Unrestricted

Warranty Management Essentials

2nd Edition – October 2026

This page is intentionally left blank

Table of Contents

DISCLAIMER **6**
1. Introduction **7**
1.1. Objective of This Paper 7
1.2. Structure and Organization 7
1.3. Revision and Enhancement 8
2. Warranty Concepts **9**
2.1. Warranty 9
2.1.1 Terminology 9
2.1.2 Warranty In the Aircraft's Lifecycle 11
2.2. Guarantee 17
2.3. Practical Differences between Warranty and Guarantee 17
2.4. Goodwill 18
3. Warranty Management – Organization Models Within an Airline **19**
3.1. In-House vs. Outsourced 19
3.1.1 In-House Warranty Management 19
3.1.2 Outsourced Warranty Management 20
3.2. Warranty Management – An Interface 21
3.2.1 Contracting 22
3.2.2 Engineering & Maintenance 22
3.2.3 Material Department 22
3.2.4 Warranty-Related Groups and Events 22
3.3. Industry Standards – Other References 23
4. Claims **24**
4.1. Contractual Basis 24
4.2. Claimable Items 24
4.2.1 Parts/Components 24
4.2.2 Service Bulletins 25
4.2.3 No Fault Found 25
4.2.4 Access, Inspection, Removal, Installation 25
4.3. Accounting Principles 25
4.4. New Aircraft Delivery and Commitment Letters 26
5. Mitigations **28**
6. How To Measure Success **30**
6.1. Defining Key Performance Indicators 30
6.2. Setting Objectives And Targets 30
7. How To Use the MIS for Warranty Management **32**
7.1. Definition Stage 32
7.1.1 Aircraft Level 32

7.1.2 Vendor Level 32
7.1.3 Part Number Level 32
7.2. Tracking Stage 33
7.3. Handling Stage 33
7.4. Warranty Reporting 34
8. Roles And Responsibilities 35
8.1. Warranty Process 35
8.2. Warranty Responsibility 35
9. New Aircraft Warranty and Use Cases 37
9.1. Use Case 1: Component Repair TAT Guarantee 38
9.2. Use Case 2: Engine Performance Guarantee 38
9.3. Use Case 3: Component Flight Hour Warranty Reduction for New Aircraft Warranty 39
10. Practical Implementation Framework for Warranty Management 41
10.1. Step 1 – Contractual Baseline and Warranty Opportunity Mapping 42
10.2. Step 2 – Critical Event and Performance Recovery Assessment 43
10.3. Step 3 – Evidence Standardization and Claim Infrastructure 44
10.4. Step 4 – Warranty Data Visibility, Portal and KPI Monitoring 45
10.4.1 Warranty Visibility Repository 45
10.4.2 KPI-Based Performance Management 46
10.4.3 Use of Dashboards and Business Intelligence Tools 51
10.4.4 Management Use of Warranty KPIs 52
10.4.5 Expected Benefits 52
10.5. Step 5 – Cross-Functional Training and Warranty Culture 54
10.6. Step 6 – Data-Driven Claim Prioritization and Decision Support 54
10.6.1 Building the Claim Inventory 55
10.6.2 Select Prioritization Criteria 57
10.6.3 Define the Weight of Each Criterion 57
10.6.4 Create a Scoring Scale 58
10.6.5 Score Each Claim 59
10.6.6 Calculate the Weighted Score 59
10.6.7 Define the Action Plan 60
10.6.8 Review and Update the Ranking 60
10.6.9 Use the Results for Management Decisions 61
10.7. Step 7 – Contract Intelligence 62
10.7.1 Contract Knowledge Database 63
10.7.2 Automated Contract Interpretation 64
10.7.3 Operational Event Matching 65
10.7.4 AI-Assisted Claim Preparation 65
10.7.5 Contract Risk and Opportunity Dashboard 66

10.7.6 Governance, Confidentiality and Human Review 66
10.8. Key Principles for Successful Execution of the Warranty Management Framework 68
11. Acronyms 69
12. Contributors 72

DISCLAIMER

The content, data and information (the "Content") contained in this publication ("Publication"), is provided for information purposes only and is made available to you on an "AS IS" and "AS AVAILABLE" basis.

IATA has used reasonable efforts to ensure the Content of this Publication is accurate and reliable. We, however, do not warrant, validate, or express any opinions whatsoever as to the accuracy, genuineness, origin, tracing, suitability, availability or reliability of the sources, completeness, or timeliness of such Content. IATA makes no representations, warranties, or other assurances, express or implied, about the accuracy, sufficiency, relevance, and validity of the Content. IATA's observations are made on a best efforts and non-binding basis, and shall not be deemed to replace, interpret, or amend, in whole or in part, your own assessment and evaluation or independent expert advice. This Publication sets out general guidance for informational purposes only and is not intended to be exhaustive, prescriptive or tailored to any particular circumstances. It should not be relied upon as a substitute for independent judgment or professional advice.

IATA has no obligation or responsibility for updating information previously furnished or for assuring that the most up-to date Content is furnished. IATA reserves the right to remove, add or change any Content at any time. Links to third-party websites or information directories are offered as a courtesy. IATA expresses no opinion on the content of the websites of third parties and does not accept any responsibility for third-party information. Opinions expressed in advertisements appearing in this publication are the advertiser's opinions and do not necessarily reflect those of IATA. The mention of specific companies or products in advertisements does not imply that they are endorsed or recommended by IATA in preference to others of a similar nature which are not mentioned or advertised.

This Publication is not intended to serve as the sole and exclusive basis for assessment and decision making and is only one of many means of information gathering at your disposal. You are informed to make your own determination and make your own inquiries as you may deem necessary and suitable. You shall independently and without solely relying on the information reported in this Publication, perform your own analysis and evaluation regarding the nature and level of information you may require, based upon such information, analyses, and expert advice as you may deem appropriate and sufficient, and make your own determination and decisions pertaining to the subject matter under consideration.

This Publication is the property of IATA and is protected under copyright. This Publication and its Content are made available to you by permission by IATA, and may not be copied, published, shared, disassembled, reassembled, used in whole or in part, or quoted without the prior written consent of IATA. You shall not without the prior written permission of IATA: re-sell or otherwise commercialize, make mass, automated or systematic extractions from, or otherwise transfer to any other person or organization, any part of this Publication and its Content in whole or in part; store any part of this Publication, or any Content, in such a manner that enables such stored Content to be retrieved, manually, mechanically, electronically or systematically by any subscriber, user or third-party; or include it within, or merge it with, or permit such inclusion in or merge with, another archival or searchable system. You must not use (or allow others to use) IATA Content and this Publication in conjunction with any Artificial Intelligence tools including without limitation, to generate any outputs based on IATA Content and Publication (such as copies, summaries, analyses, predictions, modifications or other derivative works).

TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW, IATA DISCLAIMS ANY REPRESENTATION OR WARRANTY (I) AS TO THE CONDITION, QUALITY, PERFORMANCE, SECURITY, NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THIS PUBLICATION AND CONTENT; OR (II) THAT THE ACCESS TO OR USE OF THIS PUBLICATION (INCLUDING ANY AUTOMATED FEEDS OR OTHER DELIVERY MODES) OR ANY CONTENT SUPPLIED OR CONTRIBUTED TO THIS PUBLICATION BY THIRD PARTIES, WILL BE UNINTERRUPTED, ACCURATE, THE MOST UP TO DATE, COMPLETE OR ERROR-FREE. IATA EXCLUDES ALL LIABILITY (TO THE EXTENT PERMITTED BY APPLICABLE LAW) FOR ANY COSTS, LOSSES, CLAIMS, DAMAGES, EXPENSES OR PROCEEDINGS OF WHATEVER NATURE INCURRED OR SUFFERED BY YOU OR ANY OTHER PARTY ARISING DIRECTLY OR INDIRECTLY IN CONNECTION WITH THE USE OF THIS PUBLICATION OR ANY CONTENT CONTAINED OR ACCESSED THEREFROM, OR DUE TO ANY UNAVAILABILITY OF THIS PUBLICATION IN WHOLE OR IN PART.

1. Introduction

The IATA Maintenance Cost Technical Group (MCTG) is an industry group dedicated to supporting the Technical Operations (Maintenance and Engineering). The aim of MCTG is to work on the management of maintenance costs for the aviation industry as well as to create transparency and insight into these costs.

Warranties are present in most of the categories of aircraft maintenance. The way airlines take advantage of these contractual rights, which they have paid for, can be very different. There is no standard for handling potential warranty claims and, certainly, there is no standard for warranty agreements given that warranties may vary from OEM to OEM, from maintenance supplier to maintenance supplier and from airline to airline.

The MCTG has identified a lack of publications on warranty management and has decided to write this paper to explain the warranty-related terms and describe the ways to approach warranty elements captured by these terms.

This paper is intended for airlines that do not have any experience in dealing with warranties as well as airlines, which, although familiar with warranty management, would like to get another view on this topic.

1.1. Objective of This Paper

The objective of this paper is to present the warranty management essentials. It focuses on the following points:

- Explain the process to airlines which are not familiar with warranty management
- Present additional information to airlines having their own warranty management
- Provide a common understanding of warranties in aircraft maintenance
- List the advantages and disadvantages of in-house warranty management
- Show the interfaces a warranty management system might have
- Explain the different contractual bases which could lead to a warranty claim
- Identify claimable items related to warranty in aircraft maintenance

1.2. Structure and Organization

First things first

The paper starts with important definitions and clarifies the differences between warranty, guarantee and goodwill. It also presents the various possible setups for warranty management as well as the usual interfaces a warranty department engages in.

Getting to the heart of the matter

Warranty claims are the core of every warranty management. It is important to know which items are claimable, how to handle warranty claims and how to account for them.

If you can't measure it, you can't manage it

This famous statement is also applicable to warranty management. This paper shows various ways to manage, monitor and report warranty claims in the maintenance information systems.

1.3. Revision and Enhancement

This second edition reflects the collective knowledge, experience, and feedback contributed by members of the MCTG community. As warranty management practices continue to evolve, we view this publication as a living document that will benefit from ongoing collaboration and industry expertise.

We welcome comments, suggestions, case studies, best practices, and additional material that could enhance future editions. If you would like to share your experience or contribute content for consideration, please contact us at mctg@iata.org. Your feedback will help us ensure that future versions remain relevant, practical, and valuable to the industry.

2. Warranty Concepts

In order to have a common understanding, this section reviews the commonly encountered warranty process concepts and terminology.

2.1. Warranty

2.1.1 Terminology

In this section, we define the term “warranty” in general and explain what it means in the context of aviation and airline operation.

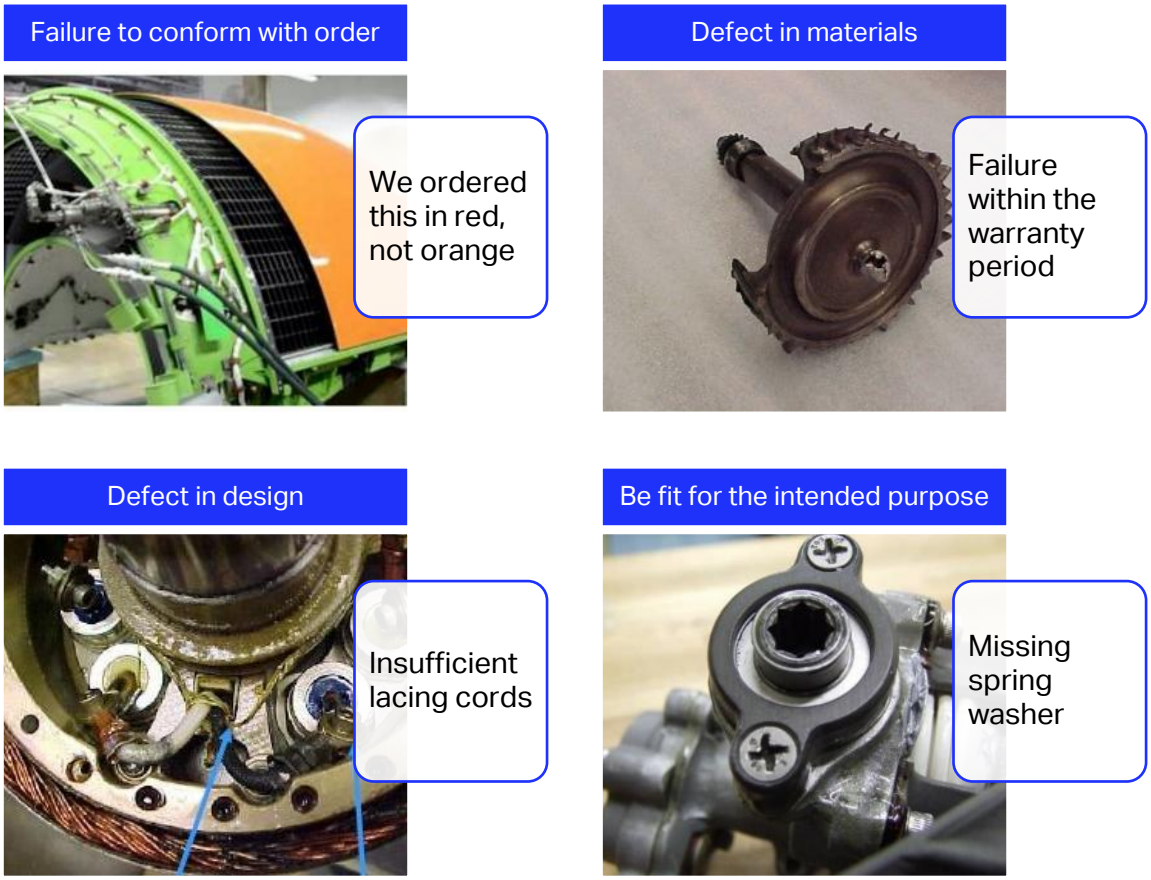


Figure 1 - Examples of Warranty Cases
Source: Airinmar

To approach the meaning of warranty, a positive or negative differentiation should be made.

Positive differentiation: What is under warranty?

Warranty is a contractual promise given by the supplier of goods (e.g. an aircraft part) or services (e.g. line maintenance) that the quality of the goods or services supplied will meet a certain standard of quality (i.e., it will meet specified standards / conditions), for example that they will be free from defects in workmanship. The standard of quality will be promised for a certain period of time, or number of hours/cycles, and the contract will

stipulate the Customer's remedies if the goods or services do not meet that standard for that time period, flight hours, and number of cycles (as applicable). The remedies available to the Customer are usually that the goods/services that have not met the standard will be repaired or replaced, or a refund will be given, or some other remedy or penalty will apply.

There are three types of warranty claims available:

- Material claims
- Workmanship claims
- Design claims

In addition, warranty claims may be allowable against SBs and /or SLs as well as against Service Life Policies whenever they affect the contractual promised attributes of the goods or services.

There can be a "First Look" clause, which is coverage over and above the standard warranty period. This clause describes parts installed at time of delivery but not inspected during the initial warranty period. These are considered to be under warranty until the first inspection as per the MPD considering that there may be time limit linked to the aircraft delivery date (i.e. landing gear, and other main structural areas).

Negative differentiation: What is not under warranty?

Normal "wear and tear" is not covered by warranty of product or component. Omissions or acts by a customer to not properly service or maintain a component can also invalidate a warranty. Any consequential or incidental damages are also excluded.

In the process of claiming labor hours associated with a warranty claim task, it is important to remember that only direct labor is claimable. Back-office labor hours and any hours spent troubleshooting or establishing the root cause of a problem are not claimable. OEMs will also not compensate for "lost time". Examples of "lost time" include:

- Time to schedule the work
- Time to adjust to the workplace
- Time to find and deliver tools/parts
- Time to access the required area/component
- Time for sealant to cure
- Time to clean up the workplace
- Time to complete paperwork at the end of the task and make claims

Additionally (and in general), the consequential costs and loss of revenues are not covered by the warranty provisions.

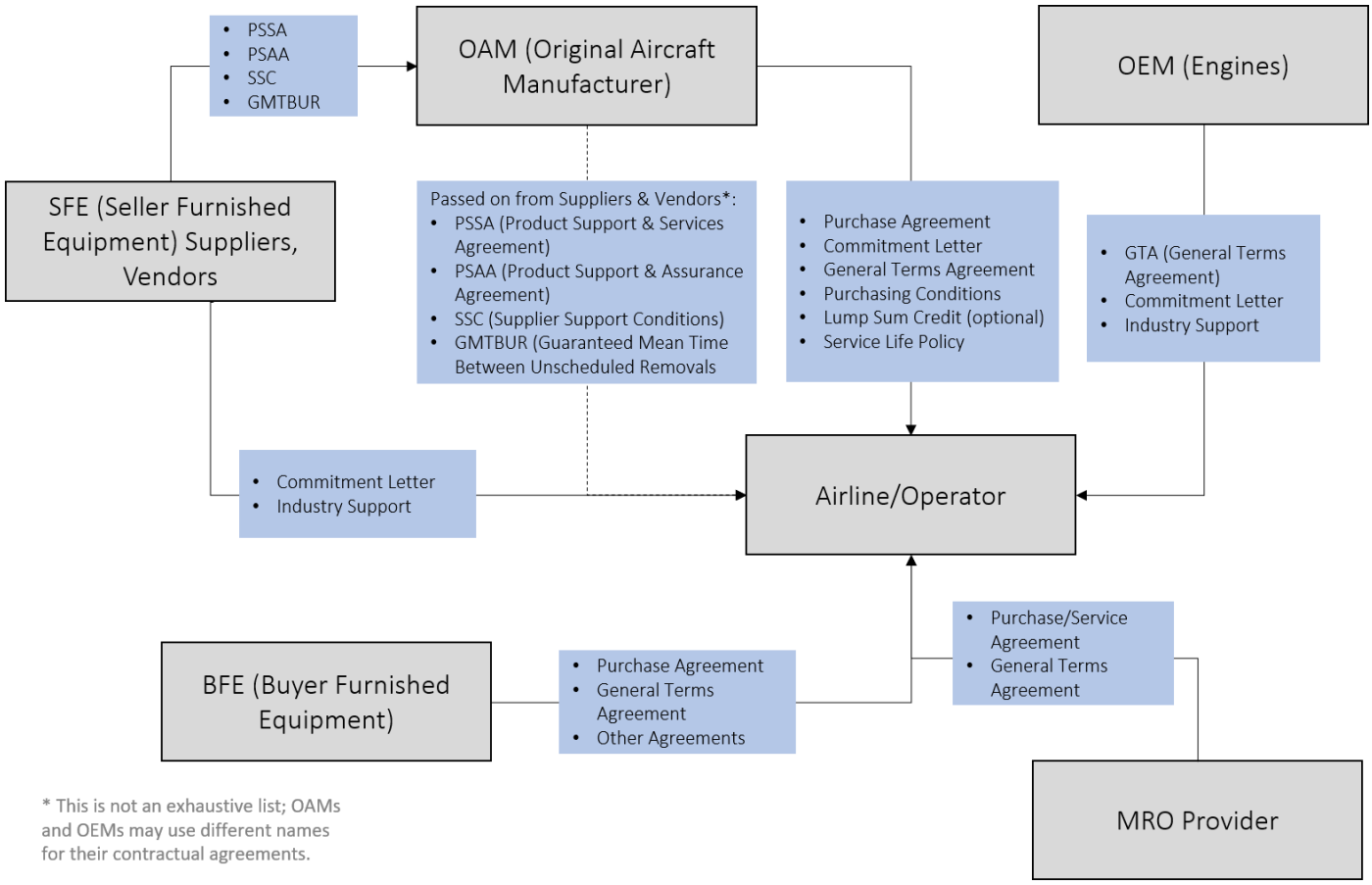


Figure 2. Mapping of the stakeholders and instruments involved in warranty management

Every newly delivered aircraft is covered under terms for New Aircraft Warranty (NAW). Airlines can refer to the aircraft manufacturers' customer portals for information and details on warranty management, e.g. AirbusWorld, MyBoeingFleet, FlyEmbraer, ATRactive, flyMHIRJ (formerly IFlyBombardier), De Havilland Portal, etc.

2.1.2 Warranty In the Aircraft's Lifecycle

Before Entry into Service (EIS), significant time should be devoted to contract negotiations about warranty coverage. The World Airlines Supplier Guide (WASG) acts as a standard for warranty agreements. (Fig. 3)

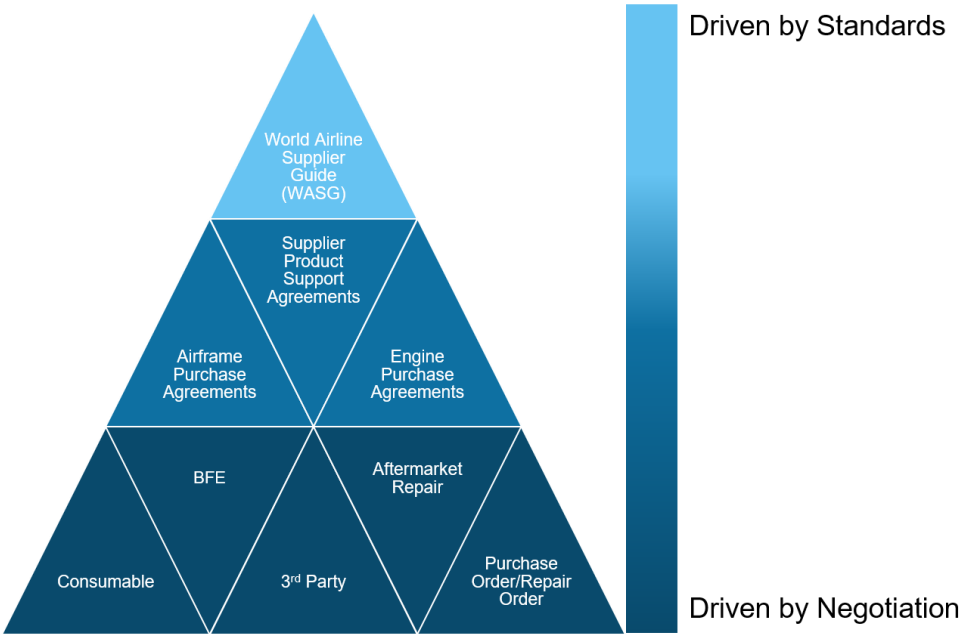


Figure 3 – Aircraft Warranties
Source: Airinmar

To better understand aircraft warranty, it is necessary to go into details regarding the contract system of OAMs (Original Aircraft Manufacturers) and component OEMs (Original Equipment Manufacturers), their products, BFE (Buyer Furnished Equipment) and services of different service providers.

SUBJECT TO WARRANTY			
OAM/OEM (TCH)		OTHER VENDORS	
AIRFRAME/AIRCRAFT	ENGINES	BFE	SERVICES

Table 1. Warranty-Related Categories

As shown in the table above, not only OEM parts are subject to warranty. Every type of material and service can be subject to warranty, which depends on the particular agreement. Therefore, an explanation of the contracts/agreements for each of the four categories is given below.

Figure 4 shows the main warranty entitlement areas to be considered and understood during negotiations.

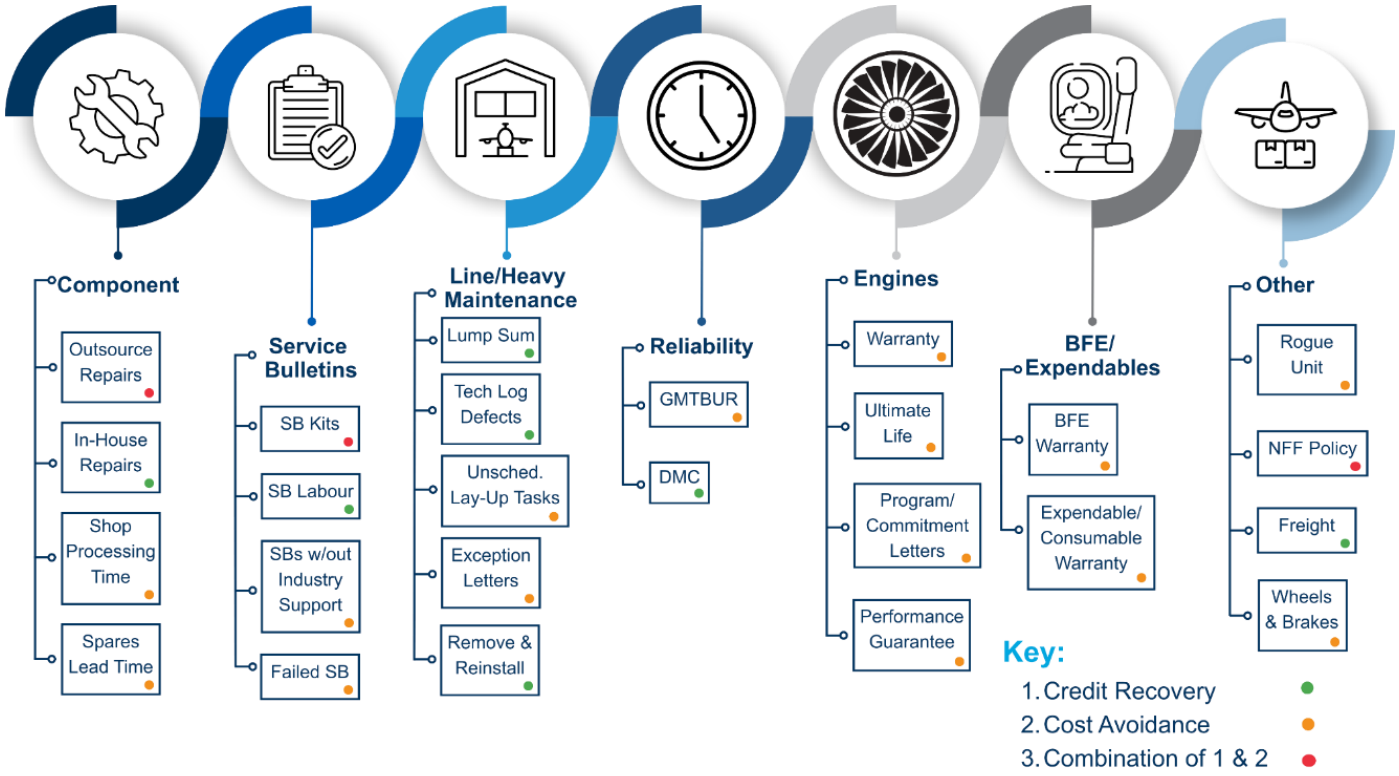


Figure 4 – Areas of Warranty Coverage
Source: Airinmar

2.1.2.1 Airframe/Aircraft

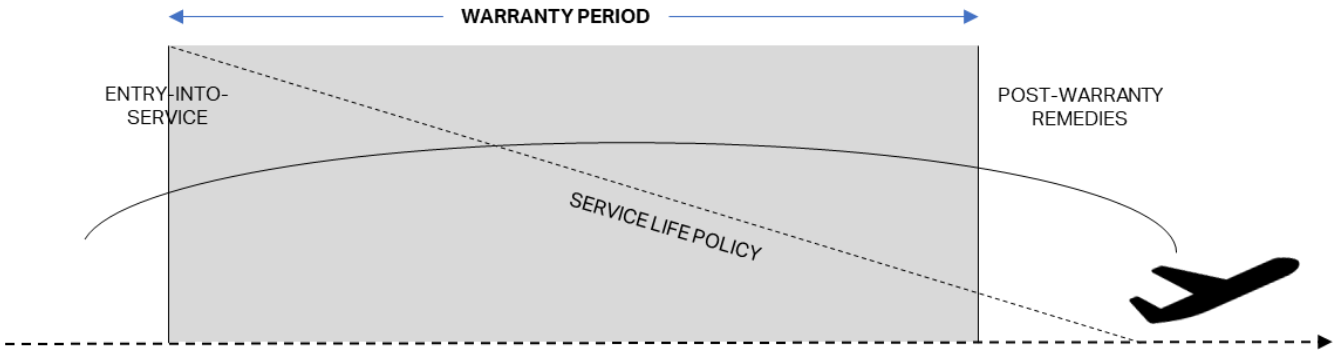


Figure 5. Aircraft Warranty Lifecycle

During the particular phases of aircraft lifetime, different contracts are important.

Entry-Into-Service

The aircraft purchaser of an airline inspects the aircraft before issuing the payment on the delivery date. Possible findings of this inspection, which could not be corrected on time before the planned delivery, can be considered in a "commitment letter". These items can be claimed within the agreed timeframe and with respect to the conditions

as contracted. In addition, the aircraft purchase agreement gives information about the warranty period and the service life policy for each aircraft. The service provides remedies for specified covered components of the aircraft structure that fail during normal service. This policy provides reimbursement for a replacement part using a calculation based on the age of the covered component at the time the failure is discovered (i.e. pro-rated mechanism).

At the time of an aircraft's entry into service, the airline has access to several contracts and agreements that define the applicable commercial, warranty, and support conditions. The terminology and document names may vary depending on the parties involved, such as the aircraft manufacturer, supplier, or lessor. Below is a selected list of these documents:

- Aircraft General Terms Agreement (AGTA): The contractual terms that apply to an aircraft purchase agreement.
- Aircraft Purchase Agreement (PA): Purchase agreement of the aircraft including the warranty and Service Life Policy (SLP). The timeframe for the SLP is much longer than the Commitment Letter.
- Customer Services General Terms Agreement (CSGTA): Provides terms and conditions that apply, after aircraft delivery, to the sale or lease of parts, tools, and services.
- Commitment Letter (CML): Agreement that is signed prior to the delivery of the aircraft between the OEM and/or supplier and the airline. It is independent from the general warranty clause of the purchase agreement, which means that the agreed conditions can be different from those in the warranty clause.
- Supplier Support Conditions (SSC) / Product Support and Assurance Agreement (PSAA): A negotiated agreement between aircraft manufacturers like Airbus and Boeing and suppliers of Seller Furnished Equipment (SFE) that is available to customers and describes the product support, including the warranty.
- Lump sum credit (optional clause): A payment from the OEM to the airline, which prohibits the airline from claiming warranty-related items lower than a certain agreed amount in general for consumable items. Rotables are covered under normal OEM warranty repairs.
- Aircraft Lease Agreement: Over 50% of the aircraft today (2026) are leased. In general, all warranties pass through the aircraft owner (lessor) to the operator. However, it is important that during the aircraft lease negotiations, the lessor and the operator discuss and agree on how warranties will work. In some cases, the OAM/OEM may need to be involved. The whole process of warranties and the whole warranty claim process should be clarified between all associated parties.

Warranty period

All of the above-mentioned contracts are still important during the warranty period. The warranty handling in the aviation industry is different from the warranty handling in other B2C businesses. As a customer, it is normal to claim only against the one who sold the claimable part. In aviation, all agreements between the OEM and their suppliers are accessible. This means that, in case a supplier's part is affected, the operator has to claim against and deal with the specific supplier directly.

For Service Bulletins (SBs), claimable man-hours and applicable labor rates are established by the OAM and OEM. Labor-rate structures vary by manufacturer and may consist of either airline-specific rates based on the region of operation and maintenance or a standardized worldwide rate established annually. For OEM SFE equipment, the applicable SSC/PSAA/other OAM agreement will specify whether the OAM rate or an OEM-defined rate is to be used. For OEM BFE equipment, the allowable labor rate may be defined by the applicable contract.

Regarding warranty issues on OEM parts (parts that are designed and manufactured by the OEM or parts that are manufactured to their detailed design) and other SFE parts, the airline can only claim:

- Direct materials: non-repairable and non-reusable items such as parts, gaskets, grease, sealant and or adhesives used when making a correction.
- Direct labor: man-hours spent to access, inspect, remove, repair, test, reassemble and reinstall a component. Removal and reinstallation may depend on the aircraft type and the agreement.

Troubleshooting or consequential costs are not claimable. For claims regarding OEM parts, the OEM is contacted while, for claims regarding SFE parts, the suppliers have to be contacted.

In general, there are three different types of OEM/SFE parts an airline can claim for:

- Credit
- FOC material
- FOC repair

It is important to note that, if a part has been replaced by a new part, a new warranty period starts for this part. If it is replaced by a serviceable part, then the remaining warranty period on the initial part takes precedent

Post-Warranty Mitigations

As previously mentioned, Service Bulletins are generally not subject to warranty, which means that they may be claimable out of the warranty period. In addition to that, the Service Life Policy (SLP) coverage starts with the delivery of the aircraft and ends much later than the warranty period. Moreover, retrofits or other policies could lead to claimable items, irrespective of the warranty period. Items that are also subject to vague warranty conditions include: Service Letters, Retrofit Information Letters, Commitment Letters, Program Letters, and similar other memos, letters, transmissions provided to an airline/operator. It is recommended that such conditions should be clarified to avoid future misunderstandings.

2.1.2.2 Engines

There are some similarities with the aircraft manufacturers. Information about warranties can be found in the individual purchase agreements, so that damaged parts of new engines are claimable under the term “new engine warranty”. During that time and even after that, engines might be affected by SBs as well. In that case, a certain commitment letter needs to be negotiated, which is the basis for the different SB-claims.

In general, though, the Airline or Operator should have negotiated guarantees (see Section 2.2) with the Engine Manufacturer to ensure engine performance and have sufficient recovery plans in place for early failures of the core engine and its LRU’s.

2.1.2.3 Buyer Furnished Equipment (BFE)

Buyer Furnished Equipment (BFE) are parts which have been purchased from a third-party vendor that does not belong to the OEMs or their supply chain. The purchase agreements have to be negotiated between the parties individually, and the warranty clause is a result of a separate negotiation and may be totally different from the OEM’s warranty.

2.1.2.4 Services

Services (e.g. MRO services) have to be contracted, which means that the agreements include warranty clauses that might lead to claimable items. For example, when an airline outsources a heavy check, it is important to ensure warranty clauses are written into the contract. Consideration needs to be given into how to keep records and track of what is warrantable and therefore claimable from either the MRO or the OEM.

Warranty management is based on contractual work, therefore the individuals responsible for warranty within an airline need unrestricted access to the contract databases.

Pool Contracts

Pool contracts are a very common type of long-term part procurement contracts. Within these contracts, part lists are defined and are procured by the pool. In case one of the pool parts is declared unserviceable, the airline sends the unserviceable part to the pool provider and receives a new or serviceable part in exchange.

Within these contracts, the warranty rights for the airline are normally compensated for by the fact that the airline receives another serviceable part. Depending on the commercial agreement, labor and material costs may be covered differently by the pool provider and/or the OEM. For example, man-hours – even for the part exchange – are generally not claimable against the pool provider.

In the case of a leased aircraft, the pool agreement should be considered in relationship to the aircraft leasing agreement's return conditions.

In the case of a brand-new aircraft, if a part fails, the airline needs to be aware that the part may be replaced by a part that is not new.

In a pool contract, the airline also has the possibility to assign the warranty rights to the pool provider. In return, the airline gets a lower cost rate. The OEM has to recognize the pool provider as a customer designee.

Software

Software plays an increasingly important role in operating and maintaining aircraft. However, as they are intangible, software products might not appear in the normal warehousing and material processes and might then be forgotten in claim/warranty management.

The warranty policies and warranty handling are very poorly defined in today's Service Level Agreement (SLA) between OEMs and operators. There has been some work done in this regard by relevant industry groups (e.g. AEEC software metrics activity, 2015–2018), however it has become evident that software as an aircraft part is lacking the same defined business practices as a hardware aircraft part (i.e. time between removal for hardware parts, combining bug fixes with block point updates, other criteria applicable for software world as specified in ITIL (IT library) practices).

2.2. Guarantee

Guarantee (as in performance guarantee) is a contractual promise given by the supplier of goods regarding the operational performance of those goods. A performance guarantee is usually given in respect of the whole aircraft or engine rather than a smaller part or sub assembly, and the promise given is that the aircraft/engine will perform to a certain standard. There are conditions attached to the performance guarantee meaning that if the aircraft is operated outside of those conditions, the guarantee will not be valid. The remedies for the customer if the aircraft/engine does not perform to the guaranteed standard are monetary, usually in the form of liquidated damages (i.e. a set amount of money) or a credit against future payments owed to the supplier.

Both “warranties” and “guarantees” are part of a risk sharing agreement between the buyer and the supplier in order to mitigate the effects of costs of poor quality induced by the sold goods/services.

The warranty is a way of protecting the buyer against early failures of such goods/services, by defining a period – starting from the EIS – in which the goods/services shall be "free-from-defect”. It is integrated in the Purchase Agreement (PA) signed between the buyer and the supplier and it is legally binding.

A guarantee can be available. It is a way of protecting the buyer from degraded performance of involved goods/services from a technical/operational/economical perspective whenever such degradation occurs. If a guarantee exists, it is integrated in an appendix of the PA, and in general, it could cover reliability (i.e. GMTBUR), direct maintenance costs (i.e. GDMC), shop processing time (i.e. GSPT) or fuel consumption.

Example: An OEM provides the avionics suite for an aircraft covering a quite large shipset including the Integrated Avionics Display (IAD). In the PA with the avionics OEM, we would find a warranty covering an IAD failure within 3 years since its installation on the aircraft, whereas in the PSAA we would find a GMTBUR of 10,000 flight hours. This means that, at the end of the fifteenth year of operation of the aircraft, a given customer could claim against the avionics OEM in case the reliability data shows that the typical time between two failures of this item is below the guaranteed value (10,000 FH).

2.3. Practical Differences between Warranty and Guarantee

WARRANTY	GUARANTEE
Usually covers defects, performance, or quality over a defined period.	Usually promises satisfaction or a specific outcome.
Typically written with legal terms and conditions.	Can be written or verbal and often less detailed.
Common for products and equipment.	Common for products, services, and customer satisfaction.
Repair, replacement, refund (or other remedy) as specified.	Refund, replacement, or other remedy promised by the guarantor.

Table 2 - Practical Differences between Warranty and Guarantee

As an example, if an aircraft part supplier states:

- **Warranty:** "This fuel pump is warranted for 24 months against defects in materials or workmanship."
- **Guarantee:** "We guarantee the pump will meet the published performance specifications."

The warranty typically specifies what happens if the part fails, while the guarantee is the broader assurance about performance.

In legal disputes, a **warranty** generally has more precise contractual meaning and defined remedies, whereas a **guarantee** is often interpreted according to the specific wording and applicable law.

2.4. Goodwill

Goodwill either follows the warranty period or, in case there was no agreed warranty, is replacing it. Goodwill is not contractually agreed and therefore doesn't secure the right to claim financial compensation. Companies sometimes settle on a goodwill basis:

- For customer loyalty
- For image and reputation improvement
- To avoid excessive paperwork, staff time and administration

3. Warranty Management – Organization Models Within an Airline

Recovering warranty should be an airline target, especially when new aircraft are acquired and/or significant levels of maintenance work are outsourced. Each airline should evaluate the existence of in-house warranty staff (or contract support) to ensure full warranty capture.

There are many ways an airline can set up its warranty management. This chapter covers the most common setups.

First, the airline has to make the strategic choice between managing warranty internally (in-house) or contracting with an outside supplier (outsourcing). In many cases, this is not a binary choice; certain aircraft or fleets may be outsourced while certain component families may be processed internally for various reasons (e.g., shop capability, economies of scale, experience etc.). This chapter presents the opportunities and obstacles of each choice, and the implication on the organization.

Then we describe the interactions of the warranty team with other departments of the airline and external providers/partners, and the critical factors of success.

3.1. In-House vs. Outsourced

The decision to insource or outsource (contract) warranty management is specific to every airline and should be based on various parameters.

For every "make-or-buy" decision, airlines should perform a thorough cost-benefit analysis in terms of:

- Negotiation and leverage (volume of claims)
- Staff requirements and skills base
- Warranty management tools
- Legal implications

For each of these approaches, various setups of organizational structure are pointed out in this section as well as "pros and cons" analyses.

3.1.1 In-House Warranty Management

Warranty management requires an interface between several departments within the airline. As it was emphasized in the previous sections, warranty management mostly consists of contractual work and could be organized within a contract department.

Other departments are also useful in organizing the warranty management:

- Material Management
- Engineering
- Production/Technical Operations
- Finance / Financial Planning
- Legal

In any case, a warranty manager has to deal with all these departments, so it requires contact points/resources in all departments.

It is impossible to quote a figure about the necessary number of employees within the warranty department, but this section should create awareness of the elements that need to be considered:

- IT infrastructure
- IT systems
- Size of fleet
- Homogeneity of fleet
- Age of the fleet (to be carefully reviewed)
- Aircraft types (e.g. new aircraft models need more capacity due to their "childhood diseases")
- Number of MROs and other service providers
- Number of managed contracts/agreements (e.g. for SBs/CMLs)
- Flow of information within the airline organization
- Number of managed AOCs

PROS	CONS
• Less confidentiality concerns • Cheaper • Is part of the team and has easier access to the various internal technical subject matter experts (SMEs) • Familiar with the processes and values of the airline • Better contractual knowledge • Better control • Can reduce turnaround time	• Steep learning curve: limited expertise/skills in warranty management at the beginning • Limited leverage: when negotiating for only one airline (especially smaller airlines) • Problems to structure/organize warranty management setup at the beginning.

Table 3. Pros and Cons of In-house Warranty Management

3.1.2 Outsourced Warranty Management

There are two ways a subcontracted party can act on behalf of an airline.

Appearance as a third-party / different company

A third-party i.e. an authorized agent filing a warranty claim on behalf of a customer airline must have the right to file a claim. This is typically called an Assignment of Rights Agreement. This is an express written agreement to assign warranty rights and to be bound by and comply with all the applicable terms and conditions of the General Terms Agreement with the customer airline.

Appearance as a specific airline

The other way is to integrate third party employees within the specific organization, which means that subcontractors act as employees of the airline (E-Mail account, OEM access etc.). In this case, an agreement for being a subcontractor is necessary, but not for claiming on behalf of the airline.

PROS	CONS
• Proven expertise/skills on warranty management • Experience from similar cases • Knows how to set up a claim management organization • Has more power when claiming for several airlines	• Needs access to the airline's contract database and the MRO software system ⇨ concerns about confidentiality • Needs to be part of the team, as warranty management can be seen as an interface between several departments within the airline • Could be more expensive than in-house warranty management. (Either provision or provision + basis fee) • May not live up to the values of the airline

Table 4. Pros and Cons of Outsourced Warranty Management

3.2. Warranty Management – An Interface

Known for the harshness of the B2C competitive environment in which they operate, airlines are also in the midst of the B2B aftermarket revenues battle. Like consumer goods in the 90s, a paradigm shift occurred where OEMs and OAMs try to sell more and more aftermarket solutions instead of focusing on the original equipment business. The OAMs' renewed interest in avionics products development (and the associated aftermarket opportunities) is a good example.

As the competition intensifies in the aftermarket, airlines are assessing how to interface with their environment and how to organize in order to maximize their Warranty "Hit Rate".

By mapping the stakeholders, one might be under the impression that chances of success are little. Airlines that usually have bargaining power thanks to their critical size (large fleet and high volume of operated flights), a diversified portfolio (multiple OAMs, open OEM selection for a given functionality, LR/SR operations, etc.), intensive in-house resources (claim managers, legal department, large engineering teams, etc.) may seem the only ones likely to succeed. Thankfully, this is not the case.

Far more than its size, the critical success factor for the airline is the alignment of its internal organization and its warranty strategy.

- Internal Organization:
  - What the airline is capable of and how it is internally structured to achieve its goal
- Warranty Strategy:
  - What the airline aims at in terms of support integration (driven by its maintenance support strategy):
    - Internal
    - External
    - Hybrid
  - Its willingness to invest in a warranty strategy: expertise/skills of the selected internal/external resources.

3.2.1 Contracting

The Procurement teams will mainly be in charge of drafting/negotiating applicable warranties/guaranties (from standard PSAA/SSC/or other OAM or GTA between the airline and the vendor). More favorable conditions might be obtained if there is a significant volume of business for the vendor (large company, OEM/OAM/MRO switch). However, more favorable conditions on the paper do not mean that these will materialize in terms of compensation in the future. It highly depends on the efforts/teams put in place to ensure contractual terms are enforced.

Should the Warranty Expert/Team be in the Contract Department? It would depend on the airline's expertise, its strategy, and the effort put in it (single staff vs dedicated team). However, given the intricate contractual terms and the complexity around the topic, legal expertise would be one of the most critical skills to develop. Required engineering insights / field reports perspective should be gained also through industry groups, conferences and workshops.

3.2.2 Engineering & Maintenance

One of the key factors of success of a warranty claim is to build a "bulletproof case". Every aspect will be debated/contested on one/several of the following factors:

- Non-compliance with operational conditions stipulated in the warranty
- MRO-driven issue
- No Fault Found (NFF)
- Environmental issues (air pollution)
- Normal wear and tear (what is normal; what was computed/anticipated by the OEM; Or once into operations, anything that differs from the average wear and tear)
- Fluency in the operator's maintenance program that helps justify the intervals and/or packaging tasks are accomplished, and defects found

If the airline's engineering team is limited in size (small airline/outsourced engineering), the airline can gain insights through industry working groups and conferences (see section 3.2.4) or through their MRO service provider upon nominee letter designation (the MRO will claim for the airline).

Closely linked to Engineering, the Maintenance department has the ability to detect failing components and collect data to build up the claim.

3.2.3 Material Department

If the airline has a Materials/Logistics department, they should have a good understanding of PSAA/SSC ground rules to understand what they should expect to be offered when buying IP or spares uplift.

3.2.4 Warranty-Related Groups and Events

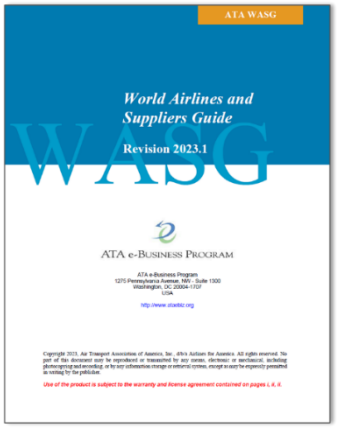
There are great benefits in joining warranty-related groups and participating in industry events. No matter how experienced one is, everyone can learn.

Here are a few reasons to consider:

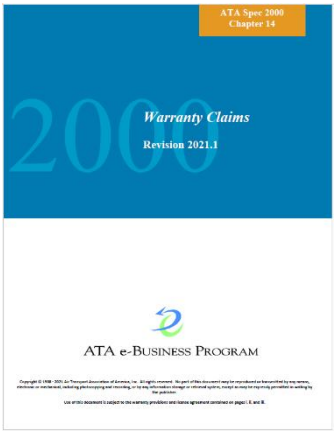
- Connect with industry peers and discuss common issues that affect everyone
- Learn new skills and gain valuable professional experience
- Have a voice to advocate for the industry
- Stay abreast of the latest industry news and developments enabling participants to be well-informed and prepared professionals
- Network and meet potential new business partners

3.3. Industry Standards – Other References

A4A/ATA e-Business Program[1] provide standards for information exchange to support engineering, maintenance, materiel management and flight operations.



The ATA World Airlines and Suppliers Guide (WASG) is an industry source that provides additional information about Warranties, Guarantees and Product Support.



ATA Spec 2000 Chapter 14 provides a standardized set of data formats and implementation guidelines necessary for a warranty claimant to electronically submit claims to a warrantor. Subscription may be required.

Other sources of information and points of reference:

- Aerospace Warranty Management: warranty.aero/
- Warranty Week: warrantyweek.com/
- Airinmar Warranty Management: www.airinmar.com/home/aircraft-warranty/

[1] **www.ataebiz.org**

4. Claims

Claims are the core activities of the Warranty department. Proactive and proficient warranty management results in maximizing the benefits from the negotiated contracts.

This chapter gives an overview on the contractual basis that needs to be monitored as well as the claimable items. In addition, some accounting principles and the commitment letters are addressed here.

4.1. Contractual Basis

The table below shows the typical warranty periods for new parts, spare parts and repaired parts at the time of writing this paper.

	New parts for a new AC	Spares Parts	Repaired Parts
Warranty Period	Typically, 36 to 48 months	- 36 months of warranty for A320, A340, 737 and 747 - 48 months for A380, A350, 777 and 787	- 18 months for A380, 787 and A350 - 12 months for the other fleets
Beginning of the Warranty	First Property or first flight regarding the contract	Date of the Reception of the part (and NOT the Data Certificate Release Date)	Acknowledgement or acceptance date.
Time to claim	90 days in general		

Table 5. Typical Warranty Periods

Important: The table above is for illustration purposes. Please check the most recent information for each OAM/OEM.

4.2. Claimable Items

4.2.1 Parts/Components

There are four types of claimable parts:

- New fitted on aircraft
- New spare part
- Repaired within the warranty period
- Equipment issued from a previous standard exchange

The minimum information to be sent with a warranty claim is (it should be described in the agreement to avoid confusion and streamline the process):

- Part number
- Nomenclature (PSAA, PSC, SSC)
- Serial number
- TSN and TSO
- CSN and CSO
- Reason for removal and date of removal
- Address to where the item was shipped and returned
- Aircraft registration number

If the claim is denied because of wear and tear, the airline can be asked to send pictures

In case the equipment is scrapped within the warranty period, a Free of Charge equipment could be sent by the OEM (if the scrap is not the airline's fault).

4.2.2 Service Bulletins

The man-hours described in the SB can be reimbursed if negotiated as well as the parts associated. The warranty does not imply that the SB will be totally free of charge. In general, if the SB relates to a reliability issue, then it should be FOC, especially if the Airline / Operator is suffering with that part.

It is usually stated in the SB whether it is warrantable or not. Airlines can challenge it on an individual basis, especially for mandatory SBs that imply a design defect.

4.2.3 No Fault Found

Every OEM/OAM has their own NFF policies. It is recommended to engage with them and understand their processes and procedures for NFF.

Examples for OAMs

- For a list of Airbus equipment: in case of No Fault Found (NFF), a Post-Flight Report (PFR) has to be sent in order to prove the NFF. This list of equipment eligible to the NFF program is available on AIRBUSWORLD
- For Boeing equipment (non-restriction): in case of NFF, the correct data proving the NFF has to be communicated.

4.2.4 Access, Inspection, Removal, Installation

Man-Hours associated with the access, inspection, removal, and installation of an equipment can be claimed. The claimable duration depends on the warranty conditions of the commercial agreement.

4.3. Accounting Principles

From IFRS[2] perspective, airlines need to consider IFRS 9[3] for definition, measurement and recognition of warranty claims.

[2] **International Financial Reporting Standards –** www.ifrs.org
[3] www.ifrs.org/issued-standards/list-of-standards/ifrs-9-financial-instruments/

A financial asset includes a contractual right to receive cash or another asset from another entity, pending warranty claims submitted to OEMs meet this definition as they represent receivables based on contractual arrangements. Accordingly, these claims are measured within the framework of IFRS 9 Financial Instruments.

Key References

3.1.1 – **An entity shall recognize a financial asset when and only when the entity becomes a party to the contractual provisions of the instrument**; Warranty terms and conditions are clearly defined with contracts with OEMs.

4.1 – **The asset would be measured as fair value through profit and loss unless it is measured at amortized cost.** As warranty claims usually do not have an interest component, they can be measured in transaction value. If the asset recognition criteria are met, airline operators should be able to recognize all open warranty claims in their balance sheet (through credit to profit and loss). The movement in open claims between two periods would represent profit and loss amount taking into account claims already accepted via credit note or invoice.

5.5.1 – **An entity shall recognize a loss allowance for expected credit losses for contract assets**; In terms of warranty claims, loss allowance = 1- Historical Success Rate (or concession rate).

For example, if the historical success rate is 85%, the initial recognition of open claims valued at $100K in ledger would be:

Debit Record – Warranty Receivables (Financial Asset) - $100K × 85%

Credit Record – Warranty Credits (Profit and Loss) - $100K × 85%

Loss allowance needs to be reviewed and updated on a regular basis.

Please note that the above section is only a guideline and does not constitute a financial advice. It is recommended that airlines check with their financial accounting team on the details of accounting treatment as well as the applicability of the IFRS or GAAP[4] standards.

4.4. New Aircraft Delivery and Commitment Letters

Prior to the aircraft delivery to the customer airline and during the final delivery phase, it is recommended to have a customer representative on site, a Delivery Manager who can then monitor, inspect and follow up on any customer airline queries. This is for the purpose of verifying the asset and ensuring its conformity to specification. This individual can inspect the cabin furnishings/interiors and witness ground checks, engine runs and customer demonstration flights. They can monitor and report on the progress of all snag rectifications consequent to the above. This is all part of the contractual acceptance process.

There is a need to ensure that the customers' questions and correction requests are followed up on and agreed by both parties.

During this period, snags may be discovered that rectification proves untimely, difficult or even impossible given the remaining time before delivery. In order not to delay the transfer of title and handover date or final contractual

[4] **GAAP: Generally Accepted Accounting Principles**

acceptance, the issuance of a commitment letter is an acceptable contractual process. This letter is a legally binding document agreed and signed by both parties whereby the supplier, OEM or vendor (SFE or BFE) may rectify an identified snag at a convenient point in the future, and free of charge to the customer if it is part of the agreement. Any deferred items agreed by the customer can also be included in a commitment letter. It should be noted that this is a negotiated process between all relevant parties, and not a blank check or open-ended period! Compensation can be monetary, as well as goods, services or fuel.

5. Mitigations

To reduce the airline's costs in the unlikely event of failure in maintenance, material or design, different steps might be considered. This chapter provides a collection of possible actions that could lead to a reduction of maintenance costs.

- Airlines should indicate their expected minimum warranty terms on component orders e.g. for serviceable units, for overhauled units and for new components as applicable. They should be proactive and always negotiate with their vendors.
- Airlines should include OEM participation in their regular training for warranty personnel so that they have a good understanding of warranty, and a basic aircraft system knowledge beyond their financial role
- Airlines can also opt to outsource warranty function/assign to a third party to hold the management of claims & warranty settlement on behalf of operator where there is insufficient personnel or inexperienced staff since warranty is a commodity that expires, claims have to be lodged within a given timeline from date of defect discovery or work accomplishment. However, this comes at a cost.
- Airlines to follow up on declined and disputed claims where there is justification. Declined claims should not be always accepted by default. OEMs to specify reason(s) for declining or disallowing a claim
- Airlines to setup/integrate their IT systems across functions that would help to check the warranty status of components and flag units/aircraft under warranty or act as triggers for same
- Airlines come together and share on their issues, data and experiences relating to warranty and claim processing by actively participating in existing forums through which airlines share technical experiences and issues affecting them
- Airlines engage and create awareness with internal stakeholders (contracts, production, shops, engineering, warehouse and Inflight teams) of what is required to lodge a credible claim e.g. photos, BITE screen shots. This will ensure the claim adjudication/repair process time is as short as possible and avoid NFF in the case of repair since not all conditions can be replicated on a bench test.

For Engine and APU

Warranty may not be applicable in case of an engine or module if (and not only if):

- Not being properly installed or maintained; or
- Being operated contrary to applicable OEM recommendations as contained in its manuals, bulletins, or other written instructions; or
- Being repaired or altered in such a way as to impair its safety of operation or efficiency; or
- Being subjected to misuse, neglect or accident

Some guarantees are only applicable under given average operating conditions (e.g. annual utilization, flight leg, take-off derate…). More severe operating conditions may require a mutually agreed adjustment.

If compensation becomes available to the customer under more than one warranty/guarantee, the customer will not receive multiple compensations but will receive the most beneficial compensation under a single warranty/guarantee.

The OEM shall not be liable or in breach of its obligations by causes beyond its reasonable control (e.g. war, severe weather conditions, earthquakes, acts or omissions of customer or customer's suppliers…).

For off-wing maintenance

It is the responsibility of the Designated Overhaul Facility (DOF)/Distributor & Designated Overhaul Facility (DDOF) to verify on a preliminary basis whether the reason for removal of an engine or module is the result of an event that was within the control of the OEM and therefore covered under warranty.

For off-wing and on-wing maintenance

It is the responsibility of the operator to maintain adequate operational and maintenance records and make them available for OEM inspection.

6. How To Measure Success

"If you can't measure it, you can't manage it." This phrase is truly one of the most important ones related to the economic understanding of any management. The warranty activities have to be measured too, to measure their success. As an approach, KPIs have been defined within this chapter.

6.1. Defining Key Performance Indicators

Key performance indicators (KPIs) are vital tools used by an organization management to understand how the business is performing. The proper set of indicators will shine a light on performance and highlight areas that need attention. Here, it is suggested to establish two general high level KPIs that measure both the efficiency of the handling of the warranty claims process within the organization, and the effectiveness of obtaining the (accurate) claimed amount. Then, various specific KPIs are developed to monitor the major process of handling claim processes.

Several parameters should be reviewed in order to design KPI formulae such as:

- Review the contractual basis and set the company objectives
- Identify the claimable items and agree what to achieve (a successful outcome)
- Set benchmarks and standards for the claims process
- Define the department's involvement in terms of handing process and functions related

The first formula is established to measure the accuracy of claimable amounts:

$$KPI = \left(1 - \left(\frac{\sum \text{Raised Amounts} - \sum \text{Actual Obtained}}{\sum \text{Raised Amounts}}\right)\right) \times 100\%$$

Also, a series of formulae can be developed based on the type of claims.

The second formula is established to measure the process speed in raising the claims

$$KPI = \left(1 - \left(\frac{\sum \text{Standard cycle time to prepare the claim} - \sum \text{Actual process time}}{\sum \text{Standard cycle time to prepare the claim}}\right)\right) \times 100\%$$

Again, a series of formulae can be developed based on the handling process for each department involved.

6.2. Setting Objectives And Targets

Despite some conceptual problems, some airlines budget and set targets for warranty claims.

Such targets are usually set based on the following parameters:

- Base level claims based on past history and proportional to fleet size and average aircraft age by fleet, particularly:
    - Number of aircraft and engines under warranty
    - Number of aircraft and engines which are a new design, which is often more problematic
- Pipeline claims not yet received but claimed
- Agreed contracts and side letters with clauses relating to "warranty performance in relation to technical dispatch reliability"
- Contractual "failure to perform" clauses agreed with manufacturer
- New and known cases of consistent part (number) failure
- Targets based on number of staff involved in claims or total numbers of claims made

Care should also be exercised not to overclaim for fear of undue friction and administrative costs with manufacturers, or the possible shifting and substituting of warranty claims into other categories of maintenance expenditure.

Warranty claims put pressure on the supplier to solve design issues. Often side deals are the result of open claims, but these are not seen in KPIs. From experience, **it is very important to have top management and key account support**. For new tenders, it is important to settle open claims.

7. How To Use the MIS for Warranty Management

A warranty management module is designed to provide an airline with an automatic method of identifying and then claiming warranty on different levels, to manage warranty agreements that are in place covering an aircraft, a vendor, a repair station, or a part / serial number.

The Maintenance Information System (MIS) provide airlines with complete solutions to deal with warranty management that work through 3 stages abbreviated as "DTH" process (Definition, Tracking, and Handling).

Figure 6. DTH Process

7.1. Definition Stage

In the definition stage, the operator determines warranty criteria based on several levels to match the many cases that may occur separately or combined. Warranty conditions and dimensions per level can be defined as follows: aircraft, vendor, part number.

7.1.1 Aircraft Level

The first step within the MIS is "Aircraft definition" where the operator defines whether the new aircraft is owned or operated by the airline.

There are many items that have to be defined at this stage, e.g. aircraft registration and serial number, fleet type, owned by, operated by, etc. In addition, the airline can define the conditions and dimensions on the airframe and the components installed on the aircraft.

7.1.2 Vendor Level

Any operator using a MIS must upload some basic data related to its suppliers, customers, authorities, etc. This data facilitates work within the IT system to issue purchase orders for suppliers or work orders for customers.

The operator should map the supplier and/or customer's data with what exists in its Enterprise Resources Planning (ERP) system if there is interface between the two systems. This will ensure that both systems retain the same level of basic data.

During the definition stage of certain suppliers within the MIS, the operator can define warranty criteria related to these suppliers on specific part numbers that have been supplied, at the same time defining the conditions and dimensions of warranty.

7.1.3 Part Number Level

When receiving rotable items, the operator can define conditions and dimensions of warranty at a part number or a serial number level.

7.2. Tracking Stage

Tracking means that the system raises warranty flags for users according to predefined conditions on specific levels. After the user defines the warranty conditions and dimensions in line with previous step and during ordinary course of business, the warranty claims are raised when conditions are met.

Example I: If we define a landing gear with serial number 123 that is installed on an aircraft with registration number XX-SSS "definition on Aircraft level", the condition of the warranty agreement is free of charge repair if the landing gear is removed before 3,000 cycles or 10 years whichever comes first. The number of cycles accumulated by the landing gear is tracked against the aircraft maintenance work. If it is recorded that this landing gear had been replaced during check on 2,000 cycles only, the system alerts the user that this serial number is still under warranty.

Example II: If we define a warranty agreement between operator and vendor "XYZ" that focuses on a specific list of part numbers with agreed conditions, and one of these part numbers does not meet the condition of warranty, the system will alert the user that this part number is still under warranty.

7.3. Handling Stage

The handling stage identifies the system's behavior when warranty conditions are achieved and is split into two stages:

- Within the MRO IT system
- Interface between the MRO IT system and the ERP system

Within MRO IT System

At the time of the booking of the component, in an unserviceable state, the component records are checked to see if any potential warranty claim can be made. This can be based on time since new, time since installation, calendar time, or time since overhaul or repair. It can check the number of cycles or hours since new or last overhauled or last repaired.

The potential claims are identified by comparing the component information held in the system against a set of criteria which have been defined for that part by the Vendor Management team.

When a claim is identified, the system automatically marks the repair order in the system as a warranty claim and advises the store person. If the store person does not want to claim warranty, they must enter a reason for not doing so.

When a warranty is claimed, the warranty order for that component is identified with a watermark as a "warranty claim". The order paperwork will also include the details of the reason for the warranty claim.

When the vendor responds to the order, the controller can update the system. They can add details such as whether the claim has been successful, partially successful, or denied. The reasons for a partial acceptance or denial of warranty can also be entered into the records to provide a full history. All of this data can then be used to provide useful statistics regarding warranty claims.

Interface Between MRO IT System and ERP System

At this stage, after the warranty claim has been raised, financial transactions are required to complete the cycle and collect the claim. When the operator implements its system, it should design the interface between MRO IT system and ERP system (e.g. Oracle, SAP, Microsoft dynamic, etc.) to generate related reports and collect the raised claim through ERP system.

7.4. Warranty Reporting

By continuously gathering data on the warranty claims and their outcome, the system has the ability to generate a variety of useful reports which help the airline monitor its performance in successfully claiming warranty. These reports can then be used to target vendors or repair stations which have a poor record of performance with regards to warranty claims and drive up the number of successful claims.

8. Roles And Responsibilities

To obtain full benefit and financial recovery from a warranty process, operators must articulate administrative roles and responsibilities associated with warranty management. This includes setting up a framework of internal systems and procedures to confirm all Engineering, Maintenance and Operating costs that may be covered by warranty are identified and recovered from respective OEMs.

8.1. Warranty Process

Here are some basic considerations in setting up internal procedures for warranty management.

Systems and processes as detailed below will determine that the warranty management processes are effective with little or no missed opportunities on warranty claims.

STEP	SET UP	DESCRIPTION
1	Warranty controls	Implement controls to identify and capture warranty opportunities
2	Assess & submit claims	Operating systems to submit claims and record recoveries
3	Manage claims	Manage claim process, disputes, recoveries, reporting

Table 6. Warranty Process

Ensure processes and workflows are defined to include (not limited to) preparation, submission and management of claims:

1. Warranty claims for the incorporation of system and component improvements introduced via Service Literature (e.g. Service Bulletins, Service Letters). This may include claims for material and/or labor.

2. Warranty/concession claims that result from business costs incurred as a consequence of OEM products not performing to specification or an agreed maintenance guarantee (e.g. time on wing guarantee)

3. Airframe warranty claims resulting from Base Maintenance visits

4. Warranty claims resulting from specific Terms and Conditions of OEM Product Support Agreements (PSAs) and Aircraft/Engine Purchase Agreements

5. Disputed claims for warranty repairs specific to components that have been rejected by OEMs.

6. Monthly reporting detailing status of all claims, recoveries and disputes.

8.2. Warranty Responsibility

Many operators retain the warranty input within business-as-usual processes across engineering and maintenance teams. Often there is no clear ownership of the associated administrative functions and responsibility to ensure that all claimable claims are filed, submitted, accepted or contested.

The responsibility for identifying actual and potential warranty opportunities must be carried across the engineering and line & heavy maintenance teams. However, by appointing a Warranty Administrator whose role includes ownership for the warranty processes and point of contact internally for all claims across departments and externally with OEMs could benefit the warranty claim process. The Warranty Administrator is also made responsible for maintaining the warranty database of opportunities, assessments, claims, disputes and follow-up actions.

9. New Aircraft Warranty and Use Cases

The goal of Warrant Management is to maximize recovery, but it is challenging to assess the opportunity. The International Aviation Warranty Association[5] (IAWA) recognizes that an airline's total warranty recovery can be modeled and targeted at 2% of Warranty Fleet Value (WFV). Note that this is a target number and it should be treated as a target only.

Example: For a new aircraft with a cost of $100M, the new warranty period is 4 years. Therefore, 2% WFV = $2M; i.e., $500k per year of potential recovery from warranties. These savings are estimated to be the result of Cost Avoidance and Credit Recovery.

The 2% WFV model is an indicative estimate of the potential warranty recovery only. Airlines have successfully achieved 1% - 2% of their WFV. The 2% WFV can therefore be used to set annual savings targets and resource requirements – *but it's not an exact science!*

From practical experience, IAWA and Airinmar show the potential 2% of the New Aircraft WFV is split in the recovery areas shown in the Figure 7.

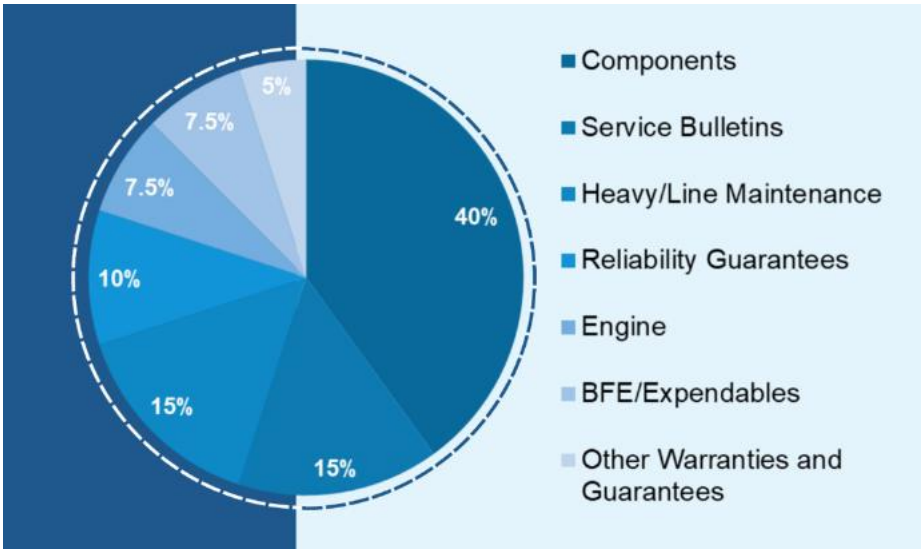


Figure 7 – Empirical Breakdown of Warranty Recovery Areas for NAW
Source: Airinmar

Airbus', Boeing's or MRO Total Support Programs, Component Flight Hour, Engine PBH and Cabin Equipment MSA are popular industry agreements that include warranty provisions for the aircraft areas that they cover.

From practical experience, 60-70% of entitlement is outsourced through suppliers (component service providers on a Flight Hour basis, Engine PBH etc.). In such cases, the airline needs to provide delegation for its suppliers, otherwise, the entitlement may be lost. At the same time, the airline should receive a reduced flight hour rate equivalent to the warranty entitlement recovery. The remaining 30-40% of the entitlement is split into Cost Avoidance and proactive recovery depending on the efficiency of the warranty detection process (e.g., the use of

[5] **IAWA is a group of airline warranty practitioners.**

MIS/ERP systems etc.). Typically, the range of cost avoidance is in the 30-70% range while the range of credit or FOC material recovery is the remaining 70-30% range.

9.1. Use Case 1: Component Repair TAT Guarantee

The Fuel pump of a 737 is covered by Boeing's PSAA and has been sent to the OEM for repair with total costs across 3 quarters at $658k. The airline submits the claim packs with all supporting documentation and provides all related answers to the OEM. The OEM employed additional staff, changed its processes and refocused on airline contracts. In the subsequent period, only two claim packs totaling $4.3k followed. The airline recovered costs and the OEM became more efficient and avoided further future TAT Guarantee Penalties of high value.

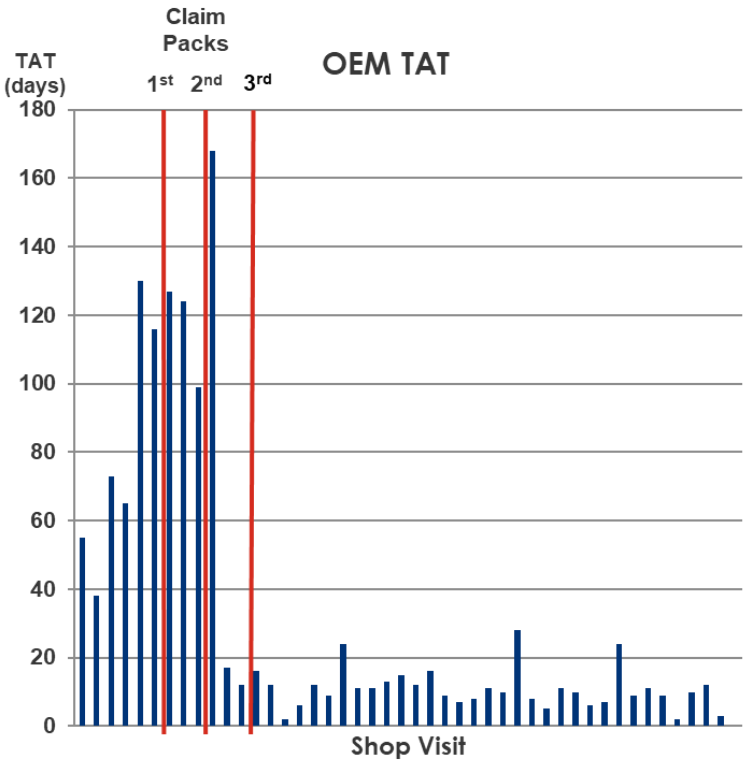


Figure 8 – Fuel Pump Warranty Repairs and Turn-Around Times
Source: Airinmar

9.2. Use Case 2: Engine Performance Guarantee

There is an Engine Oil Consumption Ten-Year Guarantee on a PW1100-powered A320. However, during the last 12 months, it averaged 0.24 U.S quarts per flight hour versus 0.2 target (performance guarantee). This resulted in oil consumption leading to an overspend of $116k for the last 12 months. This penalty rolled into a five- and ten-year reconciliation with the OEM.

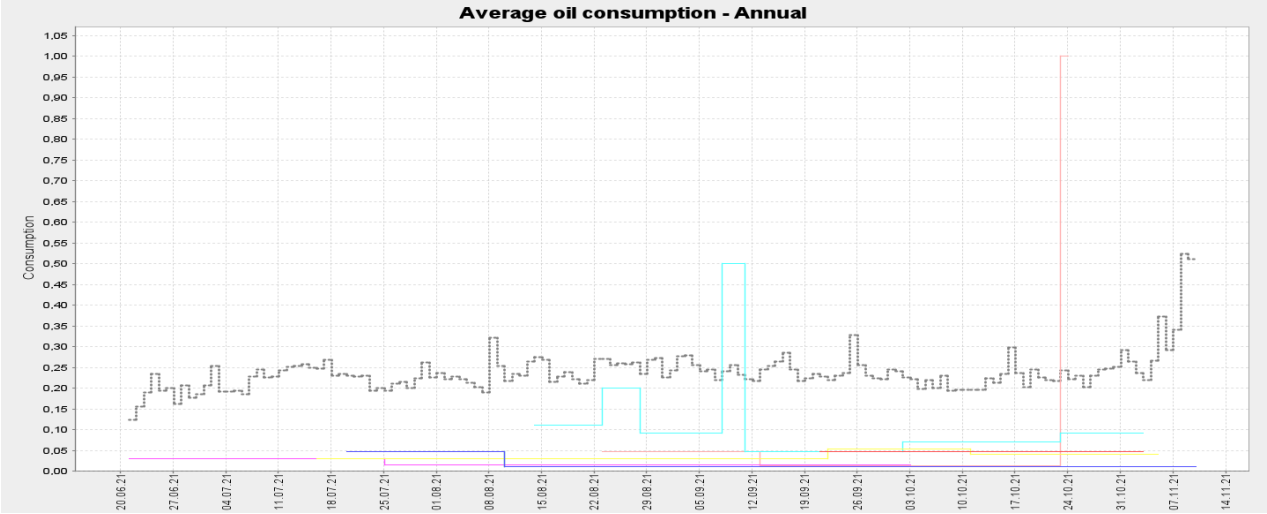


Figure 9 - Average Annual Oil Consumption as Monitored
Source: Airinmar

Example rule	Example Parameter
Oil Consumption	0.2 quarts per flight hr
Computation	Engine fleet average
Supplier remedy mitigation	None
Remedy options	Financial penalty
Financial Penalty	Excess oil consumed
Financial Penalty Cap	$2,000,000
Reporting/Claim time limit	Annual plus 5/10 year

Table 7 - Summary of Use Case 2
Source: Airinmar

9.3. Use Case 3: Component Flight Hour Warranty Reduction for New Aircraft Warranty

A window unit (Fig. 10) was removed from the aircraft within the NAW period and was sent by the Flight Hour Service Provider to the OEM. A cost of over $60k was quoted to replace the window due to Customer Induced Damage – not normal wear and tear. The removal reason was failure of the "Window Heat, Left Side". The warranty was denied due to heavy scratches on the inner main ply. The challenge was made directly to the OEM (bypassing the FH Service Provider):

- The OEM focused only on the scratches when deeming unit CID/BER, it did not recognize the root cause, i.e., the failure of the heating mechanism.
- The OEM argued that scratches on inner main ply should be considered a secondary failure, i.e., attempts to clear the window for visibility.

Eventually, the OEM agreed to replace the windshield FOC under warranty, which covered the cost of a brand new window unit replacement.

Figure 10 - Window Unit Removed from Aircraft within NAW Period
Source: Airinmar

10. Practical Implementation Framework for Warranty Management

This section moves from concepts to execution. It is intended for airlines that already understand what warranty, guarantee and goodwill mean, and now need a practical, structured way to put warranty management into daily operations, connecting contractual rights, maintenance events, technical evidence, cost recovery, supplier accountability, reliability feedback and performance requirements.

Warranty management should be understood not only as a claim submission activity, but as a structured process that connects contractual rights, maintenance events, technical evidence, cost recovery, supplier accountability, reliability feedback, and the performance requirements established between suppliers and customers, including aircraft owners and operators. Product support agreements between the airframers (OAMs) and their suppliers (component OEMs) should also be included (as applicable).

In a high-cost operating environment, airlines have limited control over several major cost drivers, such as fuel prices, exchange rates, airport charges, customs and taxation, supply chain disruptions, regulatory and other government requirements. Maintenance, however, remains one of the areas where operators can improve internal governance, reduce avoidable losses and recover value from contractual rights already negotiated with OEMs, OAMs, MROs and their suppliers in general.

A practical warranty management framework can help airlines move from a reactive and fragmented process to a proactive, measurable and cross-functional system. The following seven-step approach may be used by operators seeking to implement or strengthen their warranty management activities.

Objective of This Section

The objective is to translate the concepts introduced earlier in this paper into a practical, step-by-step framework that airlines can use to implement or strengthen their warranty management activities. It focuses on the following points:

- Present a structured, sequential framework covering the full warranty management cycle, from contractual mapping to contract intelligence
- Provide airlines with practical tools to identify, evidence, prioritize and recover contractual warranty opportunities
- Explain how to build data visibility and KPI-based performance management around warranty activities
- Support the development of a cross-functional warranty culture within the organization
- Introduce a transparent, criteria-based method for prioritizing warranty claims
- Explore how artificial intelligence and contract intelligence tools may support, rather than replace, warranty and contract management professionals

Structure and Organization

This section builds directly on the concepts, terminology and organizational models introduced earlier. While the previous sections focused on defining warranty, guarantee and goodwill, and on describing how a warranty function can be organized within an airline, this section focuses on implementation. It presents a practical seven-step framework for putting these concepts into action.

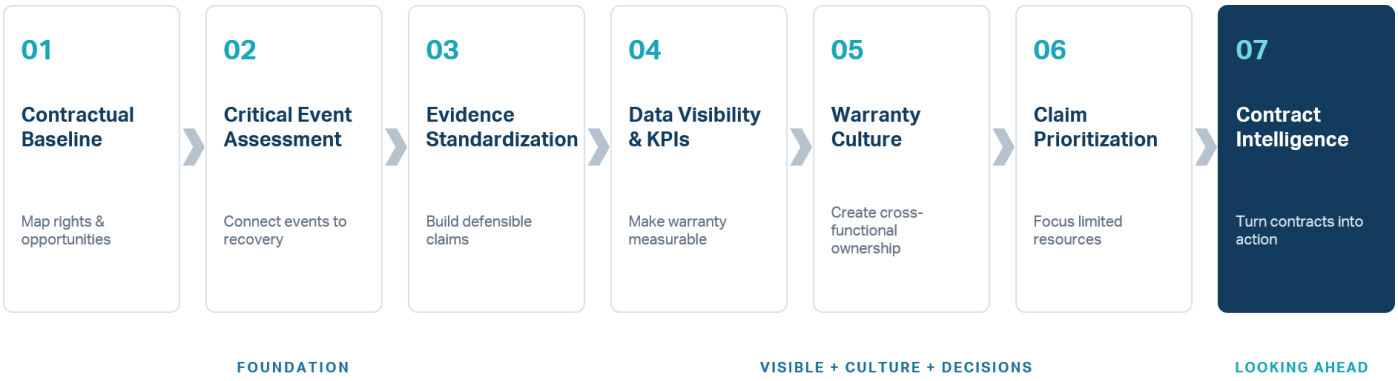


Figure 11 - Seven Steps of Warranty Management Cycle

- **Setting the foundation**: steps 1 to 3 establish the contractual and technical foundation of warranty management: mapping contractual warranty opportunities, reconstructing critical technical events and standardizing the evidence required to support a claim.
- **Making warranty visible and measurable**: step 4 addresses how to centralize warranty data and monitor it through Key Performance Indicators (KPIs), moving warranty management from individual memory to a shared, measurable process.
- **Building the right culture**: step 5 addresses the cross-functional training required so that maintenance, engineering, materials, contracts and finance teams understand their role in identifying warranty opportunities and preserving evidence.
- **Deciding what matters most**: step 6 introduces a structured, criteria-based method to prioritize warranty claims when resources are limited, using a transparent and repeatable decision process.
- **Looking ahead**: step 7 explores how artificial intelligence and contract intelligence tools may support the warranty process, while keeping human judgment and governance at the center of every decision.

10.1. Step 1 – Contractual Baseline and Warranty Opportunity Mapping

The first step is to establish a clear contractual baseline. Airlines should identify and organize all contractual sources that may create warranty, guarantee, goodwill, service life policy, commitment letter, performance requirement, penalty, liquidated damages or other recovery opportunities.

This includes, when applicable:

- Aircraft purchase agreements;
- Lease agreements covering or addressing warranty rights, maintenance obligations and return conditions;
- Product support agreements;
- Supplier support conditions;
- Service life policies;
- Commitment letters;
- Service bulletins and service letters;
- Repair contracts;
- Pool agreements;
- Loan/borrow agreements for aircraft parts, components or equipment;
- MRO agreements;
- Component purchase orders;
- Specific commercial arrangements with OEMs, OAMs, vendors, lessors, pool providers, and repair stations.

The output of this step should be a warranty opportunity matrix. This matrix should identify the asset or service covered, all the applicable terms of coverage and warranty period, eligibility criteria, claimable remedies, penalties, exclusions, required evidence, responsible internal area and supplier contact point.

It should also include the relevant time horizons applicable to each agreement, such as:

- Time to file the claim;
- Time for the supplier, OEM, OAM, MRO, lessor or service provider to acknowledge receipt;
- Time to respond with acceptance, rejection or request for additional evidence;
- Time to issue payment, credit note, free-of-charge repair, free-of-charge material, replacement or other agreed remedy.

The purpose is to ensure that warranty rights, contractual obligations and related clauses are visible before a maintenance event occurs. Warranty is time-sensitive, and opportunities may be lost when contractual terms, deadlines and recovery mechanisms are not mapped in advance.

10.2. Step 2 – Critical Event and Performance Recovery Assessment

Certain technical events may generate costs beyond the immediate repair or replacement of a component. These may include Aircraft on Ground situations, repeated removals, premature failures, performance degradation, extended turnaround time, replacement costs and operational disruption.

For this reason, airlines should establish a method to reconstruct and assess critical events. This assessment should connect technical facts, operational impact and contractual provisions.

A critical event assessment may include:

- OEM identification, CAGE code;
- Failure description;
- Aircraft registration;

- Affected part number and serial number;
- Location, date and time of occurrence; name/signature/contact information of the individual reporting;
- AOG duration or operational restriction;
- Maintenance action performed;
- Replacement, repair or exchange fee cost;
- Labor hours associated with removal, replacement, testing and repair;
- Additional material consumption;
- Delay or disruption impact, when contractually relevant;
- Applicable warranty, guarantee or support agreement;
- Supplier, OEM or OAM responsibility;
- Evidence available to support the claim, including photographic evidence, videos, data monitoring system records, maintenance records, fault messages, BITE reports, test equipment outputs, shop findings or post-flight reports.

This step does not mean that all consequential costs will be claimable. Many warranty provisions exclude consequential losses. However, structured event reconstruction allows the airline to understand the financial and operational impact of failures, support negotiations, challenge recurring issues and build stronger technical dossiers when the contract allows recovery.

10.3. Step 3 – Evidence Standardization and Claim Infrastructure

A warranty claim is only as strong as the evidence behind it. Many claims are delayed, partially accepted or denied because the documentation is incomplete, inconsistent or not collected at the time of the maintenance event.

Airlines should therefore implement a standard evidence infrastructure. This may include standard operating procedures, claim templates, photographic/audio/video evidence, removal reason guidelines, approval workflows and document retention rules.

Recommended evidence may include:

- Manufacturer and CAGE Code;
- Manufacturing date
- Part number and serial number;
- Aircraft registration;
- Installation and removal dates;
- TSN, TSO, CSN, CSO, and flight hours;
- Reason for removal;
- Maintenance records;
- Work order or repair order;
- Shop findings;
- Fault messages, BITE data, test equipment outputs, bench test results, shop test reports or post-flight reports;
- Photos or video capture of the defect;
- Service bulletin reference, when applicable;
- Repair quotation or invoice;
- Previous failure history;
- Contractual reference.

The objective is to make evidence collection part of the normal maintenance and material flow. This reduces dependency on individual experience and helps ensure that claims are technically defensible before submission.

10.4. Step 4 – Warranty Data Visibility, Portal and KPI Monitoring

Warranty management cannot be effectively controlled if information is fragmented across emails, spreadsheets, repair orders, ERP transactions, maintenance systems, supplier portals and contract files. When warranty data is not centralized, eligible claims may be missed, deadlines may expire, disputes may not be followed up, and management may not have a clear view of the value being recovered or lost.

For this reason, airlines should separate two complementary layers of warranty management: the visibility layer and the performance measurement layer.

10.4.1 Warranty Visibility Repository

The first layer is the creation of a centralized warranty repository. The purpose of this repository is to provide operational visibility over contracts, assets, claims, deadlines, evidence and supplier responses.

This repository does not need to be complex at the beginning. Airlines may start with a controlled SharePoint site, Microsoft Lists, Teams-based workspace, Excel tracker, internal portal, or an existing MIS/ERP module. As the process matures, the repository may be integrated with data visualization and business intelligence tools (such as: Power BI, Tableau, etc.), the Maintenance Information System, ERP, supplier portals or workflow automation tools.

The repository should act as the single operational reference point for warranty teams and related departments.

It may include:

- Applicable contracts and warranty clauses;
- Warranty periods by aircraft, engine, component, vendor or service;
- Aircraft and components under warranty;
- Claim submission deadlines;
- Open warranty opportunities;
- Submitted claims;
- Disputed claims;
- Denied claims;
- Approved claims;
- Credit notes and recoveries;
- Supplier responses;
- Required evidence;
- Claim owner;
- Internal status;
- Next action date;
- Escalation history.

The objective is to make warranty opportunities visible before they are lost. A well-structured repository helps the organization move from individual memory and informal controls to traceable, auditable and shared warranty governance.

10.4.2 KPI-Based Performance Management

The second layer is performance measurement. Visibility alone is not sufficient. The airline must also measure whether the warranty process is effective, fast, accurate and financially relevant.

KPIs should help management answer practical questions such as:

- Are we recovering what we are entitled to?
- Are claims being submitted on time?
- Are claims being rejected because of weak documentation?
- Which suppliers have the highest denial rates?
- Which part numbers generate recurring warranty claims?
- Where is the backlog concentrated?
- How long does each claim remain open?
- Which contracts generate the highest recovery?
- Which departments need additional training or process correction?

Recommended KPIs include:

- Financial recovery KPIs
- Total amount claimed;
- Total amount recovered;
- Warranty Recovery Rate;
- Claimed amount versus approved amount;
- Open recoverable value;
- Recovery by supplier;
- Recovery by fleet;
- Recovery by part number;
- Recovery by contract type;
- Credit notes received;
- Claims converted into free-of-charge repairs or free-of-charge material.
- Time to address or resolve the warranty issue;
- Time to settlement, including payment, credit note issuance, free-of-charge repair, free-of-charge material, replacement or other agreed remedy.

KPI	Definition	Formula / Calculation	Notes
Total Amount Claimed	Total monetary value submitted by the airline through warranty claims during a defined period.	Σ Claimed Amounts	Includes all claims submitted, regardless of whether they are approved, denied, partially approved or still open.
Total Amount Recovered	Total monetary value effectively recovered by the airline through approved warranty claims.	Σ Recovered Amounts	May include payment, credit note, free-of-charge repair, free-of-charge material, replacement, exchange, concession or other agreed remedy.
Warranty Recovery Rate	Percentage of the total claimed warranty value that was effectively recovered.	Total Amount Recovered ÷ Total Amount Claimed × 100	Measures aggregate recovery performance, not an individual claim.
Claimed Amount versus Approved Amount	Comparison between the value submitted by the airline and the value approved by the supplier, OEM, OAM, MRO or repair station.	Approved Amount ÷ Claimed Amount × 100	Helps identify partial approvals, reductions, disputes or differences in interpretation of claimable value.
Open Recoverable Value	Estimated value of warranty opportunities or claims that are still open and may potentially be recovered.	Σ Estimated Value of Open Claims or Opportunities	Includes submitted claims pending response, disputed claims and identified opportunities not yet submitted, depending on airline practice.
Recovery by Supplier	Total value recovered from each supplier, OEM, OAM, MRO, repair station or service provider.	Σ Recovered Amounts by Supplier	Useful for supplier performance reviews and contract renegotiations.
Recovery by Fleet	Total value recovered by aircraft fleet or aircraft type.	Σ Recovered Amounts by Fleet / Aircraft Type	Helps identify fleets with higher warranty activity or recovery potential.
Recovery by Part Number	Total value recovered by component part number.	Σ Recovered Amounts by Part Number	Supports reliability analysis and identification of recurring component issues.
Recovery by Contract Type	Total value recovered by type of agreement.	Σ Recovered Amounts by Contract Type	Contract types may include warranty agreements, PSAA, SSC, PSC, lease agreements, repair agreements, pool agreements, PBH, MRO agreements or service bulletin support.
Credit Notes Received	Total number and/or value of credit notes issued by suppliers as settlement for approved warranty claims.	Count of Credit Notes Received and/or Σ Credit Note Value	Can be measured by quantity, monetary value, supplier, contract or period.
Claims Converted into FOC Repairs or FOC Material	Number and/or value of claims settled through free-of-charge repair or free-of-charge material instead of direct payment or credit.	Count of FOC Settlements and/or Σ Estimated Value of FOC Repairs / FOC Material	Important because recovery is not always monetary; it may occur through services, parts or replacement.
Time to Address or Resolve the Warranty Issue	Average time required to technically and commercially address the warranty issue from identification to resolution.	Σ Resolution Time ÷ Number of Resolved Claims	Resolution time may be measured from event identification, claim opening or claim submission, depending on the airline's defined process.
Time to Settlement	Average time between claim approval and final settlement through payment, credit note, FOC repair, FOC material, replacement or other agreed remedy.	Σ Settlement Time ÷ Number of Settled Claims	This KPI measures how long it takes for the airline to receive the actual remedy after approval.

Table 8 - Recommended KPIs Definitions

Note: Airlines should clearly define the starting and ending points for each time-based KPI. For example, "time to resolve" may start from the maintenance event, claim identification or claim submission, while "time to settlement" should normally start from claim approval and end when payment, credit note, free-of-charge repair, free-of-charge material, replacement or other agreed remedy is received.

Claim Quality KPIs

- Claim approval rate;
- Claim denial rate;
- Partial approval rate;
- Denials by reason;
- Claims rejected due to missing evidence;
- Claims requiring rework;
- No Fault Found cases;
- Documentation completeness rate;
- Supplier/OEM/OAM time to respond;
- Time to Settlement After Claim Approval

KPI	Definition	Formula / Calculation	Notes
Claim Approval Rate	Percentage of submitted claims approved by the supplier, OEM, OAM, MRO or repair station.	Number of Approved Claims ÷ Total Number of Submitted Claims × 100	Measures the effectiveness of claim preparation and eligibility assessment.
Claim Denial Rate	Percentage of submitted claims that were denied by the supplier, OEM, OAM, MRO or repair station.	Number of Denied Claims ÷ Total Number of Submitted Claims × 100	A high denial rate may indicate weak documentation, poor eligibility screening, expired deadlines or contractual misunderstanding.
Partial Approval Rate	Percentage of submitted claims that were only partially approved.	Number of Partially Approved Claims ÷ Total Number of Submitted Claims × 100	Useful to identify value reductions, disagreements over labor/material coverage, exclusions or differences between claimed and approved amounts.
Denials by Reason	Distribution of denied claims by the reason provided by the supplier, OEM, OAM, MRO or repair station.	Number of Denials per Reason ÷ Total Number of Denied Claims × 100	Typical reasons may include missing evidence, expired warranty period, wear and tear, NFF, exclusion clauses, improper maintenance or lack of contractual coverage.
Claims Rejected Due to Missing Evidence	Number or percentage of claims rejected because required documentation or technical evidence was not provided.	Number of Claims Rejected Due to Missing Evidence ÷ Total Number of Denied or Rejected Claims × 100	Helps identify gaps in evidence collection, such as missing photos, BITE reports, shop findings, work orders or removal records.
Claims Requiring Rework	Number or percentage of claims that had to be corrected, completed or resubmitted before supplier evaluation or approval.	Number of Claims Requiring Rework ÷ Total Number of Submitted Claims × 100	Indicates the quality of the initial claim package and the maturity of the internal claim preparation process.
No Fault Found Cases	Number or percentage of warranty-related claims or component removals classified as No Fault Found.	Number of NFF Cases ÷ Total Number of Relevant Claims or Component Removals × 100	May indicate troubleshooting issues, intermittent failures, insufficient evidence, bench test limitations or removal process gaps.
Documentation Completeness Rate	Percentage of claims submitted with all required supporting documents according to contract or supplier requirements.	Number of Claims with Complete Documentation ÷ Total Number of Claims Submitted × 100	Required documents may include PN/SN, manufacturer, CAGE Code, removal reason, work order, BITE report, shop findings, photos, test equipment outputs and contractual reference.
Supplier/OEM/OAM Time to Respond	Average time taken by the supplier, OEM, OAM, MRO or repair station to respond after claim submission.	Σ Response Time ÷ Number of Claims Responded	Response time should be measured from claim submission date to first formal response, such as acknowledgment, request for evidence, approval, partial approval or denial.
Time to Settlement After Claim Approval	Average time taken to receive the agreed remedy after claim approval.	Σ Time from Claim Approval to Final Settlement ÷ Number of Approved Claims Settled	Settlement may include payment, credit note issuance, FOC repair, FOC material, replacement, exchange, concession or other agreed remedy.

Table 9 - Claim Quality KPIs Definitions

Technical, reliability and supplier performance KPIs

- Recurring failures by part number;
- Claims by ATA chapter or system;
- Claims by aircraft registration;
- Claims by component family;
- Repeat removals under warranty;
- Warranty claims associated with service bulletins;
- Components with high warranty activity;
- Suppliers with recurring quality issues;
- Delayed deliveries by supplier, OEM, OAM, MRO or repair station;
- Contractual penalties or liquidated damages related to late delivery;
- Number and value of late delivery penalties claimed;
- Number and value of late delivery penalties recovered;
- Delivery performance against contractual lead times or service level obligations.

KPI	Definition	Formula / Calculation	Notes
Recurring Failures by Part Number	Measures how often the same part number is associated with repeated warranty claims, removals or failures within a defined period.	Number of Failures or Claims for a Specific Part Number	Helps identify components with potential reliability, design, quality or maintenance issues.
Claims by ATA Chapter or System	Groups warranty claims according to ATA chapter or aircraft system.	Number of Claims per ATA Chapter or System and/or Claim Value per ATA Chapter or System	Useful to identify systems generating higher warranty activity, such as avionics, landing gear, engines, cabin, hydraulics or electrical systems.
Claims by Aircraft Registration	Measures the number and/or value of warranty claims associated with each aircraft registration.	Number of Claims per Aircraft Registration and/or Claim Value per Aircraft Registration	Helps detect aircraft-specific trends, repeated issues on a particular tail number or abnormal warranty activity by aircraft.
Claims by Component Family	Groups warranty claims by component family or equipment category.	Number of Claims per Component Family and/or Claim Value per Component Family	Examples may include wheels and brakes, actuators, avionics units, valves, sensors, pumps, starters or cabin equipment.
Repeat Removals Under Warranty	Measures components removed more than once while still under warranty coverage.	Number of Repeat Removals Under Warranty and/or Repeat Removals ÷ Total Warranty Removals × 100	Supports reliability analysis and may indicate premature failure, ineffective repair, installation issues, intermittent faults or supplier quality concerns.
Warranty Claims Associated with Service Bulletins	Measures warranty claims related to Service Bulletins, Service Letters or other service literature.	Number of Warranty Claims Associated with SBs/SLs and/or Claim Value Associated with SBs/SLs	Helps track commercial support, labor recovery, material support and recurring issues addressed through service literature.

Components with High Warranty Activity	Identifies components generating a high number or high value of warranty claims.	Rank Components by Number of Claims and/or Total Claimed/Recovered Value	Useful for prioritizing supplier discussions, reliability investigations and contract reviews.
Suppliers with Recurring Quality Issues	Identifies suppliers, OEMs, OAMs, MROs or repair stations associated with repeated quality-related warranty claims.	Number of Quality-Related Claims per Supplier and/or Quality-Related Claims ÷ Total Claims per Supplier × 100	May support supplier performance reviews, corrective action requests and renegotiation of support terms.
Delayed Deliveries by Supplier, OEM, OAM, MRO or Repair Station	Measures the number of deliveries completed after the contractual delivery date, lead time, TAT or SLA.	Number of Late Deliveries by Supplier/OEM/OAM/MRO/Repair Station and/or Late Deliveries ÷ Total Deliveries × 100	Can include late delivery of repaired components, replacement parts, exchange units, FOC material, loaner parts or other agreed remedies.
Contractual Penalties or Liquidated Damages Related to Late Delivery	Measures the applicability and value of penalties or liquidated damages triggered by late delivery under contractual terms.	Σ Contractual Penalties or Liquidated Damages Applicable to Late Deliveries	Should be calculated according to the specific contract clause, such as a fixed amount, percentage of order value or daily penalty.
Number and Value of Late Delivery Penalties Claimed	Measures how many late delivery penalty claims were submitted and the total value claimed.	Count of Late Delivery Penalty Claims Submitted and Σ Value of Late Delivery Penalties Claimed	Helps assess whether contractual rights related to delivery delays are being actively enforced.
Number and Value of Late Delivery Penalties Recovered	Measures how many late delivery penalty claims were accepted and the total value recovered.	Count of Late Delivery Penalty Claims Recovered and Σ Value of Late Delivery Penalties Recovered	Recovery may occur through payment, credit note, commercial concession, invoice offset or another agreed remedy.
Delivery Performance Against Contractual Lead Times or Service Level Obligations	Measures whether suppliers, OEMs, OAMs, MROs or repair stations are meeting agreed contractual lead times, TATs or service levels.	On-Time Deliveries ÷ Total Deliveries × 100	This KPI supports supplier performance reviews and helps identify chronic delivery delays or SLA non-compliance.

Table 10 - Technical, Reliability and Supplier Performance KPIs Definitions

Note: Airlines should define whether delivery performance is measured against contractual lead time, quoted lead time, repair TAT, exchange unit delivery date, FOC material delivery date or another agreed service level. The applicable baseline should be clearly stated in the contract or purchase/repair order.

Management and governance KPIs

- Monthly claim pipeline;
- Claims by owner or department;
- Escalated disputes;
- Claims discussed in internal and external performance review meetings;
- Contracts approaching warranty expiration;
- Assets under active warranty coverage;
- Training needs identified through documentation errors.

KPI	Definition	Formula / Calculation	Notes
Monthly Claim Pipeline	Measures the total number and/or value of warranty claims in the pipeline during a given month.	Count of Open, Submitted, Disputed and Pending Claims per Month and/or Σ Claim Value in Pipeline per Month	Helps management understand workload, expected recovery, backlog pressure and monthly warranty activity.
Claims by Owner or Department	Shows how warranty claims are distributed across internal owners or departments responsible for follow-up.	Number of Claims per Owner or Department and/or Claim Value per Owner or Department	Useful to identify workload concentration, accountability gaps and areas requiring additional support. Departments may include Warranty, Engineering, Maintenance, Materials, Contracts, Procurement, Finance or Quality.
Escalated Disputes	Measures the number and/or value of disputed claims escalated beyond the standard claim handling process.	Count of Escalated Disputes and/or Σ Value of Escalated Disputed Claims	May include claims escalated to supplier account managers, OEM/OAM representatives, MRO management, lessors, legal, commercial teams or executive review.
Claims Discussed in Internal and External Performance Review Meetings	Measures how many claims are formally reviewed in internal cross-functional meetings and external performance discussions with suppliers, OEMs, OAMs, MROs, lessors or repair stations.	Number of Claims Discussed in Performance Review Meetings ÷ Total Relevant Claims × 100	Helps ensure that warranty issues are not only tracked administratively, but also used for performance management, supplier accountability and corrective actions.
Contracts Approaching Warranty Expiration	Measures the number of contracts, assets or warranty coverages approaching expiration within a defined period.	Count of Contracts or Assets with Warranty Expiration within Defined Horizon	The horizon may be defined by the airline, for example 30, 60, 90 or 180 days before expiration. Helps prevent missed recovery opportunities.
Assets Under Active Warranty Coverage	Measures the number of aircraft, engines, components, systems or services currently covered by an active warranty, guarantee, service life policy or support agreement.	Count of Assets Under Active Warranty Coverage	Provides visibility over the active warranty population and supports proactive claim detection.
Training Needs Identified Through Documentation Errors	Measures process or knowledge gaps identified through recurring documentation errors in warranty claims.	Number of Documentation Errors by Type, Team or Department and/or Documentation Error Rate = Claims with Documentation Errors ÷ Total Claims Reviewed × 100	Helps define targeted training for Maintenance, Engineering, Materials, Contracts, Procurement, Finance or Warranty teams.

Table 11 - Management and Governance KPIs Definitions

Note**:** Management and governance KPIs should be reviewed periodically with both internal stakeholders and external contractual parties. Their purpose is to ensure accountability, timely escalation, process ownership and continuous improvement across the warranty management cycle.

10.4.3 Use of Dashboards and Business Intelligence Tools

Once the repository is structured, airlines may use business intelligence tools to transform warranty data into management information. Power BI, Tableau, Qlik, Excel dashboards, SharePoint dashboards or MIS/ERP reporting modules can be used depending on the airline's digital maturity.

A dashboard should not be created only to display numbers. It should support decisions.

Examples of dashboard views include:

- Executive warranty recovery overview;
- Open claims by supplier and aging;
- Claims at risk of deadline expiration;
- Denied claims by reason;
- Claim approval rate by supplier;
- Recovery by fleet and aircraft type;
- Recurring failures by part number;
- Backlog evolution;
- Monthly recovered value;
- Comparison between amount claimed and amount obtained;
- Warranty opportunities by contract;
- Components with repeated warranty events.

These dashboards can support monthly warranty reviews, supplier performance meetings, contract renegotiations, reliability discussions and internal process improvement.

10.4.4 Management Use of Warranty KPIs

Warranty KPIs should not remain isolated within the warranty team. They should be reviewed with the departments that influence the process, including Engineering, Maintenance, Materials, Contracts, Procurement, Finance and Quality.

For example:

- Engineering may use recurring claim data to identify reliability issues.
- Maintenance may use denial reasons to improve evidence collection.
- Materials may use warranty status to avoid unnecessary repair costs.
- Contracts may use supplier performance data during renegotiations.
- Finance may use open and approved claims to improve recovery forecasting.
- Quality may use recurrent failures to support supplier corrective actions.

In this sense, KPIs become more than financial indicators. They become a mechanism for operational governance, supplier accountability and continuous improvement.

10.4.5 Expected Benefits

A structured warranty repository combined with KPI-based performance management may help airlines:

- Increase visibility of warranty opportunities;
- Reduce missed deadlines;
- Reduce backlog;
- Improve claim approval rates;
- Identify weak documentation patterns;
- Support supplier performance reviews;
- Improve recovery forecasting;
- Detect recurring technical issues;

- Support contract renegotiation;
- Reduce dependence on informal spreadsheets and individual knowledge;
- Move warranty management from a reactive process to a measurable management system.

The purpose of this step is not only to monitor claims, but to make warranty management visible, measurable and actionable.

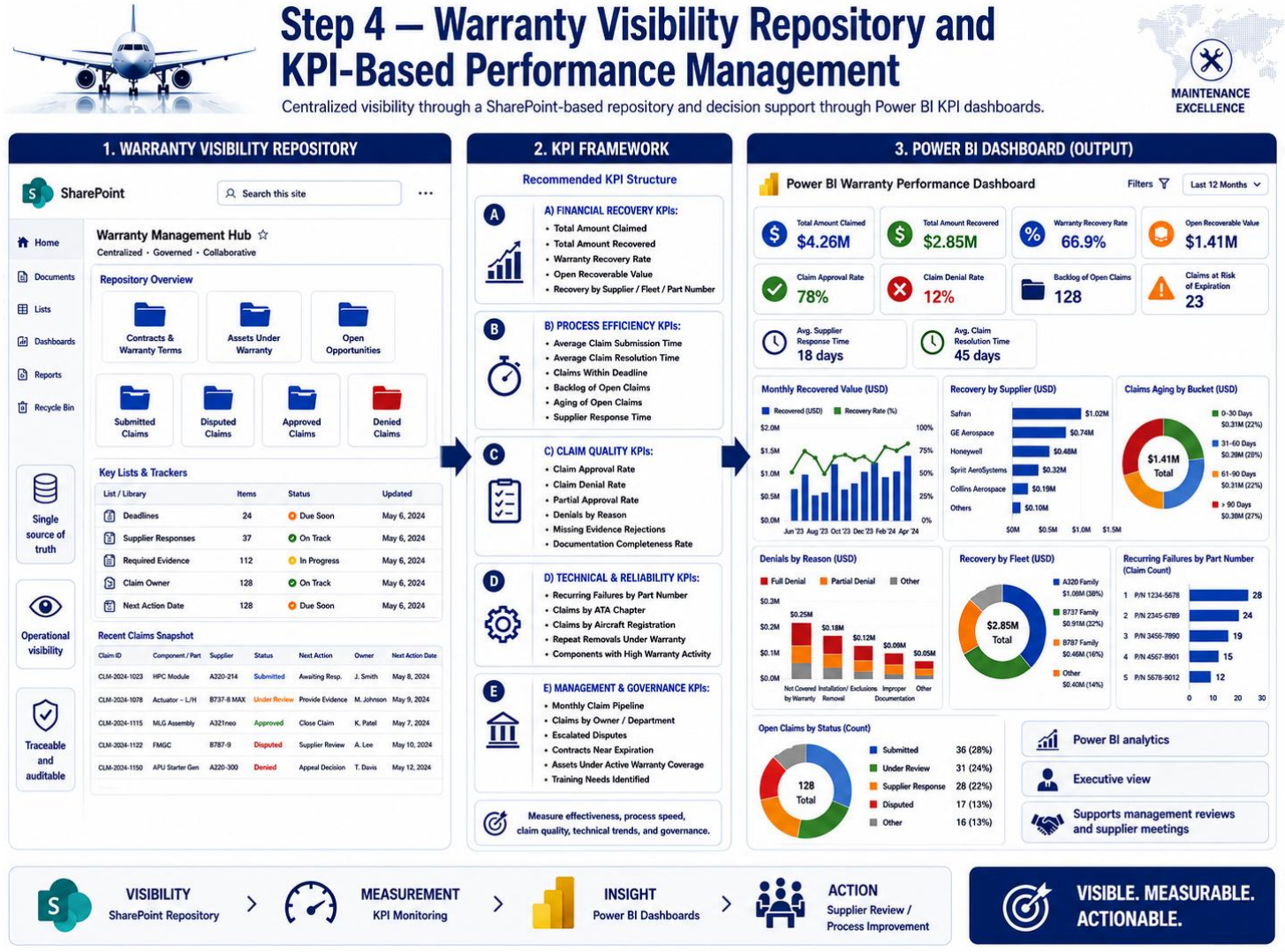


Figure 12 - Warranty Visibility Repository and KPI-Based Performance Management
For illustrative purposes only.

10.5. Step 5 – Cross-Functional Training and Warranty Culture

Warranty management is not the responsibility of one person alone. It depends on the quality of information produced by several areas, including maintenance, engineering, materials, purchasing, contracts, finance, logistics and stores.

For this reason, airlines should implement cross-functional training. Each group should understand its role in identifying warranty opportunities, preserving evidence and supporting claim submission.

Training may cover:

- Basic warranty concepts;
- Difference between warranty, guarantee and goodwill;
- Claimable and non-claimable items;
- Documentation requirements;
- Evidence collection;
- Common denial reasons;
- Use of internal warranty tools;
- Escalation process for disputed claims;
- Supplier communication;
- Importance of timely claim submission.

The objective is to create a warranty culture across the organization. When mechanics, inspectors, buyers, repair teams, engineers and contract professionals understand the process, the airline reduces missed opportunities and improves the quality of claims.

Organization Models

Airlines may also decide to outsource part or all of their warranty recovery activities to specialized service providers. Several companies in the aviation market offer warranty recovery, claim administration, contract review, data analysis and supplier follow-up services on behalf of operators. Examples include Airinmar, Aviation Warranty Solutions, Aerospace Warranty Management, Air Warranty and other specialized providers. This option may be useful for airlines with limited internal resources, insufficient warranty expertise, high claim volumes, multiple supplier agreements or complex recovery portfolios. However, outsourcing does not remove the need for internal governance. The airline should still retain visibility over contractual rights, claim status, recovery performance, supplier responses, disputed items, recovered value and lessons learned from recurring failures.

10.6. Step 6 – Data-Driven Claim Prioritization and Decision Support

When the number of potential warranty claims increases, airlines may not have enough resources to handle all opportunities with the same level of urgency. In this situation, prioritization becomes critical.

A structured prioritization method helps the warranty team decide which claims should be addressed first, based on transparent criteria rather than individual judgment alone. The method does not need to be complex at the

beginning. Airlines may start with a spreadsheet and later integrate the model into a warranty portal, dashboard, MIS or business intelligence tool.

One possible approach is to use a multi-criteria decision-making method, such as the Analytic Hierarchy Process, to rank warranty opportunities based on financial, contractual, operational and technical criteria.

The following practical steps present an adapted weighted scoring model, specifically tailored to the day-to-day operational needs of airline warranty management. It provides a practical and simplified approach to prioritizing warranty claims based on multiple criteria. Airlines may establish the criterion weights through management agreement or derive them using the Analytic Hierarchy Process (AHP), including pairwise comparisons and consistency assessment. The model can be further customized to reflect each airline's operational priorities, contractual requirements, and business objectives.

10.6.1 Building the Claim Inventory

The airline should first create a list of all potential warranty opportunities.

This inventory may include:

- Open warranty claims;
- Claims not yet submitted;
- Claims at risk of expiration;
- Disputed claims;
- Repeated removals;
- AOG-related events;
- Service bulletin-related claims;
- Premature failures;
- Repair invoices that may be covered by warranty;
- Components with recurring technical issues;
- Supplier performance or late delivery cases.

Each item should have a unique claim identification number or case reference.

Recommended minimum fields include:

- Claim ID
- Aircraft registration
- Aircraft type/version
- Part number; (Identifier assigned to a part, component, assembly or equipment item to identify the specific design, configuration or approved item being claimed.)
- Serial number; (Unique identifier assigned to an individual unit of a part, component or equipment item, distinguishing it from other units with the same part number.)
- Manufacturer; (Organization responsible for manufacturing or identifying the part, component, assembly or equipment item, preferably linked to a manufacturer code or CAGE Code when available.)
- Supplier, OEM, OAM, MRO or repair station CAGE Code
- Removal date
- Warranty expiration date
- Reason for removal
- Estimated claim value

- Current status
- Required next action
- Responsible internal owner

Optional fields for enhanced traceability and data structuring

Optional fields may also be included to improve technical traceability, system integration and reliability analysis, depending on the airline's data maturity and available systems.

One example of an optional field is the Functional Item Number (FIN). This is a standardized alphanumeric code used to identify a specific equipment item, system, component, or wire within an aircraft's design, which correlates with data exchange and structuring conventions under the ATA Spec 2000 standard. Not all airlines have FIN consistently structured or available at the same level of data maturity. Keeping it as an optional field makes the framework applicable both to airlines with mature maintenance/data systems and to operators that are still developing their warranty data structure.

Other examples of optional fields include:
- ATA chapter or system;
- Component position or installation location;
- Manufacturer CAGE Code;
- Batch number or lot number, when applicable;
- Work order number;
- Repair order number;
- Purchase order number;
- Service bulletin or service letter reference;
- Fault code or maintenance message;
- BITE report reference;
- Test equipment output reference;
- Shop finding code;
- Removal category, such as scheduled, unscheduled, premature, repeated or AOG-related removal;
- Warranty claim type, such as material, labor, service bulletin, repair warranty, guarantee, goodwill or penalty;
- Contract reference or clause number;
- Supplier response deadline;
- Claim submission deadline;
- Acknowledgment date;
- Supplier response date;
- Approval, denial or partial approval date;
- Payment, credit note or remedy date;
- Evidence completeness status;
- Link to supporting documentation repository;
- Related previous claim ID, when applicable;
- Reliability event reference, when applicable.

10.6.2 Select Prioritization Criteria

The airline should then define the criteria that will be used to compare and prioritize claims.

Recommended criteria include:

- Potential financial recovery;
- Remaining warranty period;
- Operational impact;
- Probability of claim approval;
- Recurrence of the failure;
- Documentation complexity;
- Supplier response history;
- Safety or reliability relevance;
- Strategic importance of the supplier, component or fleet.

Airlines may adapt these criteria according to their fleet size, internal resources, contractual structure and operational priorities.

10.6.3 Define the Weight of Each Criterion

Not all criteria have the same importance, for example, a high-value claim that will expire in five days may require more urgent action than a lower-value claim with complete documentation and a longer submission deadline.

The airline should assign a weight to each criterion, and the weights should total 100%.

Example of a simple weighting model:

Criterion	Suggested Weight
Potential financial recovery	25%
Remaining warranty period	20%
Operational impact	20%
Probability of claim approval	15%
Failure recurrence	10%
Documentation complexity	10%
Total	**100%**

Table 12 - Suggested weighting model for warranty claim prioritization criteria

These weights should be agreed with the relevant stakeholders, such as Warranty, Engineering, Maintenance, Materials, Contracts and Finance. The above-mentioned numbers are only a suggestion.

For airlines using the Analytic Hierarchy Process, the weights may be defined through pairwise comparisons. For airlines starting with a simpler method, weights may be defined through management agreement and adjusted over time based on results.

10.6.4 Create a Scoring Scale

Each claim should be scored against each criterion using a standard scale. A simple scale from 1 to 5 is usually sufficient.

Example:

Score	Meaning
1	Very low relevance or urgency
2	Low relevance or urgency
3	Medium relevance or urgency
4	High relevance or urgency
5	Very high relevance or urgency

Table 13 - Example of a 1–5 scoring scale for warranty claim prioritization criteria

The airline should define what each score means for each criterion.

Examples:

Score	Estimated Recovery Value
1	Very low value
2	Low value
3	Medium value
4	High value
5	Very high value

Table 14 - Example of score definitions for the potential financial recovery criterion

Score	Time Sensitivity
1	More than 90 days remaining
2	61–90 days remaining
3	31–60 days remaining
4	8–30 days remaining
5	7 days or less remaining

Table 15 - Example of score definitions for the remaining warranty period criterion

Score	Documentation Condition
1	Documentation incomplete and difficult to obtain
2	Significant documentation gaps
3	Some missing evidence, but recoverable
4	Documentation mostly complete
5	Documentation complete and ready for submission

Table 16 - Example of score definitions for the documentation complexity criterion

For documentation complexity, the airline may also choose to reverse the scale if the objective is to highlight difficult claims requiring additional effort. The scoring logic should be clearly defined before use.

10.6.5 Score Each Claim

The warranty team should score each claim against the selected criteria.

Example:

Claim ID	Financial Recovery	Warranty Period	Operational Impact	Approval Probability	Failure Recurrence	Documentation
Claim A	5	4	5	3	4	3
Claim B	3	5	2	4	2	5
Claim C	4	2	3	5	5	4

Table 17 - Example of claim scoring against selected prioritization criteria

The scoring should be performed by the warranty team with input from Engineering, Maintenance, Materials, Contracts and Finance when required.

10.6.6 Calculate the Weighted Score

Each criterion score should be multiplied by its assigned weight. The total weighted score will represent the claim priority.

Example formula:

Priority Score =

- Financial Recovery Score × 25% +
- Remaining Warranty Period Score × 20% +
- Operational Impact Score × 20% +
- Probability of Approval Score × 15% +
- Failure Recurrence Score × 10% +
- Documentation Complexity Score × 10%

Example:

Claim ID	Weighted Priority Score	Priority
Claim A	4.15	High
Claim B	3.45	Medium
Claim C	3.75	High

Table 18 - Example of weighted priority score and resulting claim priority

The airline may define priority bands such as:

Priority Band	Score Range	Recommended Action
High priority	4.0–5.0	Immediate action
Medium priority	3.0–3.9	Monitor and process according to capacity
Low priority	1.0–2.9	Process when resources are available or reassess later

Table 19 - Example of priority bands and recommended actions

10.6.7 Define the Action Plan

The priority score should lead to a clear action.

For high-priority claims, the airline may:

- Assign an owner immediately;
- Collect missing evidence;
- Escalate to Engineering, Contracts or Finance;
- Submit the claim before the deadline;
- Contact the supplier, OEM, OAM, MRO or repair station;
- Prepare a dispute package if the claim was denied;
- Include the case in supplier performance meetings.

For medium-priority claims, the airline may:

- Monitor the deadline;
- Complete missing documentation;
- Group similar claims by supplier or part number;
- Schedule the claim for submission;
- Review with the relevant internal department.

For low-priority claims, the airline may:

- Keep the case in the pipeline;
- Reassess if new evidence becomes available;
- Close the case if the effort is not justified;
- Use the information for trend analysis, even if no claim is submitted.

10.6.8 Review and Update the Ranking

The prioritization model should be reviewed regularly. A claim that is low priority today may become high priority if the warranty deadline approaches, the component fails again, the supplier issues a service bulletin, or the estimated recovery value increases.

Recommended review frequency:

- Weekly for claims close to expiration;
- Monthly for the full claim pipeline;
- Quarterly for criteria, weights and performance results.

The airline should also compare the model's ranking with actual outcomes, such as approval rate, recovery value, denial reasons and time to settlement. This helps improve the model over time.

10.6.9 Use the Results for Management Decisions

The ranking should not remain only inside the warranty team. It should support broader management decisions.

The output may be used for:

- Warranty team workload planning;
- Supplier and OAM performance reviews;
- Internal cross-functional meetings;
- Recovery forecasting;
- Contract renegotiation;
- Reliability analysis;
- Identification of recurring failures;
- Escalation of disputed claims;
- Training needs identification;
- Improvement of documentation processes.

The objective is not to replace expert judgment, but to support it with a transparent and repeatable decision process. This reduces subjectivity, improves resource allocation and helps prevent high-impact claims from being lost due to missed deadlines or lack of prioritization.

Expected Benefits

A structured warranty claim prioritization method may help airlines:

- Focus resources on the most relevant claims;
- Reduce missed high-value opportunities;
- Avoid deadline expiration;
- Improve claim preparation and submission speed;
- Increase recovery efficiency;
- Reduce subjectivity in decision-making;
- Identify recurring technical issues;
- Support supplier accountability;
- Improve reliability feedback to OEMs and suppliers;
- Provide better inputs for contract negotiation;
- Strengthen cross-functional collaboration.

In this sense, warranty management becomes a bridge between cost control, technical reliability, supplier performance and continuous improvement.

Figure 13 - Analytic Hierarchy Process (AHP) Based Warranty Claim Prioritization
For illustrative purposes only.

10.7. Step 7 – Contract Intelligence

As warranty management becomes more data-driven, airlines may benefit from using artificial intelligence tools to improve contract visibility, clause interpretation and warranty opportunity detection.

Aircraft owners, operators, manufacturers, MRO providers, lessors, repair organizations and suppliers operate under a wide range of technical and commercial agreements. These contracts define warranty rights, product support obligations, service levels, supplier responsibilities, performance requirements, performance guarantees, claim submission deadlines, eligibility rules, cost recovery mechanisms and, in the case of leased aircraft, maintenance and return-condition obligations.

Examples of relevant agreements may include:

- Airbus SSC – Supplier Support Conditions;
- Boeing PSAA – Product Support and Assurance Agreement;
- Embraer PSC – Product Service Conditions;
- Lease agreements;
- Aircraft purchase agreements;
- Supplier furnished equipment agreements;
- OEM warranty agreements;
- Repair agreements;
- Pool agreements;
- Power-by-the-hour agreements;
- Long-term service agreements;
- Maintenance service agreements;
- Service level agreements;
- Commitment letters;
- Service bulletin commercial support terms;
- Service life policies;
- General terms agreements;
- Component purchase agreements.

These documents are often complex, technical and difficult to apply consistently across the organization. For warranty management to be effective, airlines must know in advance the applicable clauses, obligations, eligibility criteria, deadlines and performance requirements established in each agreement. In practice, legitimate recovery opportunities may be missed when the relevant contractual provisions are not identified, structured and made visible to the maintenance, engineering, materials, contracts, finance and warranty teams before the event occurs.

This issue is particularly relevant when multiple contractual layers apply to the same aircraft, component or event. For example, a component installed on a leased aircraft may be subject to OEM warranty conditions, supplier support terms, repair agreement provisions, pool contract rules and lease return conditions at the same time. Without a structured way to identify and connect these obligations, the operator may miss recoverable value, fail to preserve required evidence or make decisions that conflict with contractual responsibilities.

A Contract Intelligence framework may help address this gap by converting contractual content into searchable, structured and actionable knowledge. Artificial intelligence tools can assist in structuring such a contract database further explained in the section below. The purpose is not to replace legal, technical or commercial judgment, but to support users in identifying relevant clauses, deadlines, obligations, exclusions and possible warranty remedies more efficiently.

10.7.1 Contract Knowledge Database

The first element is the creation of a structured contract knowledge database.

This knowledge database should consolidate the main contractual documents used in warranty management, including OEM agreements, supplier support agreements, lease agreements, repair contracts, pool agreements, PBH agreements, warranty clauses, service level agreements, performance requirements, eligibility criteria and aircraft return-condition obligations.

For each contract, the airline should identify and structure key information such as:

- Supplier, OEM, OAM, MRO Provider, Lessor or Service Provider;
- Aircraft, engine, component, system, service or fleet covered;
- Contract type;
- Contract effective date;
- Warranty period;
- Support period;
- Claim submission deadline;
- Claimable remedies;
- Penalties;
- Performance requirements;
- Performance guarantees;
- Service level obligations;
- Exclusions and limitations;
- Labor coverage;
- Material coverage;
- Freight or logistics coverage, when applicable;
- NFF – No Fault Found provisions;
- Service bulletin support;
- Service life policy applicability;
- Lease-related maintenance obligations;
- Aircraft return-condition requirements;
- Responsibility for removed, repaired or exchanged components;
- Escalation contacts;
- Required supporting documents;
- Internal owner responsible for follow-up.

Once structured, this information can be searched and used by warranty, maintenance, engineering, materials, contracts, procurement, finance and leasing teams.

10.7.2 Automated Contract Interpretation

Artificial intelligence tools may be used to assist in reading contracts, identifying relevant clauses and classifying contractual obligations.

This may include:

- Automatic identification of warranty clauses;
- Extraction of claim submission deadlines;
- Classification of coverage by part, aircraft, system or supplier;
- Identification of labor and material coverage;
- Detection of exclusions;
- Comparison between supplier obligations and actual maintenance events;
- Summary of applicable remedies / penalties.

For example, when a premature component removal occurs, the system may support the warranty team by identifying whether the part is potentially covered, which clause applies, what evidence is required and how many days remain before the claim deadline expires.

Example:

Maintenance event:

Premature removal of component OEMXXX D2070-11 from aircraft XYZ.

AI-assisted output:

- Potential warranty coverage identified under the applicable supplier agreement.
- Labor coverage may be available, subject to contractual conditions.
- Supporting documents required: removal report, part number, serial number, aircraft registration, removal date, reason for removal, shop findings and photos.
- Claim submission deadline: 12 days remaining.
- Human review required before submission.

10.7.3 Operational Event Matching

The framework should connect contract clauses with real maintenance and operational events.

This can be done by comparing contract data with information from the Maintenance Information System, ERP, repair orders, component removals, service bulletins, shop reports and reliability data.

The system may generate alerts when:

- A removed component is still under warranty;
- A repair order involves a supplier with active warranty coverage;
- A claim deadline is approaching;
- A recurrent failure may support a warranty or guarantee discussion;
- Labor reimbursement may be contractually available;
- A service bulletin may have commercial support;
- A repair invoice may conflict with warranty rights;
- A denied claim may require contractual review.

This step helps transform contracts from static documents into operational controls.

10.7.4 AI-Assisted Claim Preparation

Artificial intelligence may also support the preparation of warranty claims by organizing the required documentation and suggesting a claim structure based on the applicable contract.

The system may assist in generating:

- Claim checklists;
- Draft claim narratives;
- Evidence matrices;

- Contractual summaries;
- Supplier-specific submission requirements;
- Escalation notes;
- Dispute arguments for denied claims.

The warranty team should remain responsible for validating the information, confirming technical accuracy and approving the final claim before submission.

A recommended claim preparation structure may include:

- Event summary;
- Contractual basis;
- Technical evidence;
- Claimed remedy;
- Supporting documentation;
- Deadline;
- Responsible supplier;
- Internal approval status.

10.7.5 Contract Risk and Opportunity Dashboard

The framework may also include dashboards that show contractual risks and recovery opportunities.

Recommended indicators include:

- Contracts with active warranty coverage;
- Contracts with upcoming expiration dates;
- Claims at risk of deadline expiration;
- Suppliers with high denial rates;
- Recurring failures by supplier or part number;
- Estimated recoverable value;
- Claims requiring engineering support;
- Claims requiring contract review;
- Open disputes;
- Average response time by supplier;
- Recovery rate by contract type.

This visibility supports internal management decisions and external stakeholder discussions, including supplier and OAM performance reviews, MRO follow-up, lessor discussions, dispute management and contract renegotiations.

10.7.6 Governance, Confidentiality and Human Review

Because aviation contracts may contain confidential commercial, technical and legal information, any AI-enabled contract intelligence process must be implemented with strict governance.

Airlines should define:

- Who can access each contract;
- What information can be uploaded into AI tools;
- Whether the tool is approved for confidential data;

- How outputs are validated;
- How errors or hallucinations are detected;
- Who approves final contractual interpretations;
- How data is retained or deleted;
- How supplier confidentiality obligations are respected.

AI should be used as a decision-support layer, not as the final decisionmaker. Contract interpretation, legal conclusions, technical eligibility and claim submission should remain subject to qualified human review.

Expected Benefits

An Aerospace Contract Intelligence Framework may help airlines:

- Increase visibility of contractual rights;
- Reduce missed warranty opportunities;
- Accelerate contract review;
- Identify claim deadlines earlier;
- Improve consistency in warranty interpretation;
- Support stronger claim packages;
- Reduce dependency on tacit knowledge;
- Improve supplier accountability;
- Support negotiations and dispute management;
- Connect contracts, maintenance events and financial recovery.

When properly governed, AI-enabled contract intelligence can become an advanced layer of warranty management, helping airlines transform complex agreements into practical operational actions.

10.8. Key Principles for Successful Execution of the Warranty Management Framework

The effective implementation of a warranty management framework requires more than the execution of defined processes; it also depends on adherence to a set of fundamental principles that guide decision-making and operational discipline at each stage. The following key principles highlight the primary consideration that should inform the successful execution of each of the seven steps.

STEPS	KEY PRINCIPLES
1. Contractual Baseline & Warranty Opportunity Mapping	Do not wait for a failure to discover what the contract says. Know your rights, obligations, deadlines and remedies before a maintenance event occurs.
2. Critical Event & Performance Recovery Assessment	Connect technical facts, operational impact and contractual provisions.
3. Evidence Standardization & Claim Infrastructure	Capture evidence at moment of the event, not weeks later when the claim is challenged. A warranty claim is only as strong as the evidence behind it.
4. Warranty Data Visibility, Portal and KPI Monitoring	Make warranty visible, measurable and actionable. Dashboard ≠ decoration. Dashboard = decision support.
5. Cross-Functional Training and Warranty Culture	Warranty is a process across the airline; the warranty team orchestrates it.
6. Data-Driven Claim Prioritization and Support Decision	Turn the score into action, and keep the ranking dynamic.
7. Contract Intelligence	Turn complex agreements into operational knowledge. Remember that AI is a decision-support layer, not the final decision-maker.

Figure 14 - Key Principles of Warranty Management Framework

11. Acronyms

AEEC	Airlines Electronic Engineering Committee
AGTA	Aircraft General Terms Agreement
AI	Artificial Intelligence
AMC	Avionics Maintenance Conference
AOC	Air Operator Certificate
AOG	Aircraft On Ground
APU	Auxiliary Power Unit
ATA	Air Transport Association (ATA Chapter)
BFE	Buyer Furnished Equipment
BI	Business Intelligence
BITE	Built-In Test Equipment
BOE	Boeing
CAGE Code	Commercial and Government Entity Code
CID	Customer-Induced Damage
CML	Commitment Letter
CSN	Cycles Since New
CSO	Cycles Since Overhaul
DDOF	Distributor & Designated Overhaul Facility
DOF	Designated Overhaul Facility
DTH	Definition, Tracking, and Handling
ERP	Enterprise Resources Planning
FIN	Functional Item Number
FOC	Free of Charge
GAAP	Generally Accepted Accounting Principles
GDMC	Guaranteed Direct Maintenance Costs
(G)MTBUR	(Guaranteed) Mean Time Between Unscheduled Removals
GSPT	Guaranteed Shop Processing Time
GTA	General Trade Agreement

IAD	Individual Avionic Display
IAWA	International Aviation Warranty Association
IFRS	International Financial Reporting Standard
KPI	Key Performance Indicator
L/G	Landing Gear
LCC	Low-Cost Carrier
LR/SR	Long range / short range
MEC	Middle East Carrier
MIS	Maintenance Information System
MMC	Mechanics Maintenance Conference
MPD	Maintenance Planning Document
MRO	Maintenance, Repair and Overhaul
MSA	Master (Maintenance) Services Agreement
(G)MTBUR	(Guaranteed) Mean Time Between Unscheduled Removals
NAW	New Aircraft Warranty
NFF	No Fault Found
OAM	Original Aircraft Manufacturer
OEM	Original Equipment Manufacturer
PBH	Power-by-the-Hour
PFR	Post-Flight Report
P/N	Part Number
P/O	Purchase Order
PA	Purchase Agreement
PSAA	Product Support and Assurance Agreement (by Boeing)
PSC	Product Service Conditions (by Embraer)
S/N	Serial Number
SB	Service Bulletin
SFE	Seller Furnished Equipment
SL	Service Letter
SLP	Service Life policy

SME	Subject Matter Expert
SSC	Supplier Support Conditions (by Airbus)
TCH	Type Certificate Holder
TSN	Time Since New
TSO	Time Since Overhaul

12. Contributors

EDITION 1

Dragos Budeanu, IATA

Geraldine Cros, IATA

Chris Markou, IATA

Lucy England, Fox Williams

Keith Fernandes, Virgin Australia

Michael Hansen, Southwest Airlines

Manuel Sabaschus, Eurowings

EDITION 2

Geraldine Cros, IATA

Matt Davies, Gulfstream (x-Airinmar)

Owen Davies, Airinmar

Chris Markou, IATA

Amanda de Souza Santos, Aviation Professional

Greg Zuikovs, Airinmar