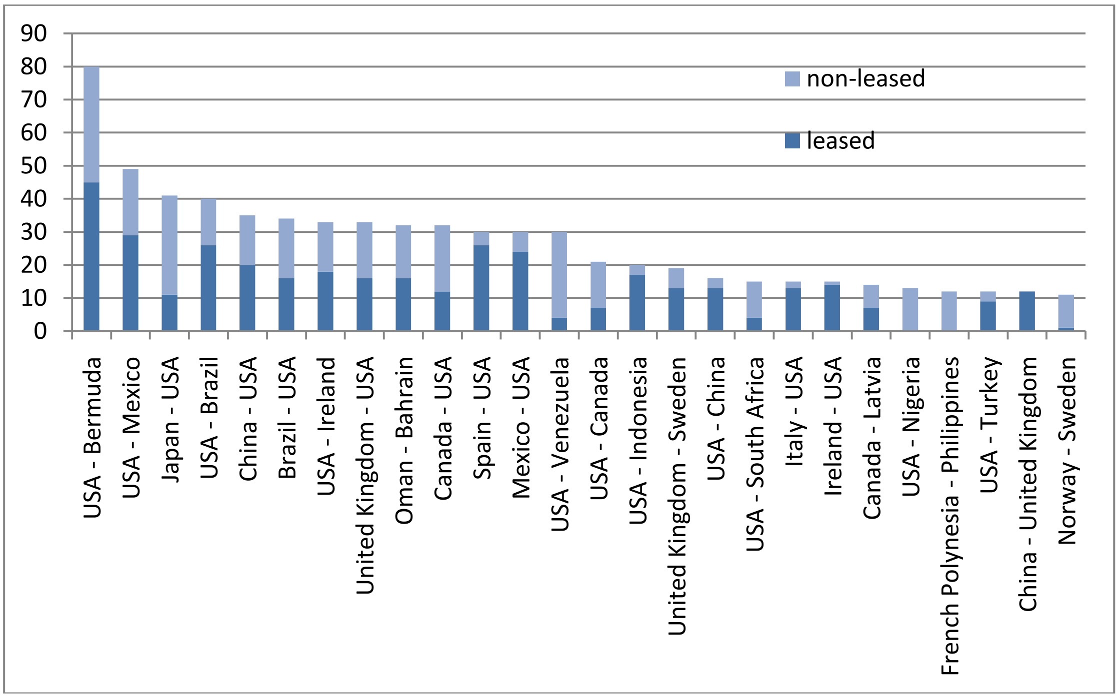
2.2 Transfers

2.2.1 Global distribution of transfers

Aircraft financing and leasing is by its very nature an international activity. When a lease terminates, the aircraft will be let to another air operator. Seldom will that operator be in the same state as the former operator. This means that between lettings, aircraft are typically transferred from one state into another. With almost 200 sovereign states in the world, plus a number of other bodies that have a separate civil aviation authority, the potential number of international transfer combinations is vast. Yet, with fleet sizes between states varying significantly (from approximately 7,300 aircraft in the USA to single digit figures in some very small states), some combinations are more common than others.

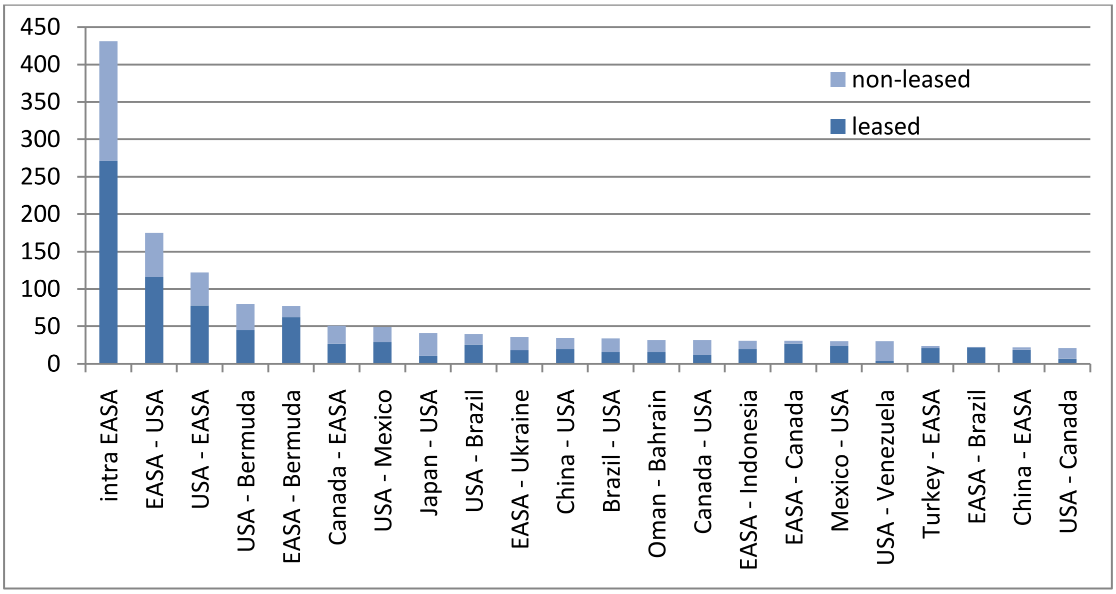
Figure 1[6] below shows the state combinations[7] between which a total of 11 transfers or more occurred during the years 2007, 2008 and 2009. Figure 2 shows state combinations where 21 transfers or more occurred in 2007, 2008 and 2009, treating the European Aviation Safety Agency (***EASA***) states as a single jurisdiction.

Figure 1 – Aircraft transfers - state combinations



[5] International transfers only.
[6] Source for figures 1 and 2: Ascend database. The Ascend database is maintained by Ascend Worldwide Ltd., a company formerly belonging to Airclaims.
[7] The transfer is from state first mentioned to state mentioned second.

Figure 2 – Aircraft transfers – state combinations (EASA as single jurisdiction)



Of the 26 combinations in Figure 1, only 6 do not involve the USA as either state of export or state of import. Although this suggests that the USA is the state with by far the highest number of transfers, not all of these are true transfers, that is, not all involve the transfer of an aircraft from an operator outside the USA to an operator inside the USA. This is because the USA serves as a 'transitioning register'. This provides a means for registering aircraft during a period when they are not being operated, and when they do not necessarily have an active Certificate of Airworthiness. The transitioning register may be used by lessors:

- when an aircraft is temporarily not subject to a lease;
- when additional work is required prior to delivery to a new lessee;
- when the importing state will not accept a direct import from the exporting state; or
- when the state of registration of the previous operator requires deregistration upon termination of the lease.

When the 31 EASA states are viewed as a single jurisdiction (as in figure 2), the EASA jurisdiction as a whole appears to be involved in a similar number of transfers as the USA, both being involved with 12 out of the 22 identified combinations.

The most common transfers are between the EASA jurisdiction and between the EU and USA. Bermuda as the second most popular destination for both US and EU originated aircraft is significant. Bermuda is an attractive state for some industry participants as its legal system is favourable to owners. Bermuda has also concluded many Article 83bis arrangements[8], which facilitate registration in Bermuda while operation of the aircraft occurs elsewhere.

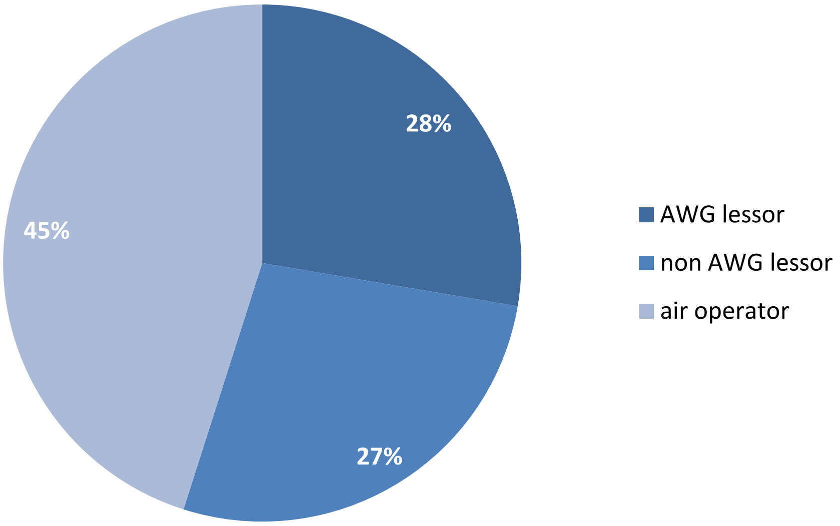
2.2.2 Number and distribution of transfers among lessors and operators

The number of international transfers of jet transport aircraft is approximately 950 per annum[9].

[8] See section 4.1.6 for an explanation of Article 83bis.

[9] Source: Ascend database, transfers in 2007, 2008, 2009.

Figure 3 – distribution of annual transfers among lessors and operators



Distribution by ownership is shown in Figure 3 above, which distinguishes between lessors and air operators. Financiers are included within the category of 'lessor' and the term 'AWG lessors' means lessors that are members of AWG.

As aircraft that are owned or managed by lessors stay with the same operator for a shorter period of time than those owned by operators, the lessors, collectively, are responsible for the majority of international transfers.

This has resulted in lessors becoming experts in the process of international transfers. During this process, lessors are confronted with inefficiencies due to differences between jurisdictions. The differences are both of a regulatory nature and an interpretational nature: some of the inefficiencies are caused by material differences in applicable safety and security regulations, whilst others result from different interpretations of identical rules and regulations.

3. METHOD

3.1 The transfer as the crystallisation point of inefficiencies

As will be seen later, the majority of regulatory-induced inefficiencies become apparent when an aircraft is transferred from one jurisdiction to another. The transfer can therefore be regarded as the crystallisation point of the underlying inefficiencies. While certain costs and losses arising from the transfer process are quite acceptable consequences of the administration involved in international trade, or adaptation to local or regional differences, others are not, going far beyond what is necessary for maintaining the highest aviation safety standards.

It is accepted that lessors incur certain costs associated with transfers, other than those driven by the dissimilar requirements. They have a commercial basis and range from costs incurred in verifying an aircraft's status upon its return after the expiry of a lease, to modifications requested by the next customer, such as interior changes. These costs are not included in this study.

3.2 The optimal transfer

From a regulatory perspective, each international transfer consists as a minimum of the four following elements:

1. **Deregistration:** the aircraft is taken off the registry of the state of export;
2. **Aircraft modifications associated with the registration change:** such as new registration marks, new crash plates, and code changes that are linked to the registration such as for identification codes of the Emergency Locator Transmitters (ELTs) and the selective calling system (SELCAL). Whilst these modifications should formally be applied between deregistration and registration, they are typically already applied before, and in anticipation of, deregistration;
3. **Registration:** the aircraft is entered in the register of state of import; and
4. **Certification:** the aircraft is issued a Certificate of Airworthiness by the state of import.

Under optimal conditions, and with advance planning, these actions can be accomplished in only a few hours and in case of unfavourable time zone differences, within not more than 24 hours.

3.3 Issues associated with transfers

Transfers that are not optimal from a regulatory perspective have issues that cause delays, and thus losses, or attract costs as a consequence of differences in aviation safety regulations or their interpretation. The views of AWG members were canvassed by means of a questionnaire to identify these issues. Virtually all members engaged in the international transfer of used aircraft responded. The issues indentified are listed in chapter 5.

3.4 Quantitative data on issues

For each of the identified issues, representative AWG members (a group referred to in this study as 'AWG R')[10], responsible for 87.5% of transfers by AWG members, provided data on costs for difficult or problematic transfers from their own experience over the past 3 to 5 years. These costs generally fall into two categories:

1. **Direct costs**, including costs relating to modifications, production of records and flight tests; and
2. **Indirect costs or losses**, resulting from additional downtime - each additional day that an aircraft is unavailable leads to loss of rentals on the part of the lessor or loss of revenue on the part of an operator.

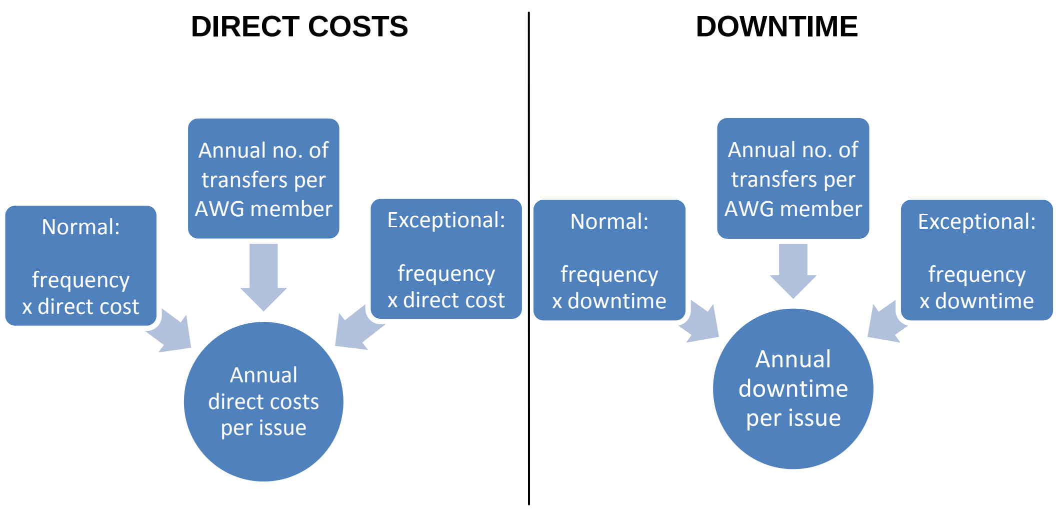
The AWG members were asked to provide data on costs and downtime in relation to the frequency that they occurred as a result of regulatory issues. For that purpose, three frequency ranges were suggested:

1. **Smooth transfer:** no extra costs or downtime incurred due to regulatory issues; the optimal transfer process;
2. **Normal transfer:** transfers where regulatory issues caused 'normal'[11] costs and downtime, in addition to those necessary for commercial reasons; and
3. **Exceptional transfer:** where regulatory issues caused excessive costs and downtime.

All transfers considered are included in one of the above three headings.

Data on costs and downtime was solicited in respect of normal and exceptional transfers. In combination with data for their annual number of transfers, as provided by the members themselves, this allows the calculation of transfer costs and downtime for each regulatory issue on an annual basis. Figure 4 below illustrates this process.

Figure 4 – Determining annual direct costs and downtime per regulatory issue



[10] By summing all direct costs for all issues, both for normal and exceptional cases, a total annual figure was determined for the AWG R members. This is further called the AWG R direct costs annual figure. It is expressed in US dollars.

[11] The word 'normal' was used in the questionnaire to refer to instances which occurred regularly. It should not be inferred to mean that the costs and downtimes are just.

3.5 Determining total of all direct costs

For the direct costs, the annual total is determined by summing all the direct costs for the individual issues. This process is illustrated in Figure 5 below.

Figure 5 – Determining total of all direct costs

3.6 Projecting direct cost data from AWG R to all transfers

The scope of this study entails all international transfers of jet transport aircraft. The direct cost data provided by the representative AWG members is therefore extrapolated to the entire industry. This is done in three steps:

Step 1: From AWG R to all AWG members.
Based on data obtained from AWG members, verified with the Ascend database[12], the members that supplied data on frequency and direct costs account for 87.5% of all transfers by AWG members. The remaining 12.5% is shared by other members, who have portfolios, and thus transfers, that are similar to those of the members of AWG R.

Step 2: From AWG members to all lessors.
According to the Ascend data, the number of transfers by AWG members represents 50.5% of the total number of transfers by leasing companies. As for step 1, it is reasonable to assume that non-AWG member transfers are similar to those for AWG members, as the fleet portfolio and customers are similar.

Step 3: From all lessors to all transfers
Transfers by non-lessors may be different from those by lessors. They typically involve transfers of ownership, as aircraft are sold by one operator to another. However, as the regulatory environment remains the same, it is considered reasonable to extrapolate the economic impact data to the entire industry.

The following table summarises the multiplicative factors used for the extrapolation:

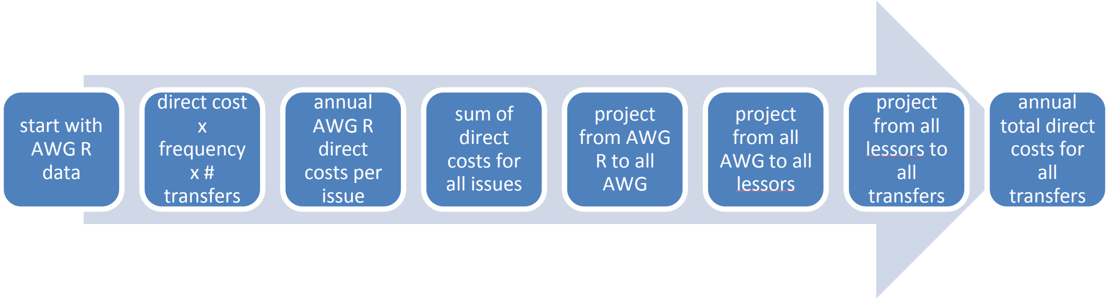
Table 3 – Ratios for extrapolating from AWG R data to all transfers

	Increase (annual number of transfers)	Ratio of increase	Cumulative ratio
AWG R to all AWG	**231 to 264**	**1.14**	**1.14**
AWG to all lessors	**264 to 524**	**1.98**	**2.27**
All lessors to all transfers	**524 to 954**	**1.82**	**4.13**

[12] The Ascend aircraft and airline database is a product of Ascend Worldwide Limited that until 2006 was part of Airclaims. It lists comprehensive data for all transport aircraft

The following figure summarises the entire process described in this sub-chapter for determining the annual economic impact of the direct costs (Figure 7).

Figure 6 – Projecting direct costs to all transfers



3.7 Determining average direct cost per transfer

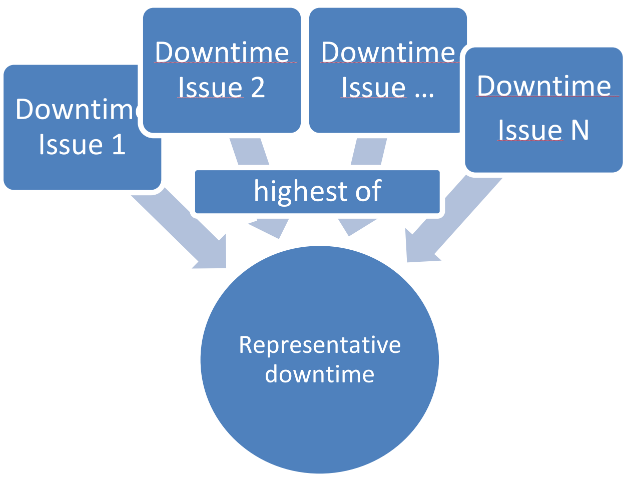
The average direct cost per transfer is determined by dividing the total for all transfers by the average number of transfers per year over the period 2007 - 2009.

3.8 Converting downtime into cost

When considering the cost impact of the dissimilar requirements in terms of additional downtime, it would not be correct to sum the additional downtime impact of each individual issue arithmetically, as is done for the direct costs. This is because more than one issue can be addressed simultaneously, or overlap, with the downtime of another issue. Some issues are, however, cumulative as they manifest themselves in different stages of the aircraft downtime. For instance, modifications to meet equipment requirements can usually be accurately predicted and such modifications scheduled well ahead of the planned downtime. However, when an authority (in the course of the transition process) applies a novel interpretation to a requirement resulting, for instance, in the need to replace a component, this will increase the downtime. The additional downtime is attributable not only to the time spent actually replacing the component, but also to time spent sourcing the replacement component.

The highest downtime for any of the 25 differing requirements that were quantified was taken for the purposes of this study to represent a reasonable estimate of the economic impact caused by the additional delay. Figure 7 below illustrates this process.

Figure 7 – Determining total of downtime



Downtime is expressed in days and, therefore, needs to be converted in order to arrive at a total figure expressed in US dollars. To do this, average daily lease rates were used. As these rates vary widely according to aircraft size, three classes of aircraft types were discerned:

1. Regional Jets (***RJ***);
2. Narrow Bodies (***NB***); and
3. Wide Bodies (***WB***).

The representative downtime, in days, was multiplied by these average daily lease rates to provide the downtime loss expressed in US dollars. The daily lease rates were weighted using the actual fleet distribution over the three classes, which is:

- Regional Jets: 17%;
- Narrow bodies: 59%; and
- Wide bodies: 24%.

These percentages apply to the entire active fleet. It is assumed that the distribution of transfers corresponds to this distribution.

The resulting figure is the average downtime loss in US dollars for a single transfer.

The process described above is illustrated in Figure 8 below.

Figure 8 – Projecting downtime losses to all transfers

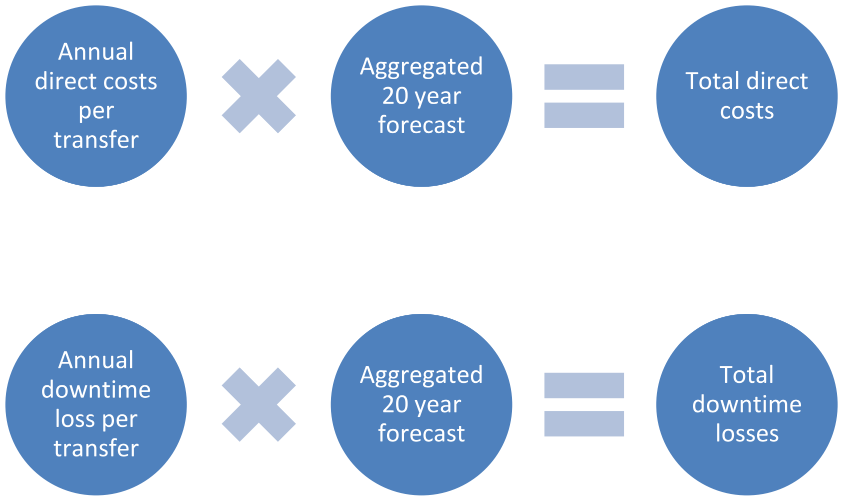
3.9 Projecting for the next 20 years

In order to truly appreciate the financial effect of these inefficiencies, estimates are included for both the direct costs for the next 20 years and the losses due to downtime. They are based on an economic projection model that assumes that no changes to the regulations or their interpretation take place. In reality, any changes that do in fact occur could be either positive or negative; improvements in harmonisation between states will lead to a reduction of costs, but, conversely, further diversification will lead to even greater costs.

The economic projection model is based on an aggregation of different factors, such as fleet forecast by type, ratio of leased aircraft versus owned, average period of lease, inflation, cost of capital and cost per transfer. The estimated fleet for the next 20 years is an essential element of the model; public data provided by Airbus, Boeing, Bombardier and Embraer was used to achieve an average view for the next 20 years according to aircraft group. The mathematics of the model are presented in Appendix 2. The direct cost forecast is achieved with an aggregated forecast fleet, while the downtime losses are projected by fleet (RJ, NB, WB) and then aggregated.

Figure 9 illustrates the process for calculating the total direct costs and downtime losses respectively.

Figure 9 – 20 year projection



4. INTERNATIONAL LEGAL FRAMEWORK

4.1 Competencies in rulemaking

4.1.1 The Chicago Convention

The Chicago Convention[13], signed by virtually all of the world's sovereign states[14], forms the legal basis for international civil aviation.

Since each state is sovereign in its territory, including the airspace above it, the state's laws and regulations apply to all aircraft operating in this territory, regardless of their nationality. This is a fundamental concept in the Chicago Convention. Yet one of the very purposes of an aircraft is to cross borders with ease, so the necessity of complying with different laws and regulations each time that the aircraft flies into a different state's airspace would be detrimental to a safe and efficient international civil aviation system. It is therefore essential that these laws and regulations are harmonised as much as possible.

The Chicago Convention aims to achieve harmonisation by setting universal standards for safety and security, as laid down in Article 37 and the Annexes to it. Of particular relevance to the subject of this study are the technical requirements of international transfers of air transport aircraft, detailed in Annex 6, Part 1[15] and Annex 8[16].

These Annexes set standards and recommended practices (***SARPs***) for the respective areas. The standards are minimum standards, from which states may deviate. In the majority of cases, these deviations are such that stricter or more detailed regulations apply. If deviations are such that they reduce the national standard to below that set by an Annex, states are obliged[17] to file a 'difference'. This practice of allowing deviations leads to a divergence of rules that apply from state to state.

4.1.2 Multilateral recognition of certificates of airworthiness

In order to enable aircraft and crew to move between multiple states on a day-to-day basis without needing to comply with national laws and regulations, the Convention provides in Article 33 for the international recognition, without further action, of certificates and licences in international civil aviation, provided that the requirements under which they were issued are equal to or above the minimum standards of the Annexes.[18]

Whilst Article 33 is primarily directed at day-to-day operations, the same principle of mutual recognition of certificates is employed in the Convention for when an aircraft transfers from one state's register to that of another:

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[13] ICAO, Convention on International Civil Aviation (1944).

[14] There are only four non-contracting sovereign states in the world (Dominica, Liechtenstein, Tuvalu, Vatican City), in addition to states the sovereignty of which is not universally accepted such as Kosovo and Taiwan.

[15] Operation of Aircraft/Part I - International Commercial Air Transport – Aeroplanes.

[16] Airworthiness of Aircraft.

[17] under Article 38 of the Convention.

[18] In this respect, the word 'certificate' refers to the Certificate of Airworthiness; 'licence' is the flight crew licence. Although not originally intended by Article 33, Air Operator Certificates as later introduced in Annex 6 now also follow this concept.

> '*When an aircraft possessing a valid Certificate of Airworthiness issued by a Contracting State is entered on the register of another Contracting State, the new State of Registry, when issuing its Certificate of Airworthiness may consider the previous Certificate of Airworthiness as satisfactory evidence, in whole or in part, that the aircraft complies with the applicable Standards of this Annex through compliance with the appropriate airworthiness requirements*.'[19]

This paragraph promotes state acceptance of the previous CoA as satisfactory evidence that the aircraft complies with the applicable ICAO standards. The ICAO notes that some states facilitate such transfers by the issue of an 'Export Certificate of Airworthiness'. Such certificates are not regulated by the ICAO and in practice are used in different ways, as further explained in Appendix 3.

The ICAO considers the multilateral recognition of certificates and licences to be a basic foundation of international civil aviation. In the ICAO's view, multilateral recognition facilitates the free flow of states' aircraft and pilots throughout the world. The organization observes, however, that many states require certificate holders to comply with additional, similar obligations through sets of dissimilar requirements that increase the administrative and financial burden for certificate holders, without any significant added safety value[20]. It is precisely this observation that echoes the concerns of the AWG.

4.1.3 Expansion in national laws and regulations

A key principle of the Chicago Convention is that of nationality of aircraft[21]. Each aircraft receives its nationality by registering with a state. A single aircraft can only be registered in one state at any point in time[22]. The state of registry is responsible for overseeing the airworthiness of an aircraft, for which the CoA, issued by that state, is an important instrument.

As discussed above, each state is competent to make its own national rules that are more specific or detailed than those of the Annexes. This means that the conditions to be met before a CoA will be granted vary between states.

In the area of initial airworthiness, that is, a *first* issue of a CoA, and also the issue of type certificates (see section 5.2 and Appendix 3), the practice of expanding on ICAO standards, resulting in more strict and detailed regulations, is particularly prevalent in the world's major aviation states. Such states may be characterised by:

- high volumes of air traffic, with correspondingly higher exposure to accidents, thus having more opportunity to learn from any such accident and reflect their experience by way of more detailed regulations; and
- having an aircraft manufacturing industry, providing detailed insight into aircraft design. Such states include the USA, Canada, selected states of the European Union, Russia, Brazil, Japan and China.

Similarly, for continuing airworthiness and flight operations, the major aviation states have developed their own sets of standards which are well in excess of those

[19] ICAO Annex 8 at paragraph 3.2.4.
[20] ICAO, High-Level Safety Conference 2010, Working Paper on Recognition and validation of approvals and certifications issued by other states, HLSC 2010-WP/9.
[21] Chicago Convention, Article 17 *Nationality of aircraft:* Aircraft have the nationality of the State in which they are registered.
[22] Chicago Convention, Article 18 *Dual registration:* An aircraft cannot be validly registered in more than one State, but its registration may be changed from one State to another.

contained in Annex 6. Other states adhere to the standards contained in Annex 6, specifying additional standards only to cater for the local environment or stemming from specific experience, such as the causes of local accidents.

4.1.4 Bilateral agreements

Even though the Chicago Convention and its Annexes constitute a multilateral agreement between states, and therefore, should lead to mutual recognition of certificates, day-to-day practice differs. A number of leading aviation states have decided to rely on bilateral agreements only, when accepting aeronautical designs and products from other states. These agreements are known as Bilateral Airworthiness Agreements (***BAAs***) and Bilateral Aviation Safety Agreements (***BASAs***). The former is limited to airworthiness only; the latter also apply to other aviation safety elements, such as flight operations and flight crew licensing.

BAAs and BASAs may be concluded because ICAO standards may not cover the level of detail as laid down in the applicable national regulations, and because not all states demonstrably meet ICAO standards.

The current trend is that of a proliferation of bilateral agreements.

4.1.5 The Universal Safety Oversight Audit Programme

During the 1990s the ICAO decided to gauge the level of compliance by states with the Annexes of the Chicago Convention, having received indications that not all states complied with its standards. In addition, investigations determined that inadequate supervision by states had been a contributory factor in some accidents. The ICAO embarked on a worldwide audit programme, whereby each state's compliance was assessed, initially with 3 of the 18 Annexes.

In a second round of audits that ran from 2005 until late 2010, all other Annexes (with the exception of two[23]) were included in the audit. The results confirmed the ICAO's initial belief that states were often non-compliant.

The ICAO published quick reference status charts, and in some cases, full reports of its findings[24]. The status charts rate the level of compliance in 8 key areas.

A breakdown of ratings for 6 key areas for the 50 major aviation states is presented in Appendix 4. These key areas are:

1) State Civil Aviation System and Safety Oversight Function;
2) Technical Personnel Qualification and Training;
3) Technical Guidance, Tools and the Provision of Safety Critical Information;
4) Licensing, Certification, Authorisation and Approval Obligations;
5) Surveillance Obligations; and
6) Resolution of Safety Concerns.

The first row of Part B of Appendix 4 presents the worldwide averages for all states audited so far. Some of the averages are surprisingly low. This particularly applies to the second element (the qualification and training levels of the state's technical personnel) where the worldwide average is only 4 (on a scale of 1 to 10) and the 8th element (resolution of safety concerns) with an average of 5. The highest average is

[23] One of which, Security, was the subject of a separate audit program and so not further discussed here.
[24] http://www.icao.int/FSIX/auditRep1_icvm.cfm.

a 7, for the element of Licensing, Certification, Authorisation and Approval Obligations.

In general, the 50 major aviation states score ratings of above the worldwide average, but there are some exceptions. It is striking that so far only one state was found in compliance with all aspects[25].

Programmes similar to the ICAO USOAP are run by:

- **The United States.** This is the International Aviation Safety Assessments Program (***IASA***). The programme started in 1992, is continuous in nature and focuses on determining whether states meet their Chicago Convention obligations; and
- **The European Union.** This is the Community list of air carriers which are subject to an operating ban within the Community[26], also known as the 'blacklist'. This programme is based on findings of the European Safety Assessment of Foreign Aircraft programme (***SAFA***) and addresses both individual air operators and states.

4.1.6 Article 83bis

The concept of nationality of aircraft, as expressed in Article 17 of the Convention, implies responsibility by the state of registry for overseeing the ability of aircraft to operate safely. This includes the airworthiness of the aircraft, the licensing of its crew and its operation.

Typically, these three aspects are overseen by the national aviation authority of the same state as the state of registry. However, with the advent of leasing, situations emerge in which the state of registry is different to the state of the operator. In order to ensure oversight of continuing airworthiness, the Convention was amended by inserting Article 83bis, which provides for transfer of certain oversight responsibilities from the state of registry to the state of operator. This amendment came into force on 20 June 1997, when the required minimum number of states had ratified it. Currently, 157 states have ratified Article 83bis[27].

States that enter into an Article 83bis agreement report this to the ICAO, which thereupon makes the agreement public pursuant to Article 83. The ICAO website currently lists about 45 such agreements, although not all are still valid. Some 40 states are party to the listed agreements, which shows that many states that ratified Article 83bis do not actually apply it. The four jurisdictions with the greatest number of agreements in place are Ireland, the Russian Federation, Austria and Bermuda.

4.1.7 Multinational bodies and cooperation

Globalisation has resulted in states in the same region cooperating on a supranational basis. The European Union is the most advanced example of this. In Europe, 27 states have voluntarily agreed to set up common institutions to which they delegate some of their sovereignty, so that decisions on specific matters of joint interest can be made on a Europe-wide level. A leading principle in this context is that of subsidiarity, which means that only those tasks that warrant execution at the highest level for reasons of harmonisation, efficiency or otherwise, should be acted upon at that level. Other tasks then remain to be conducted at lower levels.

[25] That state is Korea.
[26] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:237:0010:0027:EN:PDF.
[27] http://www.icao.int/icao/en/leb/83bis.pdf, accessed on 20 August 2010.

For aviation safety, this has taken the form of centralisation of rulemaking activities, whilst certification and oversight tasks have been split between central and non-central bodies.

Rulemaking is within the competency of the European political institutions, such as the European Commission, European Parliament and Council, who have delegated more detailed tasks of rulemaking to the European Commission and the EASA. In addition, Eurocontrol, which is the central European Air Traffic Management organisation, drafts rules relevant to its own area.

Certification of designs and design organisations has been centralised with EASA, whereas the certification of individual aircraft and other organisations, such as maintenance organisations and air operators, remain with the national aviation authorities of the EU states. The latter also applies to the licensing of individuals, such as pilots and maintenance staff. The regulatory framework for all these activities, though, is that of the European political institutions EASA and Eurocontrol. The extent to which individual member states can deviate from that framework is very limited, which effectively makes the entire European Union into a single jurisdiction for the purposes of operating and transferring aircraft. This is the *de jure* situation. As EASA is still growing in authority and areas of competence, and EU member states are finding it difficult to relinquish their own authorities, the *de facto* situation differs. This is further described in Appendix 7.

On either side of the Atlantic Ocean, the EU, the USA and Canada have a long history of cooperation on regulatory and oversight activities, with the EU-US aviation safety conference holding its 27th annual meeting in June 2010. As discussed elsewhere in this report, airworthiness codes have been harmonised to a great extent, and so have certification procedures for: (i) aircraft and components; and (ii) design, production and maintenance organisations.

In other parts of the world, regional cooperation forums are developing. Eleven Central and South American states form the Latin American Civil Aviation Commission (***LACAC***), which engages in many regional aviation activities. One of these is the compiling of uniform regional aviation safety standards. The process started in 2002 and resulted in sets of standards modelled on the US regulatory system, called the Latin American Aeronautical Regulations (***LARs***). The LARs are now slowly being implemented, starting with Approved Maintenance Organisations, as explained at the ICAO 2010 High Level Safety Conference[28]. Eventually, this will lead to the unrestricted mutual recognition of certificates amongst participating states and possibly make the LACAC region into a single jurisdiction as the EU model has done.

Other regions are also cooperating in the area of aviation safety regulations, notably in South Asia, Southeast Asia and Africa, but are at a less advanced stage than the EU, the US, Canada and Latin America.

[28] LACAC. (2010). *HLSC 2010-WP/65.*

4.2 Stages of certification

Before a transport aircraft can be put into operation, it must undergo four distinct stages of certification. These are summarised in Figure 10 below. These stages are further elaborated upon in Appendix 3.

Figure 10 – Stages of certification

Table 4 below repeats Figure 10, but adds typical frequencies and the stages for aircraft components and design changes.

Table 4 – Stages of certification

	Subject	Certificate	Frequency
Design approvals	**Aircraft type; engine type**	Type certificate	Once per aircraft or engine variant.
	Other design approval: Designs other than complete aircraft or engine; repairs	e.g. STC, TSO, PMA, repair approval	Once per design or repair.
Individual product certification	**Individual aircraft**	Certificate of Airworthiness	Once each on: • manufacture; • airworthiness review; and • international transfer.
	Individual component	Certificate of Conformity; Authorised Release Certificate	Once each on: • manufacture; and • completion of off-aircraft maintenance.
Instruments and equipment required for operation	**Circumstances of operation**	Air Operator Certificate	Once each on: • introduction of aircraft type; and • change in regulations.
	Area of operation (airspace compatibility)	Special Approvals (OpSpec)	Once each on: • introduction into specific area of operation; and change in regulations.

5. LISTING THE DISSIMILAR REQUIREMENTS

5.1 Introduction

The AWG identified 29 dissimilar requirements. They are listed in this chapter. As they are quite diverse, some ordering was necessary. This was achieved by ranking each of them against two scales:

- The certification scale (as introduced in the previous chapter); and
- The safety objective scale (this scale is explained in the next section).

5.2 Safety objective scale

When analysing the dissimilar requirements associated with international aircraft transfers, it appears that there is a variation in their aims with regards to safety.

Four different aims were identified, as follows:

1. **Duplications**.
These are situations in which the national requirements imposed by states of export and import are identical, or at least similar, yet a re-check is required by the state of import. The reasoning is that states are individually responsible for determining airworthiness and will not rely on findings by other states. In practice, this means repeating work that has already been done by the previous state of registry. An example of this is where an extra maintenance check is conducted purely to facilitate the transfer process.

Differences: These are situations where states have different requirements to ensure safety. Such differences fall into three categories:

2. **Differences arising from varying safety objectives**.
Some states have safety objectives that are unique to that state, such as the US retroactive requirement for Class D cargo compartments, explained in detail in Appendix 7.

3. **Differences arising from the same objective but differing means of implementation**.
Some differences result from the dissimilar implementation of identical safety objectives. Such differences in application may either be formal and laid down in a state's set of regulations, or informal, consisting of interpretations laid down in informal communication or simply enforced in practice by inspectors on an individual and case by case basis. An example is the interpretation by states of the high level ICAO requirement for means to monitor the cockpit entrance area[29]. Some states have transferred this into their national set of regulations as a hard, and formal, requirement for video cameras. Other states apply it as an uncodified requirement for cameras and still others leave it to the individual operator or inspector to decide whether the requirement can be met in ways other than by the use of a video camera.

4. **Non-safety instigated regulatory differences**.
Here, the differences are not so much resulting from a different philosophy towards safety per se, but rather from a conceptually different approach to

[29] 'means shall be provided for monitoring from either pilot's station the entire door area outside the flight crew compartment to identify persons requesting entry to the flight crew compartment and to detect suspicious behaviour or potential threat' (ICAO Annex 6, Part I, paragraph 13.2.3 b).

meeting aviation safety and efficiency requirements. Examples include different concepts of airspace use in Europe and the USA, the use of local language for exit signs, but also different policies for such subjects as Export Certificates and 83bis arrangements.

5.3 List of the dissimilar requirements

Each of the 29 dissimilar requirements was ranked according to the two scales, certification stages and safety objectives. The result is presented in Table 5 below. Some of the dissimilar requirements fit more than one point on the certification scale, but none fits more than one point on the safety objective scale. The essence of each of the dissimilar requirements is described in Appendix 7.

In two cases, the divergence in requirement is so extensive that it effectively prohibits the transfer of an aircraft and therefore data could be collected neither on frequencies nor on costs. These are:

- major type certification differences; and
- age limit upon import.

There are two more items which are included in this overview that have some economic impact, but the effects of which could not be quantified. These two items are:

- absence of Article 83bis arrangements; and
- export design approvals.

Table 5 – Overview of dissimilar requirements

Stage of certification		Safety objective: Duplication	Safety objective: Different safety objective	Safety objective: Different means	Safety objective: Non-safety instigated
	Design approvals	• Validation of modifications	• Major type certification differences • Ozone converter • Ice detection system	• Type III exits • 60 min battery power • Different cabin safety requirements	• Metric altimeters • Local language exit signs
	Individual product	• Maintenance check for export • Maintenance check for import • Recertification of components • Recertification of off-wing engines		• Maintenance programme diverting requirements • Different interpretations • Delays by authorities • Test flights by authorities • Age limit upon import	• Export approval • Article 83bis • Local language exit signs
	Operational certification		• Ozone converter • Cargo fire suppression	• Different cabin safety requirements • DFDR • CVR • Fixed ELT • Video camera	
	Airspace compatibility				• Metric altimeters • FM immunity • ELS/EHS • VHF 8.33 spacing • Datalink

6. INPUT DATA

6.1 Data collection

The source data used in this study consists of generic data and study-specific data.

Generic data is data of a general nature that is typically, albeit not in all cases, publicly available. For this study it includes the following:

- numbers of international transfers of aircraft;
- lease rates and air operator costs;
- fleet growth projections; and
- aviation safety regulations.

Specific data for this study was obtained from AWG members in a two phase process. In the first phase, members were canvassed to provide information on dissimilar requirements that affect transfers. In the second phase, they were requested to quantify each of those in terms of costs, aircraft downtime and frequency of occurrence.

In both cases, 3 methods to obtain such specific data were used:

- questionnaires: two questionnaires were used, one for each phase. Sample questionnaires are reproduced in Appendices 5 and 6;
- interviews with seven AWG organisations, collectively representing 98% of AWG transfers; and
- a consultation meeting with the AWG – following the two phases of data collection.

6.2 Generic data

6.2.1 Number of international transfers of aircraft

Of the AWG members, 6 provided data on the number of international transfers for their own portfolios. Over the years 2007, 2008 and 2009, that figure was 710. The remaining AWG members made 81 transfers, according to the Ascend database. The representative AWG members that completed the second questionnaire collectively made 629 transfers, or 210 on average per year.

To obtain data on transfers for non-AWG lessors and for non-lessors, the Ascend database was consulted, as follows:

For three successive years (2007, 2008, 2009), the database was searched for changes in state of registry by comparing the nationality of each aircraft in the database on the 1st of January in successive years. Using this search criterion has some drawbacks: on one hand, it will not spot multiple changes in the same year, thereby potentially underestimating the actual number of transfers; conversely it will include transfers of registration that do not represent complete transfers, but merely reflect where an aircraft has been placed on a transitioning register. Also, it may include cases where an aircraft that is already operated in a certain state, but registered in another state is subsequently reregistered in the state of operation. Such transfers are less demanding as some, if not all, of the state of registry's requirements will have already been met when the aircraft was imported into the state of the operator.

In order to verify whether the results from this search method are nevertheless representative, data provided by the AWG members was compared to that obtained by the method described above. The comparisons are reproduced in Table 6 below.

Table 6 - Comparison of transfer data

	Transfer numbers provided by representative group of AWG members	Ascend data for those members
2007	187	154
2008	203	198
2009	239	244
Average	210	198

The differences appear to be minor, and as such the method used is considered to produce (within a reasonable margin) a good estimate of the actual number of international transfers.

6.2.2 Lease rates and air operator costs

In this study, lease rates are used to convert aircraft downtime into the cost of loss of rentals. These are revenue losses incurred by lessors when aircraft are unable to be delivered to the next operator. Typical lease rates have been obtained from within industry sources and from those, three averages have been established, as follows:

Table 7 – Typical lease rates

	Share in transfer numbers	Per month (US$) (average)[30]	Per day (US$) (average)
Regional Jet	17%	164,000	4,867
Narrow Body	59%	242,000	8,066
Wide Body	24%	649,000	21,633

[30] Source: Ascend database.

6.2.3 Fleet growth projections

In order to predict the financial effect of the inefficiencies over the next 20 years, fleet growth data has been collected from the major airframe manufacturers:

- Boeing (Current Market Outlook 2010);
- Airbus (Flying Smart, Thinking Big, Global Market Forecast 2009-2028);
- Bombardier (Moving Forward: Market Forecast 2010-2029); and
- Embraer (Market Outlook 2009-2028).

Table 8 – 20 year projection of fleet growth

Aircraft group	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Regional Jet	2,702	2,799	2,895	2,992	3,089	3,186	3,282	3,379	3,476	3,573
Narrow Body	12,227	12,879	13,531	14,173	14,790	15,362	15,884	16,406	17,003	17,615
Wide Body	3,612	3,859	4,106	4,333	4,560	4,767	4,973	5,185	5,387	5,619
Total	18,541	19,536	20,532	21,498	22,438	23,314	24,139	24,970	25,866	26,807

Aircraft group	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Regional Jet	3,669	3,766	3,863	3,960	4,056	4,153	4,250	4,347	4,443	4,540
Narrow Body	18,253	18,891	19,477	19,965	20,402	20,860	21,298	21,811	22,349	22,739
Wide Body	5,855	6,092	6,301	6,493	6,684	6,911	7,128	7,354	7,591	7,692
Total	27,778	28,749	29,641	30,417	31,143	31,924	32,676	33,512	34,383	34,971

The number of transfers is expected to increase in the future, for the following reasons:

- expansion of global fleet linked to global GDP;
- increasing trend to lessor-owned aircraft versus long term ownership by operator; and
- overall decreasing leasing periods.

6.2.4 Aviation safety regulations

The SARPs relevant to airworthiness, as contained in Annex 6, Part 1 and Annex 8, and the ICAO Airworthiness Manual, formed the primary regulatory source for this study.

In addition, the aviation safety regulations of major states were consulted, in particular for items addressing or affecting international transfers. There is a large variety of regulatory systems, making it quite difficult, if not impossible, to sort and present that data in summary form in this study. Specific examples, however, are referred to in the descriptions of the dissimilar requirements at Appendix 7 and the assessment at chapter 8.

6.3 Specific data

6.3.1 List of dissimilar requirements

The data provided by the AWG members in the first questionnaire, the interviews and the two consultation meetings generated a list of dissimilar requirements. That list is presented in chapter 5.

6.3.2 Costs, downtime and frequency

The dissimilar requirements formed the input for the second questionnaire, which requested for each such requirement:

- the frequency with which the dissimilar requirement normally appears in a transfer and the resulting average cost and downtime; and
- for cases where a requirement causes exceptionally high costs and delays, the frequency with which this occurs and the associated costs and downtime.

The second questionnaire was completed by members representing 87.5% of all transfers of AWG members in the three year review period. Other members indicated that they were unable to complete the questionnaire as their volume of transfers was too small.

7. OUTPUT DATA

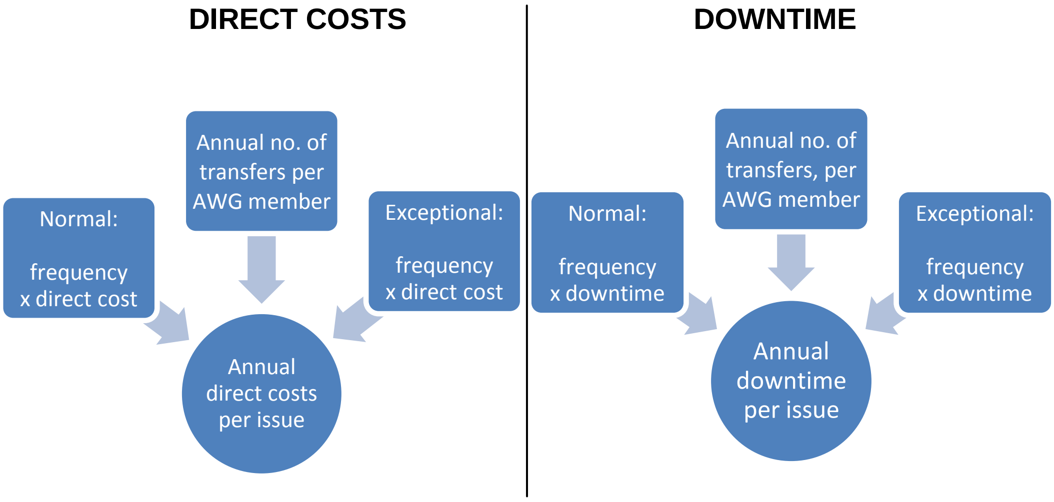
7.1 Introduction

This chapter presents data outputted by the model.

For ease of reference, the model steps are repeated here using the graphics presented in chapter 3. For each step, the output data is presented either directly or by reference to the tables starting on page 41.

7.2 Steps 1 and 2: determining annual direct costs and downtime per issue

Model



Step 1

For each of the dissimilar requirements, the annual costs in units of US$ 1000, excluding those caused by downtime, were calculated by multiplying the following figures:

- average cost per transfer;
- average frequency of occurrence; and
- annual number of transfers for the AWG R members.

This was completed for both the 'normal' and the 'exceptional' data.

In the process of averaging, a weighting factor was applied that reflects the contribution of the individual AWG member in the number of total transfers.

Thus, as an example, if four respondents provided information on costs and frequency and the number of transfers of one particular member accounted for 35% of the total for the four, then his contribution would be weighted by a factor of 0.35.

Step 2

The step 1 process was repeated for downtimes.

Output:

The data obtained from the AWG R members and processed as per steps 1 and 2 is presented in Tables 14 and 15, starting at page 41.

7.3 Step 3: determining total of all direct costs of AWG R

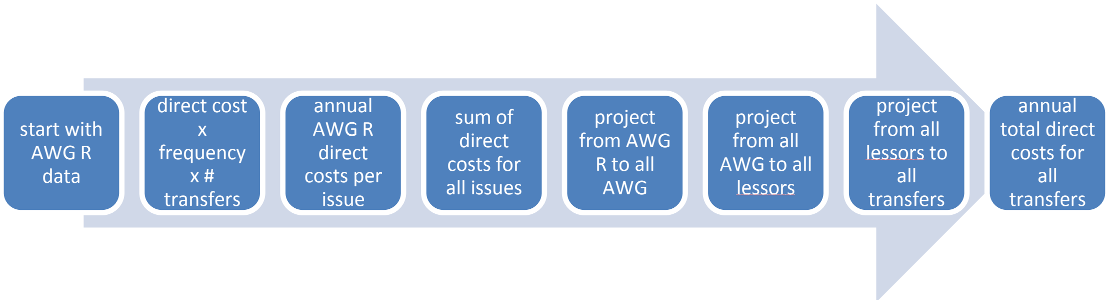
Model:

In this step, the normal and exceptional direct costs for each issue are added.

Output:
Table 14 (page 41) gives the total direct costs per dissimilar requirement. In addition, they are grouped according to the scale of safety objectives with totals added.

7.4 Step 4: projecting AWG R direct costs to all transfers

Model:



In this step, the AWG R direct costs are extrapolated in three steps to all international transfers.

Output:

Table 9 - total direct costs (annual, all transfers)

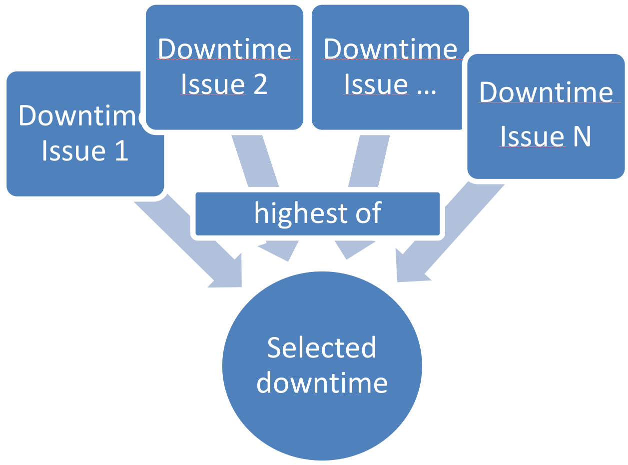
Total direct costs (US$ 1000)	AWG R	All AWG	All lessors	All transfers
Multiplicative factor	1	1.14	2.27	4.13
Factor base: annual number of transfers (see Table 3)	231	264	524	954
Duplications	12,489	14,238	28,350	51,580
Different safety objective	4,147	4,728	9,414	17,127
Different means	35,194	40,121	79,889	145,349
Non-safety instigated	8,952	10,205	20,321	36,971
Total				251,027

7.5 Step 5: determining average direct cost per transfer

With 954 transfers a year on average and total direct costs being US$ 251 million the direct costs per transfer amount to US$ 263,000.

7.6 Step 6: determining representative downtime

Model:



In this step, the total downtime (in days) is determined by taking the highest number of days as determined in accordance with step 2.

Output:

The dissimilar requirement of 'recertification of components' causes the highest delay, being 11.47 days (see Table 15 on page 42). That figure is taken as the basis for further downtime-related calculations.

7.7 Step 7: determining annual downtime loss per transfer

Model:

Output:

In Table 10 below, the downtime days are converted into weighted average losses per class of aircraft, using the lease rates as provided in Table 7 above.

Table 10 – Determining weighted average downtime loss per transfer

	RJ	NB	WB	Total
Lease rate per day (US$)	4,853	8,066	21,642	
Number of days per transfer	11.47	11.47	11.47	
Average loss per transfer (US$)	55,669	92,520	248,231	
Fleet percentage (%)	17	59	24	
Average loss per transfer per aircraft group	9,464	54,587	59,575	
Weighted average loss per transfer				123,626

7.8 Step 8: multiplying weighted average loss for all transfers

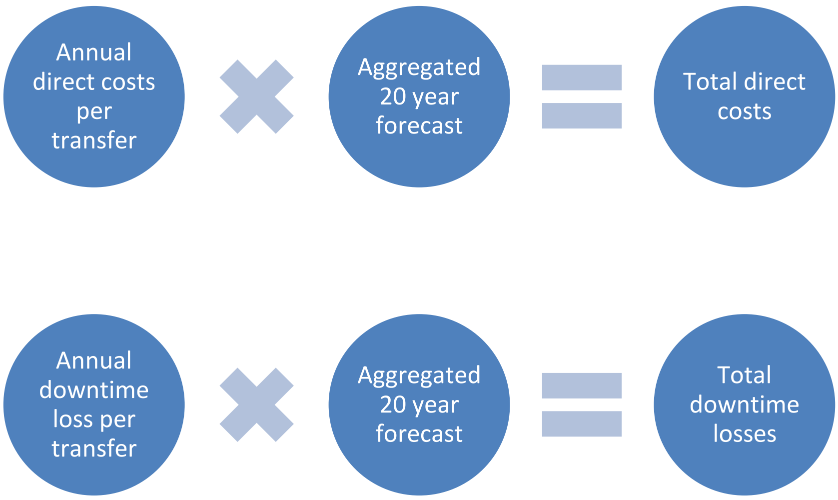
Next, the data is extrapolated to all international transfers per year by multiplying the weighted average loss per transfer with the total number of transfers (Table 11).

Table 11 – Multiplying weighted average loss per transfer for all transfers

Weighted average loss per transfer (US$ 1000)	123.6
Total average annual number of transfers	954
Annual total (US$ 1000)	117,939

7.9 Step 9: total costs and losses and projection for 20 years

Model:



Output:
Inserting the annual direct cost per transfer figure of US$ 263,131 into the 20 year projection model explained in section 3.8 gives an aggregate total for direct costs of US$ 5.002 billion (Table 12).

Table 12 – Total direct costs

Direct costs per transfer	20 yr aggregate direct costs
US$ 263,100	US$ 5,002,000,000

Inserting the resulting figure into the 20 year projection model gives an aggregate total for downtime losses of US$ 2.284 billion (Table 13).

Table 13 – Total downtime losses

Downtime losses per transfer	20 yr aggregate downtime losses
US$ 123,626	US$ 2,284,000,000

The combined total for direct costs and downtime losses then is: **US$ 7,286,000,000**.

Table 14 – Annual total direct costs (US$ 1000)

Dissimilar requirement	type	costs	costs	Duplications	Diff 1	Diff 2	Diff 3
		Normal	Exceptional				
Validation of modifications	Dupl	4390	1129	12489			
Maint. check for export	Dupl	578	90				
Maint. check for import	Dupl	798	1371				
Recertification of components	Dupl	809	2794				
Recertification of offwing engines	Dupl	54	476				
Ozone converter	Diff1	827	393		4147		
Ice detection system	Diff1	548	0				
Cargo fire suppression	Diff1	2302	77				
Type III exits	Diff2	2043	64			35194	
Different cabin safety requirements	Diff2	2750	0				
60 min battery power	Diff2	3207	683				
DFDR	Diff2	1103	126				
CVR	Diff2	1074	84				
Fixed ELT	Diff2	3963	28				
Video camera	Diff2	3147	37				
Maintenance programme	Diff2	4235	1439				
CoA inspections	Diff2	4067	1735				
Delays by authorities	Diff2	945	910				
Test flights	Diff2	2593	960				
Local language exit signs	Diff3	1346	513				8952
Metric altimeters	Diff3	1111	13				
FM immunity	Diff3	425	32				
ELS/EHS	Diff3	1632	150				
VHF 8.33 spacing	Diff3	509	44				
Datalink	Diff3	705	2472				

Abbreviations:
Dupl: duplications
Diff1: difference 1
Diff 2: difference 2
Diff 3: difference 3

Table 15 – Annual total downtime

Dissimilar requirement	type	days	days
		Normal	Exceptional
Validation of modifications	Dupl	6.32	10.37
Maintenance check for export	Dupl	1.36	1.00
Maintenance check for import	Dupl	3.19	4.46
Recertification of components	Dupl	11.47	3.43
Recertification of offwing engines	Dupl	0.12	0.81
Ozone converter	Diff1	0.22	0.41
Ice detection system	Diff1	0.36	0.00
Cargo fire suppression	Diff1	1.00	0.11
Type III exits	Diff2	0.43	0.45
Different cabin safety requirements	Diff2	4.51	1.17
60 min battery power	Diff2	0.43	0.15
DFDR	Diff2	0.91	0.15
CVR	Diff2	0.82	0.04
Fixed ELT	Diff2	1.97	0.04
Video camera	Diff2	1.82	0.05
Maintenance programme	Diff2	5.33	1.17
CoA inspections	Diff2	5.14	2.32
Delays by authorities	Diff2	1.12	2.61
Test flights	Diff2	1.53	0.88
Local language exit signs	Diff3	4.41	1.75
Metric altimeters	Diff3	0.53	0.31
FM immunity	Diff3	0.33	0.26
ELS/EHS	Diff3	0.90	0.29
VHF 8.33 spacing	Diff3	0.31	0.25
Datalink	Diff3	0.93	0.97

Abbreviations:
Dupl: duplications
Diff1: difference 1
Diff 2: difference 2
Diff 3: difference 3

8. ASSESSMENT

8.1 Introduction

The fundamental question of this study can now be answered: why do regulations and their application prevent international transfers from following the ideal pattern described in section 3.2, and what can be done to address this issue?

In chapter 3 we saw that there are many reasons for transfers to deviate for regulatory reasons from the ideal pattern. These reasons have been classified according to their aims with regards to safety in the categories introduced in section 5.2:

- duplication – no safety benefit;
- differences arising from varying safety objectives;
- differences arising from the same objective but differing means of implementation; and
- non-safety instigated regulatory differences.

In answering the fundamental question above, we follow this classification.

8.2 Duplication

8.2.1 Economic impact

Of all the costs incurred by regulation-related inefficiencies, duplications represent about 20% of the direct costs, amounting to some US$ 12.5 million for all AWG R transfers in a single year. It is estimated that this translates into US$ 51.6 million for all annual transfers. Given that duplications have no genuine safety basis, but primarily stem from a lack of mutual trust and recognition, the global aviation safety community faces a challenge in addressing these wasted costs and taking steps to eliminate or reduce them.

8.2.2 Validation of modifications

High levels of duplication arise due to the lack of mutual recognition of design approvals other than type certificates, such as supplemental type certificates (***STCs***). This study estimates such duplication to cost US$ 5.5 million (excluding downtime losses) for AWG R members, which amounts to US$ 22.8 million for all annual transfers.

Although the issue of high levels of duplication appears to be of a limited nature between some major states, it is a significant issue between the US and the EU, as this jurisdiction combination is involved in the highest number of transfers. Although the two jurisdictions have established an agreement[31] to try to avoid duplication of this nature, the validation process on the EU side can be lengthy and bureaucratic, sometimes leading to delays of several months before an aircraft can be put into service. In the US, the fact that designs from only 6 out of 27 EU states can be validated (as the blanket bilateral agreement that was finalised in June 2008 has not yet been ratified[32]) means duplication in terms of validating modifications remains an issue.

[31] EASA Decisions 2004/04/CF and 2007/001C on acceptance of certification findings made by the FAA for products designed in the USA; see also FAA order 8100.14 Interim Procedures for working with the European Community on Airworthiness Certification and Continued Airworthiness.
[32] See http://easa.europa.eu/ws_prod/g/doc/International/WebinfoSTCEU.pdf (accessed 26 August 2010).

Duplication of this nature is expected to reduce over the coming years, as most of the existing STCs have now been validated since the EU and US started the process following the creation of EASA in 2002. However, other states have now started to require individual validation of STCs.

8.2.3 Recertification of components

AWG R members estimate that recertification of components costs them US$ 4 million per annum, excluding downtime losses. This equates to US$ 16.5 million for all transfers.

The major manufacturing states have harmonised their regulations in respect of component certification and have concluded agreements for mutual recognition of certificates. However, there remains a wide variation between states as to accepted practice; this relates to a number of issues, including:

- mutual recognition of the component certificate (that is, the authorised release certificates such as the EASA Form 1 and the FAA 8130-3 tag);
- different retention periods of maintenance records;
- the required retention period for life-limited components (***LLCs***). There is a lot of confusion in this area: some interpretations essentially require back-to-birth traceability, meaning that all data for a component, including the aircraft on which it has been installed on since manufacture, needs to be kept. The ICAO, FAA and EASA have issued guidance material, albeit of an informal nature, that requires only that information on cycles and hours must be kept in a reliable way;
- maintenance records being kept in different languages;
- not all states accepting electronic records;
- some states insisting on recertification of all components that are imported, other than on the aircraft itself, even where existing documentation meets the standards applied in the major aviation states. This practice is a major impediment to the import of components in those states, thereby causing major costs and delays;
- engines becoming ‘stateless’, caused by an aircraft from which they have been removed being transferred to another state such that the registration reference on the engines’ authorised release certificate becomes void; and
- inadequate level of oversight by national authorities.

Due to issues such as these, components may not be considered airworthy, leading to the need for recertification. This typically requires appropriate tests and inspections of the components, which may lead to further overhaul or even repair.

A solution that would address the majority of these issues, albeit only in the long term, would be a global standard for electronic recordkeeping. This could be achieved by the use of a database, developed by or in association with stakeholders, in which all relevant information is kept in a format that is easy to update, yet resistant to errors, and easily transferable. Such a database might serve as a ‘digital passport’ for aircraft.

8.2.4 Maintenance checks

AWG R members estimate that maintenance checks as a result of dissimilar requirements cost them US$3 million annually. This equates to US$12.3 million for all transfers.

The new state can require recertification in the form of a complete maintenance check of the aircraft before granting the CoA. Such a check has no added safety value in circumstances where the aircraft has been properly maintained and kept in an airworthy condition.

In some cases, the state of export, when issuing an Export CoA, requires a 'C' maintenance check to be performed. The United States, for example, required an 'annual type of inspection' (which was interpreted as meaning a 'C' check), but dispensed with the requirement in April 2010.

Although engines have type certificates, and may have a separate CoA, no equivalent Export CoA requirements exist for engines, according to AWG members.

8.3 Differences between safety objectives

The number of differing safety objectives is less significant and, at about US$ 17 million (7% of the total), so is the economic impact. However, this figure does not include examples involving older aircraft types, which have major differences in type certification bases between states. The extent of these differences is so great that the cost of making the major modifications required would exceed the value of the aircraft, and thus effectively prohibits transfers.

Of the remaining instances, the major jurisdictions continue to differ in opinion, occasionally coming to a consensus after many years of divergence. An example is the requirement for an ozone converter that was introduced in the US in 1980, but only brought into force in Europe about 23 years later (and then only in respect of new designs). This means that many non-US designed aircraft that were not originally delivered to the USA require modification upon transfer to the US. A similar situation may arise in respect of the recently introduced US Class D cargo compartment retroactive regulation and the 16 g seat testing retroactive requirement. A requirement relating to ice detection equipment may also be applied by Europe, some time after its introduction in the US.

It should be noted here that the number of differing safety objectives (or different means of achieving the same objective) have been reduced very significantly over the past 35 years. The situation in 1975, when the Joint Aviation Authorities (***JAA***)[33] started to draft a common European airworthiness code, was such that many countries in Europe applied different safety objectives. This caused newly built aircraft of the same type to be in fact substantially different. The initial state of import determined the configuration of the aircraft. Subsequent export, even when both states were in Europe, often required major modifications that were sometimes so excessive that they made the transfer prohibitive. Intensive harmonisation efforts over the years resulted in a single code for all EU countries by the early 2000s. Subsequently, similar efforts across the Atlantic, involving the EU together with Canada, the USA and Brazil, have led to a single, global, airworthiness code that has only minor variations between the four jurisdictions. This proves that international

[33] In 1975 operating under a different name, but later becoming known under this name.

harmonisation of aviation safety regulations at a level deeper than the ICAO standards is achievable.

8.4 Differences arising from the same safety objective, but differing means of implementation

8.4.1 Economic impact

The next category is that of differences where similar safety objectives have dissimilar safety requirements associated with them. This category can be split into three subcategories:

- equipment requirements;
- CoA process; and
- age limits.

The annual economic impact of the first two of these dissimilar requirements, which are further explained in Appendix 7, amounts to US$ 145 million (excluding downtime losses) or 58% of the total. The effect of differing age limits is more difficult to quantify.

8.4.2 Equipment requirements

The equipment requirements that fall in this category are based on the ICAO Annex 6 and 8 equipment standards and recommended practices. They encompass a wide variety of instances where regulatory authorities share the same safety objective as that laid down by ICAO, but differ in opinion as to when, and to what categories of aircraft, they apply. In some cases, the actual technical requirements differ.

They fall into two certification levels: those of type certification and Air Operator Certification. For type certification, harmonisation has largely achieved its goal, for the outstanding list of dissimilar requirements is small. However, this list does include some examples where differences will remain, such as those surrounding access to Type III exits. For operationally required items, however, harmonisation of applicability dates, ranges and technical standards is still needed.

8.4.3 CoA process

The issuing of a CoA by the state of import in respect of used aircraft is largely an administrative process. The new state may consider the previous CoA (or the export CoA) as satisfactory evidence that the aircraft complies with the applicable ICAO standards[34].

However, in practice, many states do not accept a CoA from another state on face value. Typically, they require an inspection of the aircraft and its records.

AWG members identified the following areas associated with the issuing of a CoA as having a significant economic impact, discussed further in Appendix 7:

- different technical interpretations by authorities;
- delays by authorities;
- test flight requirements; and
- dissimilar maintenance programme requirements.

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[34] under Annex 8, sub-chapter 3.2.4.

Accepting a CoA issued by another state at face value would meet the principles of mutual trust and recognition as laid down in the Chicago Convention. However, it is acknowledged that recognition cannot always be based on this underlying principle, as pointed out by the ICAO secretariat at the ICAO 2010 High Level Safety Conference[35]. The results of the USOAP unfortunately illustrate that not all states have demonstrated full compliance with the ICAO standards (although many have). The quick reference chart of results for 50 major aviation states is presented in Appendix 4 and discussed at section 4.1.5.

Within the EU, the introduction of the Airworthiness Review Certificate (***ARC***) has significantly improved the transfer process. Aircraft being transferred between EASA states are no longer subject to inspections upon import. However, there are reports that some states still perform inspections, arguing that this is expected from them as part of their ACAM obligations[36].

8.4.4 Age limit

Age limits were introduced only recently by some states, but are particularly prevalent in states within South Asia, the Middle East and Africa. The requirement is that upon import, an aircraft must not be over a certain age (ranging from 10 to 22 years). Once imported, the aircraft may continue to be in operation in that state for an unlimited period, although in some states an end of service life date is set.

The formal rationale for this regulation is safety, but this is difficult to understand. One state that introduced an age limit cited its formal reason as being an accident that occurred in the US during 1988, in which a part of the upper fuselage structure separated in flight. Informally, however, it appeared to be a political reaction to an accident in its own territory, where the media blamed the old age of the aircraft[37]as the cause. The 1988 accident has lead to extensive ageing aircraft programmes aimed at ensuring a safe life based on a given number of hours and cycles. The safe life is determined by the type certificate holder through extensive testing and scientifically based predictions. Maintenance programmes have been adapted accordingly and should be applied in all those states.

The economic impact of having an age limit is very difficult to determine, other than the fact that it has a devaluing effect on aircraft as assets.

8.5 Non-safety instigated regulatory differences

8.5.1 Economic impact

The differences resulting from different concepts and administrative policies are the following:

- airspace compatibility;
- local language exit signs;
- export approvals; and
- Article 83bis arrangements.

The first two items are capable of quantification (see below).

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[35] ICAO, High Level Safety Conference 2010. Mutual recognition. *DGCA/06-WP/8.*
[36] EASA Part M.B. 303 Aircraft Continuing Airworthiness Monitoring.
[37] Eventually the cause was established as purely operational.

Article 83bis arrangements belong to the group of 'non-transfers', i.e. cases in which a transfer cannot be executed due to dissimilar requirements. The export approval is an issue that raises transfer issues and costs that are difficult to quantify, and occasionally lead to a non-transfer.

8.5.2 Airspace compatibility

The dissimilar requirements associated with airspace compatibility are a direct result of decisions taken at a regional level about airspace architecture. Their economic impact on international transfers, at US$ 29 million of direct costs, is significant. Whilst these differences cannot be avoided, there is still opportunity for further harmonisation of technical standards.

8.5.3 Local language exit signs

Many states require that safety instructions for passengers, such as exit locations, exit operation and life vest locations are given in the local language. For exits, the airworthiness codes specifically prescribe that the word 'Exit', or its translation, must be used. This single dissimilar requirement accounts for direct costs of US$ 8 million annually.

EASA amended its airworthiness code in 2007 in order to allow the use of symbols as an alternative to words for passenger exit signs. That amendment was based on an international study in which aircraft passengers from all continents were tested as to their comprehension of internationally standardised exit symbols. The FAA introduced a policy in June 2010 following suit, but with minor operational conditions attached.

8.5.4 Export approval

Export approvals, such as the Export CoA, have no legal basis in either the Chicago Convention or its Annexes. The practice of issuing Export CoAs varies from state to state and appears also to vary in respect of new and used aircraft; this is further explained in Appendix 3. Even in relation to exports from Europe, there is no standardisation between the EASA states; some EASA states issue Export CoAs, whilst others do not. For the purposes of the leasing industry, Export CoAs are a useful instrument as they form a reconfirmation by the exporting state that a used aircraft is meeting its airworthiness standards. This in turn enables the new state to issue its own CoA without further action.

8.5.5 Article 83bis

The number of states that have entered into Article 83bis arrangements is far below the number that have ratified it. There is a tendency amongst states not to take advantage of its benefits. The reason for introducing the Article was to create efficiencies in the oversight of airworthiness, where the state of the aircraft operator differs from the state of registry. The Article 83bis agreement transfers oversight responsibility to the state of the operator, and gives the state of registry greater control over the state of the operator in terms of obtaining and assessing information and the ability to carry out systematic inspections, when compared to other forms of agreement. It also makes it clear to other states where the responsibility for airworthiness oversight rests.

The absence of an 83bis agreement has caused the failure of potential transfers of lessor-owned aircraft because of the state of registry's inability to transfer certain oversight tasks and duties. Such non-transfers have a significant, yet difficult to quantify economic impact.

Recently, and following audits by ICAO in EU member states, EASA started a review of the compatibility of Article 83bis with the applicability provisions of the Basic Regulation[38]. A tentative position taken is that the Basic Regulation and its subordinate regulations would only allow full transfers and not partial transfers. Full transfers would entail a situation where the state of registry delegates all oversight responsibilities, including the issue of the CoA to the state of operator. This position is contrary to the current widespread practice of partial transfers, where the responsibilities for continuing airworthiness are divided between the two states. EASA is currently canvassing stakeholders as to their position. Indications so far are that stakeholders, including EU member states, are not supportive of this view.

8.6 Accessibility of regulations

For this study, numerous sets of aviation safety regulations were examined, with particular focus on items addressing, or affecting, international transfers.

Although the contents of such regulations meet, or should meet, the standards contained in the Annexes to the Chicago Convention, the format in which each state publishes its requirements is not specified. It follows that each state[39] has developed its own system of aviation safety regulations. This leads to a large variety in:

- the structure of aviation safety regulations;
- accessibility to foreign users (for example in terms of the availability of the regulations on the internet, and their availability in different languages);
- possible interpretations; and
- provision of detail about the import and export requirements and procedures.

The way in which the above measures are communicated by states varies greatly. Some states publish information via their regulation system and on their website; in other cases, this information may only be obtained by directly approaching the intended state of import. In addition, cases are reported where the conditions for the issue of a CoA are not documented and only become known when actually importing an aircraft.

The US system probably rates highest in terms of accessibility. Although its system of regulations is very extensive, it is logically structured and easily accessible via the internet. In addition, the FAA website contains extensive information, including Frequently Asked Questions, on items pertaining to the import and export of aircraft and other aviation products.

Europe (specifically the EASA states) has much to do in order to match the US standard of accessibility. EASA uses its website as the formal means of making available European aviation safety regulations. The ‘total system approach’ for structuring aviation safety regulations that is currently being introduced and which attempts to encompass all aviation safety regulations in a single codification system makes it easier to find the applicable regulations. However, it is to be noted that upon

[38] In particular, Article 4(1)b, which reads: ‘Aircraft, including any installed product, part and appliance, which are […] registered in a Member State, unless their regulatory safety oversight has been delegated to a third country and they are not used by a Community operator […] shall comply with this Regulation’.
[39] Except for the 27 EU member states that share a common system, even though some EU member states continue to publish additional requirements and interpretations.

an import from the US into the EU, it is the US FAA's website, rather than the EASA site, that details the formal import requirements of EASA states[40].

Whilst it is accepted that each state must fit its aviation safety regulations with the codification practices for that state, states should at the same time recognise that increasing globalisation demands proper access to the substantive regulations. In this respect, reference is made to the proposal by AWG to ICAO to consider establishing, under ICAO auspices, a web-based registry which records national requirements relating to the importation of aircraft[41].

Such a registry would not be the first to have been maintained by the ICAO. The ICAO is already notified by states[42] of any variations to the detailed specifications of the Technical Instructions for the Safe Transport of Dangerous Goods by Air (***TI***). The variations that are notified include both deviations that fall below the minimum ICAO standard and those that exceed or vary the standard in any way. The variations are published by the ICAO in Appendix 3 to the TI and, in association with the TI itself, effectively form a registry of the national requirements for the transport of dangerous goods by air.

8.7 Future trends

As part of this study, a number of areas were identified where further dissimilar requirements may emerge. They have not been further analysed in this study, nor has any attempt to quantify them been made. These areas are:

- fuel tank inerting systems (US initiated);
- the 16g dynamic seat testing retroactive rule (US initiated);
- facilities for the disabled (US and Europe following different approaches); and
- Foreign Air Operator Certificates, such as FAR 129 requirements in the US and Third Country Operator regulations now being drafted in Europe.

[40] http://www.faa.gov/aircraft/air_cert/international/export_aw_proc/sp_req_import/media/EU.pdf (accessed 15 July 2010).
[41] Letter by AWG to ICAO being sent with this study.
[42] Pursuant to the standard of paragraph 2.5.1 of Annex 18.

9. SUMMARY OF FINDINGS

9.1 Overview of costs

The economic impact due to dissimilar requirements is significant. The information provided by AWG R members on the cost and frequency of occurrence, when analysed, indicates US$ 87 million is directly attributable to such requirements imposed on them.

When extrapolating this figure to all international transfers by the entire aviation industry, the resulting annual cost is US$ 369 million. This consists of US$ 251 million of direct costs and an estimated US$ 118 million of downtime losses. With 954 transfers per year on average, this is equivalent to an average of US$ 386,000 per transfer.

Projecting the total economic impact over the next 20 years gives a total of US$ 7.286 billion.

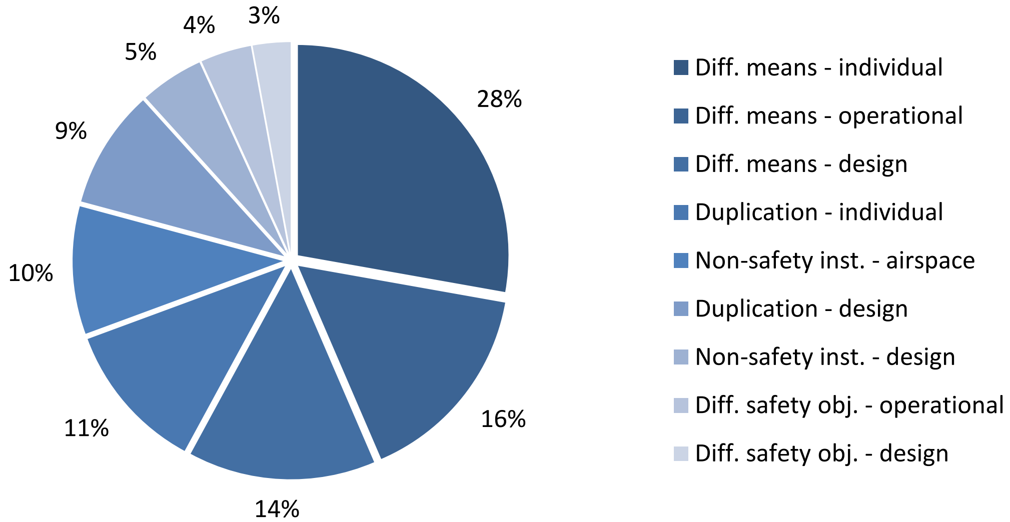
Table 16 below is a development of Table 7 (overview of dissimilar requirements) with the annual direct costs inserted for each group of dissimilar requirements.

Table 16 – Breakdown of direct costs

		Safety objective				
	US$ million	**Duplication**	**Different safety objective**	**Different means**	**Non-safety instigated**	**Total**
Stage of certification	**Design approvals**	22.8	7.3	36.1	12.3	78.5
	Individual certification	28.8		69.7		98.5
	Operational certification		9.8	39.5		49.3
	Airspace compatibility				24.7	24.7
	Total	51.6	17.1	145.4	37.0	251.0
	In percentages	20	7	58	15	

When ranking these groups by volume, Figure 11 results.

Figure 11 - Ranking of direct costs



The following findings follow the ranking order of Figure 11 and highlight dissimilar requirements with significant contributions to costs.

9.2 Individual certificates (duplications and different means)

1. The dissimilar requirements with respect to individual certificates, such as the CoA and the Authorised Release Certificates (Form 1) account for 39% of all direct costs.

2. The underlying reason is lack of mutual recognition, which manifests itself in various forms and by means of varying requirements, such as:
   - the requirement by some states for a maintenance check of the 'C' type;
   - the need to recertify components, for reasons explained earlier in this report and in Appendix 3;
   - test flight requirements;
   - the confusing requirements for retention of records for life-limited components; and
   - other import requirements, such as inspections of aircraft and records, with the inherent problem of the state or inspector's personal interpretations of the regulations.

3. The high contribution of this group to total direct costs can be explained by the lack of a global standardised process for export and import of used aircraft, making local deviations and interpretations commonplace. Whilst the relevant ICAO Standard[43] allows for mutual recognition of individual certificates, it is not binding for aircraft transfers. Conversely, there is mandatory recognition of certificates in international operations pursuant to Article 33 of the Chicago Convention. Many states have decided not to accept such certificates at face value, but rather apply their own methods of scrutiny to ensure that the aircraft or other aeronautical product being imported is airworthy. These methods vary widely and there is also a significant element of arbitrariness in their application.

4. With respect to aircraft and component records, there are two major issues at stake: (i) not all organisations appear to properly control maintenance records of

[43] Annex 8, sub-chapter 3.2.4.

aircraft and components, and this is not always spotted by the authorities responsible for oversight; and (ii) there is a lot of confusion over the record retention requirements for life-limited components. Also, for non life-limited components, the situation has worsened now that EASA earlier this year extended the general record retention period to three years[44]. This was not in line with the EASA opinion issued on the subject or the FAA's requirements.

5. The many systems available to test the equipment of modern aircraft on the ground make test flights redundant. The instructions for continuing airworthiness by the type certificate holder require a test flight only in a very limited number of instances. However, many states still require test flights to be conducted in a greater number of circumstances. The additional requirements may be motivated by the guidelines in the ICAO Airworthiness Manual. Other states have recognised that test flights are inherently less safe than normal flights and only require them where absolutely necessary.

6. Current inter-state recognition of certificates is often not based on the Chicago Convention and its Annexes, which is a multilateral, binding, international agreement, but rather on bilateral agreements such as BAAs and BASAs.

7. The ICAO's USOAP provides a unique source of data for gauging a state's performance in overseeing airworthiness. For the vast majority of contracting states, extensive audit reports are published, in addition to quick reference status charts. A summary of the latter for 50 states is presented in Appendix 4. Both give a good indication of the status of implementation of the ICAO standards and could be used to adjust the amount of scrutiny a state exercises when importing an aircraft from another state.

8. For a transfer between states within the EASA, a valid Airworthiness Review Certificate (***ARC***) is sufficient proof of airworthiness for the state of import. Such ARCs are typically issued by an appropriately privileged Continuing Airworthiness Management Organisation (***CAMO***) following an airworthiness review.

9. For imports into EU states, a recommendation submitted by a CAMO to the state of registry following an airworthiness review results in the issue of a CoA and an ARC. For imports into the USA, a similar process takes place, except that no ARC is issued. The recommendation to the FAA is submitted by an individual designated by the FAA, the Designated Airworthiness Representative (***DAR***).

10. There is no harmonised application of the Export CoA. Indeed some states do not issue them at all. In other cases, their function is ambiguous: are they meant to revalidate the CoA that was issued for an unlimited duration, or do they certify that an aircraft (or product) meets the design requirements of the state of import?

9.3 Different means – operational certification

11. The economic impact of dissimilar requirements affecting operational certification (other than airspace compatibility) accounts for 16% of all direct costs.

12. In the majority of cases, it is not the technological substance of operational certification that differs, but rather the applicability requirements in terms of both the date of effectiveness and the ranges of affected aircraft.

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[44] Commission Regulation (EU) No 127/2010 of 5 February 2010.

13. In some cases, the technical specifications themselves differ.

9.4 Design approvals (duplications, different objective, different means)

14. Airworthiness codes of the active aircraft manufacturing states are harmonised to a great extent. However, there are still variations in the detail that deserve further attention. Also, it is anticipated that emerging manufacturing states will not participate in the harmonisation efforts and new differences may develop, which is undesirable from the point of view of uniform global standards.

15. The validation of design approvals as an economic impact issue is relatively new. Traditionally, many states had no separate process for approving designs, other than type designs; they recognised modifications and repairs automatically or implicitly upon import of an aircraft.

16. With the advent of Supplemental Type Certificates, this has changed. In practice, this process, in which modifications and repairs by one jurisdiction are validated by another jurisdiction is unnecessarily tedious and bureaucratic. Its economic impact accounts for 9% of the total direct costs. The two jurisdictions primarily involved, the EU and the US, have not yet concluded a bilateral agreement.

17. An additional missing element is the linking of bilateral agreements. For example, an aircraft is transferred from state A to state B and then on to state C. States A and B have a bilateral agreement, as do states B and C, but no bilateral agreement exists between states A and C. Design approvals accepted by state B during import from state A are then not automatically recognised by state C when importing an aircraft from state B.

9.5 Non-safety instigated

18. Different airspace concepts exist, leading to different requirements for airborne equipment to ensure airspace compatibility.

19. Many states require that text exit signs be translated into their local language. This requirement, although minor in nature, has a significant economic impact because of the high frequency of occurrence. In Europe, the option of using symbolic exit signs has been introduced in the airworthiness code. The FAA recently introduced a policy to the same effect.

9.6 Other

20. More and more states are introducing aircraft age limits upon import. These limits are not based on data established by the type certificate holder or state of design and are not scientifically justified. They further ignore the aircraft ageing programmes and attendant maintenance programme amendments.

21. Although 157 states have ratified Article 83bis of the Chicago Convention, only about 40 states have actively engaged in 83bis arrangements.

9.7 Availability and accessibility of regulations

22. It appears that there is an extremely large variety in the availability and accessibility of state import requirements. Many states do not publish their import requirements at all.

23. In addition to differences, states currently file with the ICAO their varying requirements in relation to dangerous goods, called variations. The ICAO publishes these in the TI, where these standards are recorded. This effectively results in a registry for national requirements for the transport of dangerous goods by air. In addition, variations relating to regional airspace use are published by the ICAO[45].

[45] ICAO Doc 7030 - Regional Supplementary Procedures.

10. RECOMMENDATIONS

10.1 Introduction

The recommendations are presented in the same order as the conclusions, namely by order of economic impact volume. Each recommendation is addressed to the policy maker(s) named in square brackets.

10.2 Individual certificates (duplications and different means)

Harmonisation of standards

1. A standard process for export and import of used aircraft should be developed. [ICAO]

2. The Export CoA and associated procedures should be made unambiguous and should be made mandatory to facilitate the export and import of aircraft. [ICAO]

3. A global format for the authorised release certificate accompanying overhauled components, commonly known as a Form 1 or 8130-3 tag, should be developed, based on the format in use by the EU, US, Canada and Brazil. [ICAO]

4. The concept of airworthiness reviews and associated recommendations to the state of import as developed by EASA should be introduced globally. [ICAO]

5. The requirement for test flights when importing used aircraft should be eliminated. The ICAO Airworthiness Manual should be adjusted accordingly. [ICAO]

Mutual recognition

6. States of import of used aircraft should make use of the USOAP reports about the state of export when determining the level of inspection necessary before issuing a CoA, such that no further proof of airworthiness is required when the USOAP results are high. A suggestion for acceptable scores would be a score of either 8, 9 or 10, or when the world wide average is lower than 6, a score at least two points above the average. [States]

7. States should be encouraged to publish USOAP reports. [ICAO]

8. States should study the feasibility of returning from a system of bilateral agreements to a multilateral recognition system, in which they preserve the right to demonstrate compliance and enforcement. [States]

Records

9. The informal interpretations used by EASA and the FAA with respect to the subject of 'back-to-birth traceability' should be formalised and minimum retention periods for detailed maintenance records should be harmonised. [EASA, FAA]

10. Electronic aircraft and component records should be accepted. [States]

11. A system for electronic recordkeeping of components should be developed. [ICAO]

10.3 Different means – operational certification

Harmonisation of standards

12. Applicability dates, applicability ranges and technical standards should be globally harmonised in respect of operationally required equipment. [ICAO]

10.4 Design approvals (duplications, different objective, different means)

Mutual recognition

13. The EU/US bilateral agreement should be extended to include automatic recognition of basic STCs. [EU, US]

14. Bilateral agreements should be linked such that design approvals recognised through bilateral agreements with a third state are recognised without further action. [States]

Harmonisation of standards

15 Airworthiness codes at a level beyond those of the ICAO SARPs should continue and be expanded to emerging manufacturing states. [EASA, FAA, other states]

16 Harmonisation of airworthiness codes should be expanded to the level of Acceptable Means of Compliance, Advisory Circulars and Guidance material. [EASA, FAA, other states]

10.5 Non-safety instigated

Harmonisation of standards

17 Whilst it is accepted that different airspace concepts are inevitable, maximum harmonisation of technical requirements in and between regions should be facilitated. [ICAO]

18 The use of symbolic exit signs should be allowed as an alternative to text exit signs. [ICAO, States]

10.6 Other

Harmonisation of standards

19 Ageing aircraft programmes from the type certificate holder and/or state of design data should be recognised. [States]

20 The use of age limits upon import should be discouraged. [ICAO]

21 The use of 83bis agreements should be encouraged. In particular, states with high USOAP scores should be encouraged to utilise these agreements as a means of promoting protection of assets and encouraging improvement of standards for other states. [ICAO]

10.7 Availability and accessibility of regulations

Registry of differences

22 A registry should be created for detailing *all* import requirements applied by states, indicating any variations from ICAO standards. [ICAO]

23 All import requirements should be filed with ICAO for publication in the registry as per recommendation 22 above. [States]

APPENDICES

Appendix 1 – Glossary

ACAM
Aircraft Continuing Airworthiness Monitoring. An EASA requirement directed at member states to ensure that the airworthiness of aircraft on their register is being monitored.

Air Operator Certificate
The certificate issued by a state to an airline that proves that it meets the required safety regulations to conduct commercial air transportation.

Article 83bis
Article 83bis of the Chicago Convention establishes that agreements for the transfer of certain oversight responsibilities from the State of Registry to the State of Operator shall be recognized by all other Contracting States which have ratified it.

Airworthiness Review Certificate (ARC)
The certificate issued either by an EASA member state or an organisation appropriately approved that ensures the validity of a Certificate of Airworthiness issued by an EASA member state.

Approved Maintenance Organisation
Any organisation duly approved by one or more civil aviation authorities which carries out maintenance on aircraft, engines or other aeronautical products.

Authorised Release Certificate (ARC)
The certificate issued upon production of a component or at the completion of any maintenance on a component whilst off the aircraft. Also known as EASA Form 1 (EU) and Form 8130-3 (US).

Basic Regulation
The Regulation of the European Parliament and of the Council that defines the roles and responsibilities of EASA and establishes common rules in the field of civil aviation.

Certificate of Airworthiness (CoA)
The certificate issued by the State of Registry attesting that the aircraft conforms to its type design and is considered airworthy.

Continuing Airworthiness Management Organisation (CAMO)
Any European organisation duly approved by the authority of a EU member state where it has its principal place of business, or any non-European organisation duly approved by EASA, which carries out continuing airworthiness management activities.

Difference
A departure by a contracting state from an international standard or procedure established in an ICAO Annex.

Downtime
Time during which an aircraft cannot be operated for reasons such as ongoing maintenance, modifications, operational, or regulatory issues.

EASA
European Aviation Safety Agency. An agency of the European Union which has been given specific regulatory and executive tasks in the field of aviation safety and for those tasks acts on behalf of the member states of the European Union, Iceland, Liechtenstein, Norway and Switzerland.

Export Certificate of Airworthiness
A certificate of airworthiness that is issued specifically for the purpose of export and that attests that the aircraft meets the airworthiness and special requirements of the state of import. It does not constitute authority to operate an aircraft.

EU OPS
The regulatory safety standards established by the European Commission with regards to common technical requirements and administrative procedures applicable to commercial transportation by airplane.

FAA
Federal Aviation Administration. The national aviation authority of the United States of America.

Instructions for continuing airworthiness
Instructions issued by an aircraft type certificate holder that are necessary for maintaining the aircraft in an airworthy condition.

ICAO
International Civil Aviation Organization. The principal international organisation for civil aviation, charged with developing the principles and techniques of international air navigation and to foster the planning and development of international civil aviation.

International transfer
A transfer of an aircraft from one State of Registry to another State of Registry. In the context of this study, transfers of an aircraft from one Sate of Operator to another State of Operator are not considered to be international transfers.

Life limited components (LLCs)
An aircraft component for which the instructions for continuing airworthiness specify a time limit, expressed in aircraft cycles, landings, flight hours or calendar time. The limit is either a service life limit or a certified life limit. A service limit identifies the time between manufacture and overhaul, or between successive overhauls. A certified life limit identifies the time between manufacture and mandatory disposal.

Mutual recognition
The acceptance by contracting states of certificates issued by other contracting states without further act.

SARP
Standards and Recommended Practices. SARPs are issued by ICAO in the form of Annexes to the Chicago Convention to secure the highest practicable degree of uniformity in regulations, standards, procedures, and organization in relation to aircraft personnel, airways and auxiliary services in all matters in which such uniformity will facilitate and improve air navigation and aviation safety.

State of Operator
The state that issued the Air Operator Certificate currently listing the aircraft.

State of Registry
The state that issued the current Certificate of Registration of an aircraft.

Total system approach
The codification system developed by EASA for encompassing safety standards for all areas of aviation, namely airworthiness, crew licensing, air operations, aerodromes and air navigation services.

Transitioning register
A register that allows the registration of aircraft without necessarily issuing a certificate of airworthiness.

Type certificate
A certificate issued to the design organization of an aircraft, engine or propeller and attesting that the design meets the applicable airworthiness code.

Universal Safety Oversight Audit Programme (USOAP)
A programme run by ICAO to promote global aviation safety through the regular auditing of safety oversight systems in all ICAO contracting states. Specifically, the USOAP audits focus on the state's capability for providing safety oversight by assessing whether the critical elements of a safety oversight system have been implemented effectively. The audit teams also determine the state's level of implementation of safety-relevant ICAO Standards and Recommended Practices (SARPs), associated procedures, guidance material and practices.

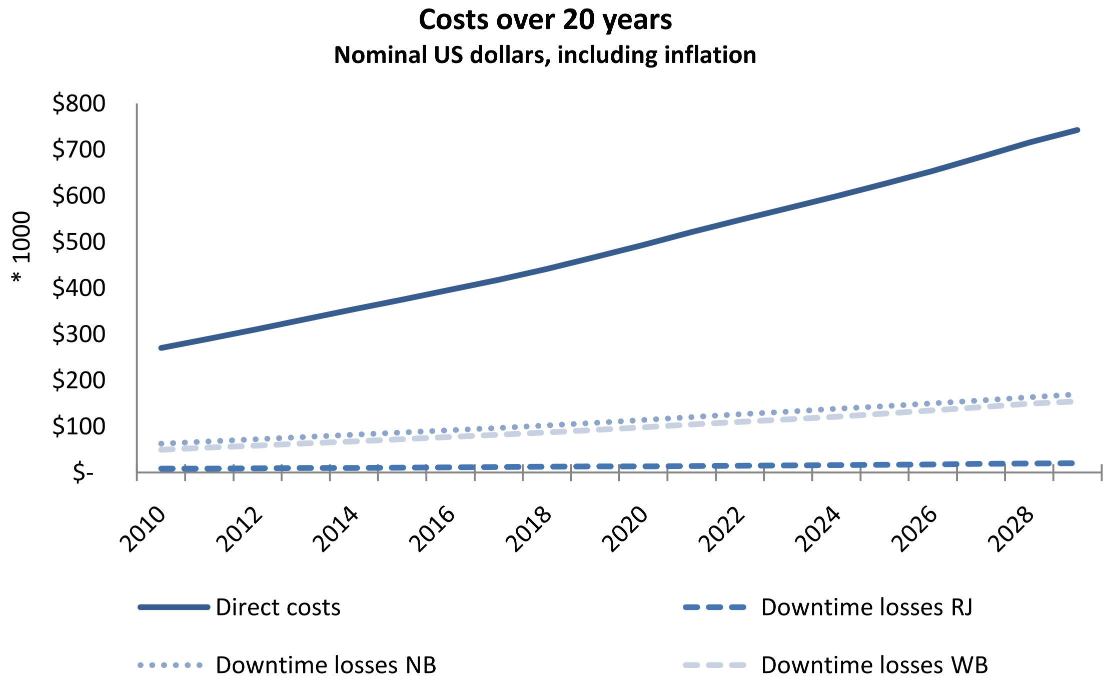
Appendix 2 – The Economic Projection Model

The economic projection model has two steps. In the first step, it forecasts the stream of the direct costs and downtime losses for the next 20 years. In the second step, the cash flows are then discounted to the net present value.

The first step uses information from:

- the four major manufacturers on fleet growth in the next 20 years; and
- the Ascend database on the proportion of the air transport fleet that is subject to an operating lease. The Ascend data indicates that this is 32%. Aircraft subject to operating leases are more frequently transferred compared to operator-owned aircraft. On average, a leased aircraft changes operator approximately 3 times during its leasing life. This equates to about 4.5% changes of operator per year per lessor-owned aircraft.

The calculation is as per formula 1 (page 65). When assuming a 2% inflation, which is compounded every year, adding above annual transfer rate data and fleet forecast data as presented in Table 8, a nominal value results as presented below.



The next step is to convert the stream of nominal cash flow on a constant dollars basis, using a discounted cash flow methodology. In economics, discounted cash flow calculation is a method of valuing a stream of cash flow using the concept of the time value of money. All future cash flows are estimated using the nominal value presented above and then discounted using the Weighted Average Cost of Capital (***WACC***) of the industry to give the sum of their present value in constant dollars.

The WACC was calculated using an industry cost of capital in which each category of capital (common equity, preferred equity and debt) is proportionately weighted, see formula 2 on page 65. It is calculated taking into account the relative weights of each component of the capital structure and applying the associated capital cost. The WACC is expressed as a percentage in the same way as interest. The debt and equity percentages used are taken from the Bloomberg database on 23 September 2010, which comprises data from 29 major companies, mostly leasing companies.

Formula 1 –

$$\sum_{n=1}^{20} \frac{[(\mathrm{a} \times \mathrm{b} \times \mathrm{c}) + (\mathrm{a} \times (1-\mathrm{b}) \times \mathrm{d})] * [(\mathrm{c_t} + \mathrm{c_d}) * (1+\mathrm{i})^{\mathrm{n}}]}{(1+wacc)^n} = \frac{[(\mathrm{a} \times \mathrm{b} \times \mathrm{c}) + (\mathrm{a} \times (1-\mathrm{b}) \times \mathrm{d})] * [(\mathrm{c_t} + \mathrm{c_d}) * (1+\mathrm{i})^{1}]}{(1+wacc)^1} + \frac{[(\mathrm{a} \times \mathrm{b} \times \mathrm{c}) + (\mathrm{a} \times (1-\mathrm{b}) \times \mathrm{d})] * [(\mathrm{c_t} + \mathrm{c_d}) * (1+\mathrm{i})^{2}]}{(1+wacc)^2} + \frac{[(\mathrm{a} \times \mathrm{b} \times \mathrm{c}) + (\mathrm{a} \times (1-\mathrm{b}) \times \mathrm{d})] * [(\mathrm{c_t} + \mathrm{c_d}) * (1+\mathrm{i})^{3}]}{(1+wacc)^3} + \cdots^{n}$$

Where:

a = Total fleet for the year for the specific aircraft type, as aggregated by the manufacturer's studies (see Table 8);
b = Proportion of operating leases, assumed to be 32% and constant;
c = 1 / (average operating lease term in years), assumed to be 7 years;
d = Proportion of transferred aircraft not subject to an operating lease per year (which equals 100% minus b, or 68%), assumed to be 1.4% and constant;
c_t = Average cost to transfer an aircraft;
c_d = Downtime loss per transfer per Aircraft Group (RJ, NB, WB) (see Table 10);
= Inflation, assumed to be 2% and constant.

Formula 2 -

$$WACC = [\{D * \rho_D\} + \{E_C * \rho_C\} + \{E_P * \rho_P\}]$$

$$where: \ \rho_D + \rho_C + \rho_P = 1$$

Where:

= Cost of debt at 2.09%;
= Cost of common equity (C) at 16.8% and preferred equity (P) at 29.58%;
= Proportion of debt (D), common equity (C) and preferred equity (P) in the structure;
$_D$ = Proportion of debt, assumed to be 63.4%;
$_C$ = Proportion of common equity, assumed to be 36.3%; and
$_P$ = Proportion of preferred equity, assumed to be 0.3%.

Appendix 3 – The levels of certification

1 Design approval

The first certification level is that of design approval for aircraft, aircraft components as well as changes and repairs.

1.1 Aircraft

Design approval for an aircraft is evidenced by a type certificate. Certification is performed by the state where an aircraft was designed, using the standards (typically referred to as the 'airworthiness code') in existence in that state on the date of application for the type certificate. Generally, these standards will not change over the years, so that later amendments to the airworthiness codes will have no effect on the type certificate of an existing aircraft design. There are two exceptions to this:

- Where a safety issue has been identified with a specific aircraft type, it may be corrected by means of an airworthiness directive;
- Generic regulatory improvements that are considered essential for later implementation may be introduced on a retroactive basis. This can be done either in the airworthiness code itself, by means of operational requirements (see section 3), or a hybrid form, such as JAR-26[46]. These methods have primarily been used for certain improvements in cabin safety and survivability measures.

The type certification process can be very extensive. For a large aircraft such as the Boeing 787 it can take up to seven years[47] and entail hundreds of hours of flight testing, in addition to many tests and demonstrations on the ground.

The type certificate as issued by the state of design is a legal document only in that state. It is not a certificate to which Article 33 of the Convention applies, and therefore is not automatically recognized in other states[48]. Each state into which an aircraft of a certain type is imported may issue its own type certificate for that type, following a validation process. The basis for this process is the type certificate of the state of design, even when the validation takes places significantly later than the original type certification. Yet due to differences in airworthiness codes between states, the conditions for validation may differ significantly from those in place when type certification was completed, leading to extra costs for technical inspections, evaluations, testing and, indeed, design changes.

Over the past decades, the leading aircraft design states of the world have, to a great extent, harmonized their airworthiness codes. This process started in Europe in the 1970s, and led to the adoption of a single airworthiness code in the early 1990s for all European states that were a member of the JAA. Yet its application by states was initially far from harmonized. The airworthiness code itself included national variants, in addition to which states also applied 'Additional National Design Requirements' (ANDRs). Furthermore, other requirements, some of a more operational kind, were applied, dubbed by industry as 'hidden national variants'. All these differences were

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[46] JAR-26: Additional Airworthiness Requirements for Operations.

[47] This is exceptional. Normally, five years is the maximum allowed between application for the type certificate and its issue. This is because at the start of the process, the basis for certification is established using the airworthiness codes valid at that time. Changes in the code cannot be adopted while the certification process is underway, and so if the process were to take longer than five years, the version of the code on which the certificate is finally issued would have become unacceptably outdated.

[48] Weber, L. (2001). Type certification of commercial aircraft calls for enhanced international rules. *ICAO Bulletin , 56* (2).

gradually removed, and by the time EASA became active in 2003 there was a genuine single set of airworthiness codes, without national variations or hidden extras, which was universally applied by a single authority, namely the EASA.

The process of code harmonization was repeated between Europe, the USA and Canada. Most of the differences in design requirements have now been harmonized, leaving a limited number of remaining, well-identified differences[49]. Some of these differences, as far as they affect transfers, are discussed in Appendix 7. By virtue of this harmonization, certification programmes of new aircraft types now run concurrently in the USA, Canada and Europe[50]. These joint certification programmes greatly facilitate the import and export of these types between states.

These harmonization efforts have not been applied retroactively. This means that older aircraft types do not benefit from harmonization. This is the downside of the concept of establishing a fixed-for-life certification basis: once established, it will neither change when the design requirements get stricter, nor when they are relaxed.

Airworthiness codes continue to be updated. Recent and expected significant impact changes include ignition prevention and fuel tank inerting devices and automatic ice detection and alerting systems.

1.2 Other design approvals

In addition to design approval for the aircraft type, other forms of design approval exist, such as:

- supplemental type certificates for major changes not designed by the type certificate holder;
- design approval authorizations issued to either individuals (such as Designated Engineering Representatives, (***DER***), in the United States) or organizations (Design Organisation Approval holder, in Europe), allowing the holder to approve minor design changes and repairs to aircraft;
- Technical Standard Order authorizations for certain components, authorizing the holder to approve the design and changes to it; and
- Part Manufacturing Approval (***PMA***) for parts, authorizing the holder to approve the design and changes to it. PMA is a US term without a European equivalent, although the essence of it is covered in EASA regulations.

Of particular relevance to this study are approvals of aircraft modifications and repairs by other states. In the course of their service life, aircraft are modified for a variety of reasons. Some modifications are done for product improvement, others have a regulatory motivation. Sometimes modifications consist of removing earlier modifications. Often, such modifications are carried out when aircraft are being transferred, to meet the demands of the new operator or the new regulatory environment.

Each modification, including a removal, may only be carried out in accordance with an approved design. When such designs are made by the OEM, they are typically approved under the conditions of the type certificate. However, modifications may also be designed in isolation, that is under a Supplemental Type Certificate (***STC***) or

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[49] The FAA publishes those differences between FAR-25 and CS-25 where FAR is more stringent:, such as www.faa.gov/aircraft/air_cert/design_approvals/transport/transport_intl/media/CS25A3SSD122.PDF No reciprocal list is known to be published by EASA.

[50] The Boeing 717 was the first aircraft type subject to this process of concurrent cooperative certification, completed in September 1999.

otherwise by a separate design organization or DER. Such designs are then approved by the state of the STC holder, a DER or the holder of the design organization approval.

Installation of such modifications on aircraft registered in the same state is then allowed, and most of the world's states will also accept them without further certification. However, some major jurisdictions, including the USA and, since the advent of EASA, the EU, require that each design that is new to that state be formally validated. The US and the EU have concluded an agreement covering the reciprocal acceptance of each other's approved designs. This agreement, however, has a number of limitations, which are explored further in Appendix 7.

2 Individual certification

The second level of certification is the Certificate of Airworthiness, for individual aircraft, and the Statement of Conformity and Authorised Release Certificate, for components.

2.1 Certificate of Airworthiness

A Certificate of Airworthiness (***CoA***) is issued for each individual aircraft to prove that it conforms to the specification of the type certificate and that it is in a suitable condition for safe operation.

CoAs are issued by the State of Registry, so registration must precede the issue of a CoA[51]. Furthermore, each time an aircraft is transferred to another register, a new CoA needs to be issued.

For new aircraft, the CoA will be issued to the manufacturer, that is, the production organization approval holder. In case the aircraft is to be exported immediately, an export CoA may be issued by the state of manufacture rather than a standard CoA; for more details on this, see section 2.3.

ICAO has not prescribed a validity period for the CoA, but does require that continuing airworthiness be ensured either by periodical inspections at appropriate intervals or by a system of inspection[52]. Some states require renewal at set intervals, typically one year. Other states issue a CoA for unlimited duration. The latter applies to EASA states on the condition that a detailed airworthiness review is conducted every three years, with smaller-scale reviews annually, and provided that the aircraft remains within the control of the organization conducting the review.

As stated above, when aircraft are transferred from one state to another, a new CoA is required. ICAO prescribes that the previous CoA may be considered as satisfactory evidence that the aircraft complies with the applicable ICAO standards[53]. In practice however, many states do not blindly accept a CoA issued by another state, but require further proof that the aircraft is airworthy and conforms to the new state's airworthiness codes, to the extent that they differ from those of the old state. Additional requirements that are imposed by the new state include:

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[51] Although registration itself does not involve any act of proving airworthiness, it does involve certain technical tasks on the aircraft, such as changing the 'crash plate' and changing codes for ELT, the Mode S transponder and selcal, amongst others.
[52] ICAO Annex 8, 3.2.3.
[53] ICAO Annex 8, 3.2.4.

- provision of supplementary information[54] by the applicant;
- inspection of the aircraft;
- inspection of maintenance records;
- a maintenance check;
- a variation in the maintenance programme; and
- test flights.

Appendix 7 describes the application of such measures by various states.

2.2 Authorised Release Certificate and Statement of Conformity

Just as for the aircraft as a whole, each component needs documented proof that it has been manufactured according to an approved design, and has subsequently been properly maintained. This is shown by a Certificate, or Statement, of Conformity (available for new products only) or an Authorized Release Certificate (available for both new and used products). ICAO does not prescribe any specific format for such documentation. Traditionally, different formats were in use, but recently this has been harmonized between the major manufacturing states. The EASA Form 1, the FAA 8130-3 tag, the Canadian Form 1 (replacing the TCCA 24-0078) and the Brazilian SEGVOO 003 form now have identical formats.

The retention period for these documents varies. For those components that are life-limited or subject to a mandatory overhaul life, the total time in service and the time in service since last overhaul, respectively, need to be recorded. Varying interpretations exist as to what parameters need to be recorded for total time in service or since last overhaul: see Appendix 7.

2.3 Export Approvals

The export Certificate of Airworthiness is a document commonly used between states, but without formal basis in ICAO standards or recommended practices[55]. It is generally used for two distinct purposes:

- the delivery of new aircraft to states other than the state of manufacture; and
- the transfer of used aircraft.

In the case of newly manufactured aircraft, the export CoA is a document issued by the state of manufacture that certifies that the aircraft meets the airworthiness requirements of the state of import. As explained in section (1.1), the airworthiness requirements may differ from state to state as each state expands differently on the minimum ICAO standards. In order for a national aviation authority to certify that an aircraft meets the requirements of another state, it must be cognizant of that state's requirements or, at least, the differences from those of the state of manufacture. This requires the exchange of information between states, which most aircraft manufacturing states have now established, such as in the form of Bilateral Aviation Safety Agreements (BASA).

The transfer of used aircraft often takes place between states without any form of agreement for exchanging information. In most cases, the importing state requests an export CoA from the state of export. The aircraft then undergoes an assessment as it would for the issue of a standard CoA. This 'recertification' is necessary

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[54] An extensive list of such information is contained in European Union - Special Requirements as listed on the FAA website (http://www.faa.gov/aircraft/air_cert/international/export_aw_proc/sp_req_import/media/EU.pdf)

[55] Although extensively covered in the ICAO Airworthiness Manual (ICAO, 2001).

because standard CoAs can have unlimited validity, so the condition of the aircraft may have deteriorated since the last CoA was issued. The export CoA therefore serves as proof that the aircraft was recently found to be meeting all of the requirements for continuing airworthiness. A condition for issuing an export CoA is typically a detailed inspection of the aircraft and its technical records by, or on behalf of, the state of export within 30 to 60 days prior to the date of transfer. The USA, until recently, required an 'annual type of inspection' for this, but dropped that requirement in April 2010.

Codification of the export CoA varies. The USA, and states that have adopted the US aviation safety regulatory system, have regulated it. It is not regulated by the EU and EASA. Some EU members have local regulations for it, others do not. EASA recommends its member states accept either an export CoA or a recent CoA.

Similar to complete aircraft, the concept of export approvals is also used by some states for components.

3 Operational Certification

The third layer of certification is that for enabling commercial air transport. This applies to air operators only. It results in an Air Operator Certificate, issued by the State of Operator.

Although such certification is predominantly concerned with matters of crew qualification and flight operations, it includes certain requirements that affect aircraft hardware which are not part of the aircraft design approval[56]. Typically, these demand additional instruments and equipment specific to the circumstances under which the flight is operated, such as oxygen for passengers when flying above 10,000 ft and water survival equipment when flying over stretches of water. The requirement for crash resistant recorders is also imposed by operational regulations only.

The two major jurisdictions of the US and the EU have added items to these lists, with differences between them in a number of areas[57].

Differences from this list that AWG members identified as dissimilar requirements are detailed further in Appendix 7.

Operational certification is also used by some states to apply changes in airworthiness codes to aircraft that received type certification before the changes came into effect[58].

4 Airspace compatibility

Operational certification includes certain airspace-related requirements. These differ from the items listed above in that they are not related to the *kind* of operation, but the *area* of operation. To improve the efficient and safe use of airspace, advanced systems have been introduced to ensure reliable navigation and communication.

[56] These are set out in ICAO Annex 6, Part I, chapters 6 and 7 and, for security provisions, chapter 13.

[57] These include: crash investigation recorders, video cameras for the cockpit door area, fixed Emergency Locator Transmitters. low level windshear detection systems and dual HF communication equipment.

[58] Examples include Type III exit access, Class D cargo compartments, 16 g seats, thermal/acoustic insulation material, fuel tank inerting systems, automatic ice detection system and, in Europe, TCAS 7.1.

These requirements vary between airspace regions, and so procedures for verifying that airborne equipment is compatible with ground-based devices also vary.

Acceptance, or certification, of such equipment is normally not performed by the airspace operator, but by the state of the operator[59]. However, different approaches are being followed in the EU[60] and the US[61]. Examples of airspace requirements that are unique to certain regions include:

- VHF 8.33 spacing: the ability for very-high-frequency airborne radio equipment to transmit and receive at reduced frequency channel spacing;
- FM immunity: airborne navigation and communication equipment to be free from interference;
- ELS/EHS: airborne equipment to improve the automatic detection, identification and altitude reporting of aircraft by air traffic control organisations; and
- Datalink: communication between aircraft and air traffic control organizations by electronic data as opposed to voice-over-radio.

[59] Approval is given using the Operations Specification, as required by ICAO Annex 6.
[60] SESAR, including a data link requirement and ADS-B.
[61] NextGen, relying on ADS-B.

Appendix 4 – ICAO Universal Safety Oversight Audit Programme ('USOAP')

1. Sample of ICAO USOAP status chart and scores

Level of Implementation of the Critical Elements of a Safety Oversight System										
Critical Element	1 = Not Implemented									
	10 = Fully Implemented									
	■ = States' Level of Implementation									
	▣ = Global Average									
	1	2	3	4	5	6	7	8	9	10
Primary Aviation Legislation	☐	☐	☐	☐	☐	☐	▣	☐	☐	■
Specific Operating Regulations	☐	☐	☐	☐	☐	▣	☐	☐	☐	■
State Civil Aviation System and Safety Oversight Function	☐	☐	☐	☐	☐	▣	☐	☐	■	☐
Technical Personnel Qualification and Training	☐	☐	☐	▣	☐	☐	☐	☐	☐	■
Technical Guidance, Tools and the Provision of Safety-Critical Information	☐	☐	☐	☐	☐	▣	☐	☐	■	☐
Licensing, Certification, Authorization and Approval Obligations	☐	☐	☐	☐	☐	☐	▣	☐	☐	■
Surveillance Obligations	☐	☐	☐	☐	☐	▣	☐	☐	■	☐
Resolution of Safety Concerns	☐	☐	☐	☐	▣	☐	☐	☐	■	☐

2. Scores of 50 major aviation states

	State Civil Aviation System and Safety Oversight Function	Technical Personnel Qualification and Training	Technical Guidance, Tools and the Provision of Safety-Critical Information	Licensing, Certification, Authorization and Approval Obligations	Surveillance Obligations	Resolution of Safety Concerns
World average	**6**	**4**	**6**	**7**	**6**	**5**
Argentina	8	5	8	8	7	7
Australia	9	5	9	9	9	9
Austria	9	5	8	9	8	7
Belgium	6	3	7	9	7	7
Bermuda	7	6	7	7	7	7
Brazil	9	8	9	8	7	8
Canada	10	9	9	9	10	9
Chile	8	6	9	9	8	8
China	9	9	8	9	8	8
Colombia	5	3	7	8	7	5
Denmark	9	6	9	9	8	8
Egypt	9	9	9	9	8	9
France	9	9	10	10	10	9
Finland	In progress					
Germany	8	9	7	9	8	9
Greece	5	3	7	9	8	8
Hong Kong	9	8	10	10	9	10
Korea	10	10	10	10	10	10
India	4	2	6	9	7	5
Indonesia	8	6	9	9	9	7
Iran	In progress					
Ireland	In progress					
Israel	6	3	7	6	6	6
Italy	6	4	8	8	6	8

Notes
1 Inclusion of states is based on ICAO 2005 data on scheduled services' total tonne kilometres performed.
2. Netherlands and United Kingdom overseas territories are excluded from scores. Bermuda is included separately because of the high number of air transport aircraft registered there.

	State Civil Aviation System and Safety Oversight Function	Technical Personnel Qualification and Training	Technical Guidance, Tools and the Provision of Safety-Critical Information	Licensing, Certification, Authorization and Approval Obligations	Surveillance Obligations	Resolution of Safety Concerns
Japan	In progress					
Kuwait	7	8	7	9	8	9
Luxembourg	3	2	5	7	5	5
Malaysia	7	7	7	9	9	8
Mexico	6	2	8	8	7	8
Netherlands	9	7	9	9	10	9
New Zealand	8	8	8	9	9	9
Norway	8	6	9	9	8	8
Pakistan	In progress					
Philippines	In progress					
Portugal	8	4	8	8	7	7
Qatar	In progress					
Romania	7	7	8	8	8	7
Russia	7	5	9	9	9	7
Saudi Arabia	In progress					
Singapore	In progress					
South Africa	9	8	9	9	8	8
Sri Lanka	In progress					
Spain	In progress					
Sweden	7	6	9	9	8	8
Switzerland	In progress					
Thailand	8	8	8	9	8	8
Turkey	7	4	8	10	8	8
UAE	6	6	9	9	7	7
UK	10	10	9	10	10	9
USA	9	9	9	10	9	10
Viet Nam	4	1	4	6	3	4

Appendix 5 – First questionnaire (sample)

Questionnaire on Economic Impact Assessment relating to Technical Requirements Impacting the International Transfer of Aircraft

23 February 2010 (version 1.1)

Introduction
This questionnaire is part of a study conducted by SGI Aviation for the Aviation Working Group (AWG) on the inefficiencies of international aircraft transfers such as: Lack of harmonization among National Aviation Authority requirements;

- Restrictive national rules;
- Lack of easily accessible information.

The study will include recommendations for use by the AWG to counteract the inefficiencies and thus improve the international transferability of aviation assets, without compromising aviation safety or the responsibilities of the National Aviation Authorities.

Version 1.1 note: Following an analysis of first responses, two tables have been amended by adding a column *Attributable to regulatory differences/inconsistencies?*

Guidance for completion of the questionnaire
Please provide as much information as possible and attach relevant data / documents if necessary. Completion boxes are free format style and can be expanded at wish. **Please respond to the person listed under contact**. All information will be treated in confidence and will be de-identified for inclusion in the final report.

Definitions

Aircraft:	used commercial air transport jet aircraft
Duration:	period of time required for a transfer, as defined below.
Scope:	international transfers of aircraft in scope period
Scope period:	2005 – 2009.
State of Origin:	State of Registry and/or operator before transfer
State of Destination:	State of Registry and/or operator after transfer
Transfer:	set of activities to bring an aircraft from State of Origin to State of Destination.

These exclude:

- modifications required by the new lessee;
- overhaul and storage.

These include:

- modifications required by the State of Destination;
- downtime due to airworthiness inspections, etc.;
- certification issues related to lessee requested modifications

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Q1 – DURATION

Note: This section is aimed at determining the number of transfers, the normal duration (i.e. when conditions are optimal) of such transfers and, particularly, the exceptions and the reasons for those.

How many transfers of aircraft in your portfolio meeting the scope took place each year?

2005: 2006: 2007: 2008: 2009:

What do you consider as a normal duration for a transfer?

What are the elements that constitute a normal transfer?

For transfers of extended duration, please complete the following table:

Aircraft type	Duration	State of origin	State of destination	Reason for extended duration (see note)	*Attributable to regulatory differences/ inconsistencies?*

Note: reasons for extended duration
There are multiple reasons for extended duration. It is the aim of this questionnaire to identify these as much as possible, so that specific recommendations can be drafted. We expect that the majority of these reasons lie with the state of destination. However, there may be reasons associated with the state of origin.
Possible reasons include, but are certainly not limited to:

- *Lack of easily accessible information on requirements;*
- *Lack of clarity on applicability of requirements;*
- *Lack of comprehensiveness of requirements (e.g. import requirements for obtaining CoA may not cover other requirements, such as operational, airspace, or other);*
- *Lack of oversight (in state of origin);*
- *Issues of interpretation of regulations;*
- *Administrative requirements, such as extended application processes; fees that must be paid in advance;*
- *Duplication of efforts, such as multiple inspections;*
- *Downtime to implement state of Destination requirements*
- *Compliance burden;*
- *Incomplete records;*
- *Customs requirements.*

In your experience, which states are more ‘demanding’ than others?

Where possible, please provide detailed information on the more exceptional transfers

Q2 – COSTS

Note: This section is aimed at determining the costs of transfers and particularly those that were excessive. The costs may be expressed in various forms, such as euros or dollars, as percentage of the aircraft value, storage days, man days, etc.

In a perfect world, with full efficiency by all stakeholders, what would be the baseline cost for a transfer? If this varies by aircraft type, please answer this question for a range of aircraft types.

What additional costs or inefficiencies are typically incurred and for what reason?

Costs or inefficiency	Reason (see note)	*Attributable to regulatory differences/ inconsistencies?*

Note: reasons for costs
There are multiple reasons for costs. It is the aim of this questionnaire to identify these as much as possible, so that specific recommendations can be drafted.
Possible reasons include, but are certainly not limited to:

- *Modifications mandatory for the specific transfer;*
- *Overhauls mandatory for the specific transfer;*
- *Certification efforts ;*
- *Loss of revenue;*
- *Inspector days;*
- *Record retrieval;*
- *Transfer management;*
- *Inefficiencies due to lease structure (e.g. export credit restrictions).*

Q3 - NON-TRANSFERS

The costs and efforts of international transfers of aircraft may be such that you have decided not to start such a process at all.

Please indicate for approximately how many aircraft in your portfolio this applies and specify aircraft types, reasons and states of origin and destination.

Q4 - STUDIES

In addition to the foundation paper by AWG dated 4 July 2008, do you have available or are you aware of other studies on the current subject? If so, please provide copy or details.

Q5 - FUTURE TRENDS

Please indicate what trends you observe that aggravate or ameliorate the issue of international transfers of aircraft.

Q6 - RECOMMENDATIONS

Please provide your ideas or recommendations for solutions to reduce the inefficiencies, added with estimates of the savings in duration and/or costs.

Appendix 6 – Second questionnaire (sample)

***SECOND* questionnaire on** Economic Impact Assessment relating to Technical Requirements Impacting the International Transfer of Aircraft (a study conducted by SGI Aviation for the Aviation Working Group) 1 April 2010 (version 2.0)

Purpose
To generate relevant information and data: on items which, in the course of the development of the study prove to be of vital importance; and on items for which insufficient data has been received so far.

Background
The first questionnaire generated much information with respect to the kinds of inefficiencies in international aircraft transfers. This information prompted the factor model and the economic model. Both were presented in the interim AWG consultation on 25 March. Prime input elements of the two models include:
Frequency of the inefficiencies
Jurisdictions associated with these inefficiencies
Typical and extreme durations/downtime
Typical and extreme costs

The interim consultation concluded that most inefficiencies have now been identified, as well as the major jurisdictions where these typically occur. However, data is still lacking for the frequency, durations and costs. This second questionnaire is designed to specifically collect that data (see Part 1). At the same time, this second questionnaire aims to collect data on the baseline, optimum transfer (see Part 2). Although accurate data obviously is preferred, it is acknowledged that this may be difficult to retrieve. In the interest of this study however, estimated data is sufficient where accurate data is not available.

Any other relevant information you wish to provide is very much welcome. Parts 3, 4 and 5 provide space for that.

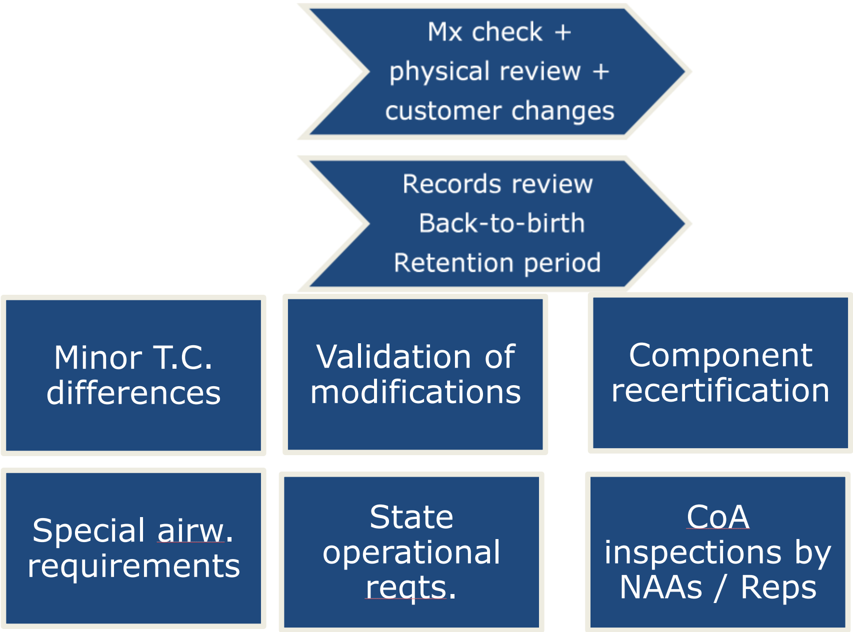
PART 1 – INEFFICIENCIES, THEIR FREQUENCY, DURATIONS AND COSTS

Please complete below table as much as possible.

In order to get an indication on the frequencies and associated durations and costs three rough categories of cases are introduced in it:
A: optimum - no duration or costs due to regulatory issues
B: typical – 'average' cases of inefficiencies.
C: extreme cases of inefficiencies

The total of A+B+C for each (sub) inefficiency should be 100%. Again, in the absence of accurate data, give estimates, even if they are rough.

The inefficiencies are graphically presented below. This is based on sheet 22 of the March 25 presentation, with the following items removed: 'non-transfers'; poor oversight, customs.



	A – optimal	B - Typical cases of inefficiencies			C -Extreme cases of inefficiencies		
INEFFICIENCY	**Frequency**	**Frequency** (in percentage of total transfers) (Please add jurisdictions as appropriate)	**Duration/ downtime** (in days)	**Costs** (other than downtime) (in USD or EUR)	**Frequency of inefficiency** (in percentages of total transfers) (Please add jurisdictions as appropriate)	**Duration/ Downtime** (in days)	**Costs** (other than downtime) (in USD or EUR)
Maint. Checks							
Maintenance check required by authority for export							
Maintenance check required by authority for import							
Records review							
Ambiguous regulatory back-to-birth requirements							
Longer record retention periods							
Recertification of components as result of inadequate records (driven by ambiguous requirements)							

	A – optimal	**B - Typical cases of inefficiencies**			**C -Extreme cases of inefficiencies**		
INEFFICIENCY	**Frequency**	**Frequency** (in percentage of total transfers) (Please add jurisdictions as appropriate)	**Duration/ downtime** (in days)	**Costs** (other than downtime) (in USD or EUR)	**Frequency of inefficiency** (in percentages of total transfers) (Please add jurisdictions as appropriate)	**Duration/ Downtime** (in days)	**Costs** (other than downtime) (in USD or EUR)
Minor T.C. differences							
Type III exits							
Ozone converter							
60 min. battery power							
Local language placards							
Metric altimeters							
Other (please specify)							
Validation of modifications							
Delays and/or costs due to validation of modifications (of which there is proof of certification by state of design)							
Component recertification							
Recertification of off-wing engines							
Recertification due to non-acceptance of existing release certificates							

	A – optimal	B - Typical cases of inefficiencies			C -Extreme cases of inefficiencies		
INEFFICIENCY	**Frequency**	**Frequency** (in percentage of total transfers) (Please add jurisdictions as appropriate)	**Duration/ downtime** (in days)	**Costs** (other than downtime) (in USD or EUR)	**Frequency of inefficiency** (in percentages of total transfers) (Please add jurisdictions as appropriate)	**Duration/ Downtime** (in days)	**Costs** (other than downtime) (in USD or EUR)
Special airworthiness req'ts							
Cabin safety additional or diverting req'ts							
Fuel venting and exhaust req'ts							
Maint. Programme additional or diverting req'ts.							
Other (please specify)							
CoA inspections							
Difference in interpretations of existing regulations							
Delays, directly caused by authorities without relation to compliance with regulations							
Authority driven test flights							

	A – optimal	**B - Typical cases of inefficiencies**			**C -Extreme cases of inefficiencies**		
INEFFICIENCY	**Frequency**	**Frequency** (in percentage of total transfers) (Please add jurisdictions as appropriate)	**Duration/ downtime** (in days)	**Costs** (other than downtime) (in USD or EUR)	**Frequency of inefficiency** (in percentages of total transfers) (Please add jurisdictions as appropriate)	**Duration/ Downtime** (in days)	**Costs** (other than downtime) (in USD or EUR)
State operational req'ts							
DFDR							
CVR							
Fixed ELT							
FM immunity							
ELS / EHS							
VHF 8.33 spacing							
Datalink							
Cargo fire suppression							
Video camera							
Other (please specify)							

PART 2 – OPTIMUM SITUATION

The optimum transfer situation is graphically represented as follows:

This situation serves as the baseline for the transfer model and hence cost model. To quantify it, please provide optimum data for:

- **DURATION: ....**
- **COSTS: ....**

Note: costs would typically consist of fees for certificates and possibly a report showing that the registration requirements (second arrow from left) have been met.

PART 3 – CASE STUDIES

Please attach case studies from your own experience, both for difficult transfers and situations leading to non-transfer. The Foundation Paper www.awg.aero/pdf/AWG%20FOUNDATION%20PAPER.pdf provides examples on pages 17 and up.

PART 4 – REGULATORY DEVELOPMENTS

Which future regulatory developments do you foresee which may create new inefficiencies, or strengthen existing ones?

PART 5 – OTHER RELEVANT INFORMATION

Appendix 7 – Dissimilar requirements

1 Duplications

1.1 Validation of modifications and repairs

Many states do not require separate approval of design changes resulting from modifications and repairs, but those that do are among the major and leading states in aviation. This has led to high costs and extended delays without tangible safety benefits.

Two jurisdictions that do require additional approval are the EU and the US. A bilateral agreement exists that automatically accepts in all EU member states minor modifications and all repairs that have been approved by the US[62]. However, for major changes involving non-OEM modifications, the validation process of Supplemental Type Certification can be very time consuming, involving numerous parties: two states, the STC holder or design organization and the party that wants the modification installed.

Where the modification is merely a product improvement, it is possible to carry out the work, deactivate the modification and continue operating the aircraft, pending completion of the validation process. However, for essential safety or regulatory-driven modifications, the aircraft cannot be operated until certification has been completed. Sometimes this can require taking the aircraft out of service for many months.

Conversely, the US only accepts modification and repair approvals from 6 EU states. In 2008 a bilateral safety agreement was finalized between the EU and the US covering reciprocal acceptance of all design approvals. That agreement has yet to be ratified, so that the existing agreements between the US and the 6 individual EU states remain in effect. This means that design approvals for the remaining 21 states are still not accepted.

The process of validation of major changes is a duplication as it merely involves repeating work that has already been carried out by another respected aviation authority, with no added safety value.

1.2 Maintenance checks

A maintenance check consists of a series of maintenance activities for which an aircraft must remain in the hangar for a considerable amount of time.

Such activities include inspections at regular intervals and tests of aircraft systems and components, as prescribed by the maintenance programme. Such checks are commonly referred to by letters, such as A, B, C and D. A and C checks are the most common and typically must be repeated at intervals of 6 weeks for an A check and 12 to 18 months for a C check. As the aircraft is in the hangar for the duration of the checks, this time is also used for repair activities and the installation of modifications. A maintenance check is also seen as a means to ascertain the quality of an aircraft. For that reason, many lessors require a C check as a contractual obligation on the lessee before returning an aircraft.

Some states also use the maintenance C check as a means to ascertain the airworthiness of the aircraft. The completion of this check may be imposed as a condition for issuing an export CoA (the ‘export maintenance check’) or as a condition for issuing a CoA upon import (the ‘import maintenance check’).

[62] See note 32 above.

Aircraft transfers seldom coincide with the C check intervals, which means that extra C checks need to be scheduled to permit export and import, even when the lessor has decided not to require the check from the lessee airline.

AWG members report that they consider the regulatory requirement imposed by some states for either an export or import C check to be a duplication, for the airworthiness of the aircraft is controlled by other means: the C check at the other intervals as dictated by the maintenance programme, regular inspections and other maintenance between C checks.

The USA recently lifted its requirement for the 'annual type of maintenance inspection' as a prerequisite of an export CoA in April 2010.

EASA and the USA do not require a maintenance check upon import, but rather an airworthiness review. In Europe, such a review is carried out by a CAMO, in the USA by Designated Airworthiness Representatives (***DAR***). They typically take two days and result in a recommendation to the state to issue a Certificate of Airworthiness.

1.3 Recertification of components and off-wing engines

Components may not be considered airworthy by states and then need to be recertified. This typically requires overhauling the component, subjecting it to appropriate testing and inspecting. In the case of life-limited components whose history cannot be traced, it may require disposal of the component.

Reasons for not accepting a component as airworthy include the following.

No mutual recognition
Some states insist on recertification of all components that are imported other than on the aircraft itself, even with documents meeting the standards of the major aviation states, such as the EASA Form 1 and the FAA 8130-3 tag.

Life-limited components (LLCs)
These are parts for which the designer has specified a maximum time between overhaul ('service LLC') or a maximum life ('certified LLC'). There is much confusion as to the required retention period of maintenance records for these parts, and the level of recording detail required, such that differing requirements between states can lead to LLCs being deemed non-airworthy on transfer.

Typically, parameters such as hours, calendar time and cycles will be recorded. However, some states impose more stringent requirements, such as noting each individual aircraft on which the component has been installed since manufacture, and the aircrafts' operators – so-called 'back-to-birth traceability'.

Both the FAA and EASA, however, accept records where time in service information alone is kept in recordkeeping systems in a reliable and robust way, without showing all previous installations and overhauls. ICAO agrees with this approach and states that 'when life-limited parts are transferred between operators, a written statement by the previous operator, attesting to the current status of life-limited parts, is an acceptable method of indicating prior service of the part(s).'[63] It continues by stating that where records are lost or destroyed, the level of safety may be determined by considering other records available, such as technical records, utilization reports and the manufacturer's information[64]. This indicates that before requiring recertification, there should be other options to explore first.

[63] ICAO Airworthiness Manual, Volume II, Attachment A to Chapter 10, section 3.3.1.
[64] Ibid, section 3.3.3.

Maintenance records in another language
Some states do not accept records in another language, and require translation before acceptance.

Longer retention periods
The major manufacturing states have harmonized their regulations for the component certificates. Yet even between those states, differences exist as to the retention period of maintenance records. Some states require 12 months, others 24. The European Commission recently amended its regulations so as to require a 36 month retention period, even though 24 months was the period that was earlier proposed by EASA when consulting the public and subsequently offered to the European Commission in its Opinion[65]. EASA earmarked this change as one of a series of editorial, that is non-substantial, changes. The effect however is that some records which may have been discarded in line with local regulations are required by the next state due to a difference in retention period requirements. When records can no longer be produced, recertification of components may be required.

2. Different safety objectives

2.1 Major differences in type certification
As explained in section 1.1 of Appendix 3, there has been a significant improvement over the years in harmonizing airworthiness codes. Many differences in airworthiness codes of the various states have been removed.

However, for type certification the principle applies of 'once certificated, forever certificated'. This means that the results of harmonization do not apply retroactively. Thus aircraft types that were certificated some decades ago may have type certification bases that differ significantly from state to state. Since these differences often originate from historically differing views on how best to maintain safety standards, significant modifications may be required when transferring individual aircraft of these types. As these aircraft are older, the cost of the modifications required to transfer them may be prohibitive, given the value of the aircraft. However, the number of aircraft types affected is small, and will gradually diminish as these types are retired from service.

2.2 Ozone converters
A requirement for ozone converters was introduced by the US in 1980, both for type certification and air operator certification[66]. Ozone concentrations are higher at altitude and may cause discomfort to passengers and crew on long flights. Converters reduce the ozone concentration by breaking down ozone (O_3) into oxygen (O_2).

The same requirement was only introduced in the European JAR airworthiness code in 2003, and then only for new type certificate applications. Converters are still not an operational requirement for European and many other operators. Consequently, many aircraft of non-US design that were not initially made for US airlines, and therefore did not meet the US type certification requirement, were delivered without these converters. When transferring such aircraft at a later stage into the US, they need to be modified.

2.3 Ice detection systems
A number of accidents involving in-flight icing prompted the FAA in 2009 to introduce for new type certificate applications a requirement for an automatically activating airframe ice

[65] EASA NPA 9/2004, EASA Opinion 06/2005, Commission Regulation (EU) No 127/2010 of 5 February 2010.
[66] FAR 25, Amendment 50, FAR 121, Amendment 154, both later amended.

protection system. In November 2009, the FAA issued a Notice of Proposed Rulemaking (NPRM) to also require this for the existing US fleet. At this stage, there is no European equivalent, thus making this a dissimilar requirement.

2.4 Cargo compartment fire protection

Following a number of accidents involving fires that started in lower deck, inaccessible, cargo compartments, in 1998 the USA introduced a rule prohibiting air operators to have cargo compartments where restricted ventilation was the only means to extinguish fires.

These 'Class D' cargo compartments were required to be converted into another Class by installing fire detection and extinguishing equipment. The requirement applied to both new designs and the existing fleet. Europe only copied this requirement for new designs, but not for the existing fleet, and other states did neither of the two. This means aircraft imported into the USA may need to be converted.

3. Different methods of achieving the same safety objective

3.1 Equipment requirements

3.1.1 Type III exit requirements.

The aim of emergency exits is to facilitate a rapid evacuation of the aircraft. Type III exits are emergency exits of a given size that are common in narrow body aircraft and particularly over the wing.

In 1985 and 1991, accidents occurred in the UK and the USA respectively in which these exits failed to perform correctly, with consequent loss of life. Both states amended the airworthiness codes as well as the operational requirements, however in different ways. The UK imposed additional airworthiness requirements outside the JAA airworthiness code[67]; the USA amended in 1992[68] their type certification standards and air operator requirements. The main difference between the two codes is in the access width to the exit. The US requires an unobstructed width of 20 inches, whereas the UK variant only requires 10 inches. The EASA airworthiness code until August 2010 did not specify a dimension but prescribed the access width in an objective manner, which in practice results in a minimum of about 7 inches. From that date it requires an access width of 13 inches for new type certificate applications. The effect of this is that in a typical narrow body aircraft, up to 5 more passenger seats can be installed in European-registered aircraft than in US-registered aircraft that were type certificated using the amended standards.

3.1.2 Different cabin safety requirements

There is a number of other cabin safety requirements which diverge between the US, Europe and other states. In all cases, the safety objective is the same: prolonged protection of the aircraft, crew and passengers against the effect of a fire inside the pressurized fuselage, and optimum evacuation capability. These include interior fire resistance requirements, thermal/acoustic insulation materials, lavatory fire protection and seat crash resistance. The major differences are not so much in the technical substance of the regulations, but rather in the varying applicability dates. In some cases, interpretations also differ from state to state and, occasionally, from inspector to inspector.

For example, according to some interpretations, a change in the colour of the fabric used for seat belts would require new dynamic load testing to be carried out. The reason for this

[67] CAP 747 Mandatory Requirements for Airworthiness, Section 2, Part 3, GR No. 3.
[68] FAR 25, Amendment 76; FAR 121, Amendment 228.

is not because the safety performance would be different, but because the detailed nature of the requirements demands that each new configuration must be tested. The overall effect is that when transferring an aircraft from one state to another, significant additional testing, and possibly modifications to the interior may be required.

3.1.3 60 minutes' battery power

When an aircraft loses normal electrical power, a back-up system must be available for essential systems and instruments. In many aircraft batteries are used for that purpose. A supply for 30 minutes is prescribed in US airworthiness codes, but EASA standards require a supply of at least 60 minutes. This means that transferring an aircraft into Europe may require the installation of extra batteries.

3.1.4 DFDR and CVR

The purpose of Digital Flight Data Recorders (***DFDRs***) and Cockpit Voice Recorders (***CVRs***) is to assist accident investigators. DFDRs and CVRs are required by operational regulations only; they do not form part of the airworthiness code.

The sets of parameters that must be recorded by the DFDR vary between states. The set prescribed by ICAO in Annex 6 has been adopted in many states, including European states by means of EU-OPS. Conversely, due to a number of accidents in the USA where the cause could not easily be established, DFDR parameter recording requirements there are in excess of those of ICAO.

For CVRs, the US applies different requirements for power supply and recording pick-up points. Also, a requirement for a recording duration of 2 hours (as opposed to 30 minutes) will become applicable to the entire fleet in 2012. In Europe, this requirement was introduced in 1998, but limited to new aircraft.

A possible consequence is that when transferring aircraft between the EU and the USA (or other states that adopt either EU or US regulations), the DFDR or the CVR may need to be changed, and links to associated sensors may need to be installed.

3.1.5 Fixed Emergency Locator Transmitter

The Emergency Locator Transmitter, or ELT, assists in locating a crashed aircraft in remote areas. One type, known as fixed, or automatic, ELTs, activate automatically when crash loads are sensed. A fixed ELT is typically installed near the tail and requires wiring to the cockpit instruments. Installing this wiring on used aircraft is a significant modification.

ICAO requires fixed ELTs for aircraft produced after 1 July 2008. This requirement was adopted in Europe with an earlier implementation date, whereas the US has not adopted it at all. This results in aircraft that did not need a fixed ELT in one state being required to have one when they are transferred into another state.

3.1.6 Monitoring of cockpit area

Following the September 2001 terrorist attacks, ICAO introduced a requirement to enable pilots to monitor the area behind the cockpit door with the door kept closed. The requirement states the objective, rather than prescribing the technical means of its implementation. States have given different interpretations to the requirement, ranging from purely procedural means to requiring a video camera system. Even within the European Union, where the ICAO wording was copied into EU-OPS 1, states have interpreted this requirement differently. This is an example where objectively worded rules have the effect of creating different technical solutions, thus affecting international transfers of aircraft.

3.2 Certificate of Airworthiness process

3.2.1 Different interpretations

In spite of section 3.2.4 of ICAO Annex 8, which allows states to recognize each other's certificates of airworthiness, many states require an inspection of the aircraft before issuing a CoA. The reasons for requiring such inspections include:

- verifying that the aircraft meets the standards of the type certificate;
- checking the maintenance records;
- verifying that the aircraft is undamaged and safe for operation; and
- verifying the installation of operational equipment. Although these formally are not a condition for issuing a CoA, in practice the CoA inspection is combined with checking that the aircraft meets certain operational requirements.

Such a check is carried out either by, or on behalf of, the aviation authority of that state.

AWG members, amongst others, report that state inspectors have very detailed expectations in some technical areas, offering interpretations that go beyond the wording or intent of the statutory regulation. These interpretations not only concern the aircraft itself, but also its records. In order not to risk the Certificate of Airworthiness being delayed or refused, applicants typically give in and have the aircraft 'corrected', sometimes at great cost and with significant downtime. This practice is reportedly also still applied by state inspectors to intra-EU transfers, even though according to EASA regulations, Airworthiness Review Certificates should be accepted on face value. In addition to the maintenance checks described at section 1.2, different interpretations by state inspectors cause the issuing of a new CoA to have a significant economic impact.

When the inspection is not done by a state inspector, there are typically two scenarios: the previous state of registry performs the inspection and certifies that the aircraft is airworthy by issuing an export CoA or renewing the domestic CoA, or a third party performs the inspection. US and EU regulations allow inspections to be delegated to designated airworthiness representatives or airworthiness staff working for a CAMO respectively.

Because there is a choice, there are fewer logistical issues and there is also more room to confirm matters of interpretation.

3.2.2 Delays by authorities

When the inspection is performed by a state, it is subject to planning and availability restrictions of state inspectors. The resources of some states are limited, causing significant delays and downtime losses. Added to that is the time required for inspectors to travel. Some states insist that the inspection is carried out before the aircraft reaches the new state. Other states require that the aircraft is first brought to that state, under a temporary permit if necessary, to be inspected there.

3.2.3 Test flights by authorities

The ICAO Airworthiness Manual suggests that a test flight be performed as part of the CoA application process to prove satisfactory functioning of the avionics[69], for the issue of a CoA on the import of a used aircraft[70] and on renewal of a CoA[71]. A number of states indeed require such test flights.

[69] Volume 1, Section 5.2.2.2.j.
[70] Volume 1, Section 5.2.5.
[71] Ibid.

The technology of modern aircraft is such that many tests that once had to be performed during flight can be performed on the ground. Furthermore, some tests require that the aircraft be brought to operational limits, creating hazards of its own. For this reason, some states have limited test flights to the absolute minimum. EASA and the US FAA have not adopted the ICAO Airworthiness Manual guidelines in their sets of rules.

3.2.4 Maintenance programme

It is the responsibility of the operator to compile a maintenance programme for the aircraft it operates. Such a programme is based on data supplied by the type certificate holder, amended by the operator to suit its own operations and based on its own service experience. Thus maintenance programmes for the same aircraft type differ between operators.

As a result, when transferring an aircraft, a different maintenance programme may apply. Normally, a bridging programme is established to gradually align the maintenance programme with that of the new operator. However, some states apply strict requirements that the new operator must meet upon introduction of the aircraft into its fleet, leading to significant costs or downtime.

3.2.5 Age limit upon import

Following an accident to a high cycle Boeing 737 in the USA in 1988, in which a section of the upper fuselage structure was lost in flight, the type certificate holder and the state of design implemented a series of measures to prevent the recurrence of a similar accident. These modifications to ageing aircraft have since been extended to other aircraft types and have successfully been in force for more than 20 years.

Recently, a number of states have introduced regulations prohibiting the import of aircraft older than a specified age limit, expressed in years. They apply on import only. The regulations are not always easy to locate and the reasoning is difficult to determine. In the regulation of one state which does give its reasoning, the 1988 accident mentioned above is cited, but without acknowledging the measures introduced since then.

The states that have introduced age limits are predominantly in Asia (from the Mediterranean area to the Southeast) and Africa. The fact that the limits only apply on import and not otherwise suggests that the reason for this dissimilar requirement may be more political than technical.

4. Non-safety instigated

4.1.1 Metric altimeters

The majority of the world's states use units of feet for expressing altitudes. The CIS states, China and Mongolia, however, use units of metres. This requires different cockpit instruments. Modern aircraft have avionics that allow the altitude unit presentation to be switched easily. However, older aircraft have single unit instruments which need to be changed when the aircraft is transferred from a state using feet into a metric state or vice versa.

4.1.2 FM immunity

In European airspace, FM immunity performance standards apply.

4.1.3 ELS/EHS

In European airspace, Mode S Elementary Surveillance (ELS) and Mode S Enhanced Surveillance (EHS) requirements apply to improve the quality, detection, identification and altitude reporting of aircraft. Different technical standards and areas of applicability apply for ELS and EHS respectively.

4.1.4 VHF 8.33 spacing

To accommodate the high traffic volume in European airspace, and associated radio communication, airborne radio equipment must be able to operate at reduced frequency channel spacing as compared to other regions in the world. The minimum required channel spacing is 8.33 kHz.

4.1.5 Datalink

From 2011 for new aircraft, and 2015 for existing fleets, aircraft operating in European airspace must be capable of operating data link services. These services enable exchange of flight data with ground stations.

4.1.6 Local language exit signs

Airworthiness codes prescribe that exits in the passenger cabin be identified by signs. In English-speaking states the word 'EXIT' is used. Many other states require that these words are translated into their national language. They do this either as a type certification requirement or an additional requirement for issuing a Certificate of Airworthiness. This dissimilar requirement is quite common, as there are about as many main languages as there are states. A typical passenger aircraft can have up to 30 exit signs, which are all affected.

A solution is the application of symbolic signs rather than worded signs. EASA recently changed their airworthiness codes[72] to specifically allow this. That change was based on a 1995 study[73] which indicated that such symbols are comprehended by airline passengers from all regions of the world. The FAA introduced a policy to the same effect[74], except that it is contingent upon operational conditions such as pointing these signs out to passengers before each flight and before each landing and explaining the signs on the passenger safety card.

[72] CS-25, Amendment 3, September 2007.
[73] Moerly, F. J. (1996). *An evaluation of the comprehensibility of graphical exit signs for passenger aircraft.* Department of Applied Psychology, College of Aeronautics, Cranfield University.
[74] FAA Memorandum PS07-0585-CS-10, dated June 30, 2010.