

Back to basics? A commentary on the management of Airworthiness

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INTRODUCTION

The modern-day challenges faced by the aviation industry are plenty; many focus on the performance of human beings in complex systems. Appropriate behaviour of personnel is key to contributing to systemic safety, but this requires a clear understanding of not only Human Factors, but also the basic concepts of, and relationships between, Airworthiness and Maintenance. In a world where non-compliance with rules and standards is still a major issue, how many of these unsafe acts can be attributed to insufficient knowledge of how the system within which they work was designed to operate?

This paper examines whether a gap exists between the Maintenance Programme and the Maintenance Organisation's output, i.e. between Airworthiness and Maintenance. It proposes that the foundations upon which the concepts of Airworthiness are built seem to have been lost (or never fully implemented) and questions whether there is a need for industry to go "back to basics" in terms of the knowledge and understanding of the two functions.

WHERE ARE THE PROBLEMS?

Problems resulting from misunderstanding the relationships within the approval system vary, are numerous, and exist at all levels within organisations. From the Continuing Airworthiness Organisation (for Commercial Air Transport this is part of the Operator) not supplying correct information to the Maintenance Organisation in time or at all, to the technical records staff seeing their role as 'just a clerk', to the maintenance technician feeling that the data limits are a guide only

and that a deviation can be justified based upon experience. Such mindsets can be argued to result from insufficient awareness of how the system is designed to operate. National regulations provide clear lines of responsibility for those organisations involved in Managing Continuing Airworthiness and those involved in Maintenance yet the relationship between these requirements is often lost in translation. The Operator's Continuing Airworthiness Management Organisation is responsible for ensuring that a contract is in place between such organisations and this key document should then play a pivotal role in how the maintenance activity is performed. It is common however, for the contract to focus mainly on commercial, rather than "technical", aspects, and in some cases, loss of a contract is used as a bargaining tool or threat, rather than setting out how each party will contribute to the overall objective of ensuring airworthiness. Without the correct focus on the basic understanding of the system as a whole, unfounded myths and beliefs will prevail, exacerbated by inappropriate operator behaviours that are not in line with the contract or regulation. In the event of unforeseen circumstances, these unwanted behaviours can leave the operator and maintenance organisation exposed.

WHAT IS MEANT BY "AIRWORTHINESS"?

The terms "airworthy" and "airworthiness" are used throughout ICAO, global and national standards; however, none of these provides a definition of what is meant by them. For the purposes of this paper, we shall assume the following, developed from a UK Ministry of Defence definition: "Airworthiness is the ability of an aircraft or other airborne equipment or system to operate without significant hazard to flight and cabin crew, ground crew, passengers, cargo or mail (where relevant) or to the general public and

property over which such airborne systems are flown.”

So, what does that look like from a regulatory perspective? Many activities contribute to Airworthiness and, as illustrated, is more than just maintenance.



Certain elements of Airworthiness are either accomplished directly or influenced by the performance of maintenance, yet in some cases these stand in isolation and lose their connection with the greater airworthiness management system.

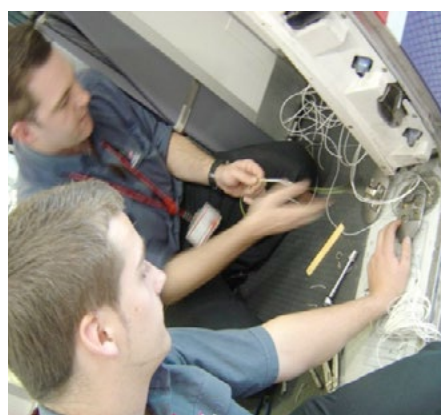
The overall responsibility for ensuring that these elements are accomplished lies with the Organisation managing Airworthiness. Maintenance activities that contribute to Airworthiness must be performed by Approved Maintenance Organisations. It must therefore be clear and unambiguous what is required of those organisations – something provided for by the contract.

WHAT IS MEANT BY “MAINTENANCE”?

This sounds like a simple question to answer, however the objectives of maintenance are varied. For example, scheduled maintenance serves to:

- establish the inherent safety and reliability levels of the aircraft (as determined by design);

- restore safety and reliability to their inherent levels as should deterioration occurs;
- obtain information required for re-design in light of system inadequacies;
- and accomplish this at a minimum total cost (including the costs of ‘in-service’ failures).



The link between the two functions is the Maintenance Programme; a Continuing Airworthiness requirement, which should reflect the needs of the operator’s aircraft as driven by data collected via the reliability programme. The Maintenance Organisation performs the required Maintenance tasks as determined by the Programme and contracted by the operator. That is the concept of the system in a nutshell. It is still a common belief amongst maintenance staff, however, that it is they that are solely responsible for the Airworthiness of the aircraft. This is often reinforced and perpetuated by technical representatives who manage the interface between the Operator and the Maintenance Organisation, many of whom have a Maintenance, rather than an Airworthiness, background.

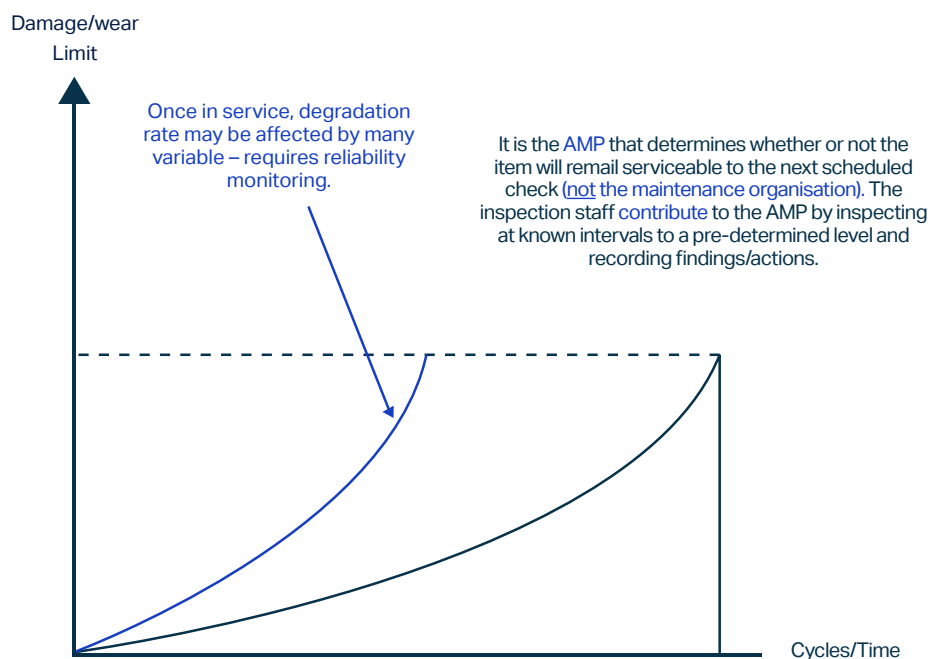
HOW DOES MAINTENANCE AFFECT AIRWORTHINESS?

Experience has shown that many maintenance personnel still feel that it is appropriate to make a judgement

on an item: for example, not changing a component that is marginally out of limits based upon previous experience or, conversely, changing an item close to limits even though its degradation since last inspection may be zero. The former example, to some, may be seen as qualified, experienced staff using engineering judgement and that is what they are paid for. The latter may raise eyebrows and of course best practice would dictate that it is brought to the operator's attention to decide on a course of action after reviewing the records. Given the principles of Airworthiness, however, it would be very difficult for an inspector within a Maintenance organisation, who at the time of inspection sees only a snapshot and not the full Airworthiness picture, to satisfactorily make an accurate judgement on whether an item would remain serviceable until the next planned inspection. Such a judgement would require knowledge of the specific degradation rate and the failure modes and effects of the item. Having the 'next due date' on the work card would not be sufficient information from which a judgement can be made; data such as

utilisation, operational profile, environmental considerations, wear rates, and so forth would all need to be considered, which is something that can only be achieved by the Organisation Managing Airworthiness (assuming effective management). Such data are fed into the Maintenance Programme and whether an item will remain serviceable to the next check will be determined by the Maintenance Programme.

The engineer's contribution is to inspect at a scheduled interval, to a pre-determined inspection standard and compare any findings the limits defined in applicable maintenance data, for example, the Aircraft Maintenance Manual. The inspection intensity (distance and inspection aids) and conditions (lighting, access and cleanliness) will effectively dictate the threshold for reportable defects. These criteria are carefully selected, based on the design criteria, criticality of each item aligned with maintenance and operational economics. Inspection staff must not be permitted to deviate from such limits, unless authorised through a company procedure



and involving the Operator, most likely their CAMO as the decision maker.

The tragic accident involving an Alaska Airlines' MD-83 in January 2000 revealed many failings, including failure to consider degradation rates effectively. The subsequent investigation by the National Transportation Safety Board determined that inadequate maintenance and insufficient lubrication led to excessive wear and catastrophic in-flight failure of the threads of the horizontal stabiliser trim system jackscrew assembly's acme nut.



What was not considered at the time by the Maintenance Organisation was the fact that historic maintenance on the affected item was substandard and in conjunction with other failings (some the fault of the operator), the degradation rate was increasing. The two worlds came together on that day and the outcome was catastrophic.

WHY DO THESE PROBLEMS EXIST?

The world of perceived or real commercial pressure, as we know, does lead to some well intentioned yet potentially unsafe acts being committed. Yet, the question of how many of these acts are due to insufficient basic knowledge of "the system",

remains unanswered. A recently overheard conversation in a restaurant between two maintenance technicians prompted a discussion that began to explore that question. To summarise the debate, one of the technicians was encouraging the other to consider becoming certifying staff. 'I would not know what to look for' stated the less experienced technician. The response was alarming: 'You soon pick it up – you know what to look for and what you can get away with'. The conversation continued and revealed more examples of maintenance staff making judgements, based on experience, yet clearly well beyond the limits of the applicable maintenance data. In this case, rivets as per the drawing, were not available, so the certifier decided, whilst eating his dinner, that he would fit 'alternatives'. This behaviour clearly begins to move the degradation curve away from that expected, making future 'judgements' potentially lethal.

So, was this being unprofessional? Some would argue yes, but in mitigation, how many other technicians in the organisation would have acted in the same manner? Did the Maintenance Organisation fail the technician by not providing the right parts? It would appear from the conversation that this was indeed the case.

Would the customer have reacted inappropriately if the technician had behaved assertively and not agreed to certify the task? Recent experience indicates that this is not unheard of. How much was down to the operator, the Maintenance Organisation, and/or the Technician not understanding the basic principles of Airworthiness? A rhetorical question.

Many issues that are seen today, it may be argued, could be linked back to this gap in our knowledge. Further examples:

- The classic sign off statement 'SATIS', which means little to the CAMO when trying to determine degradation rates (as opposed to recording measured dimensions, tolerances, and so forth),



- Considering "greasing" as a mundane task, rather than one preventing a failure mode of, possibly, a safety critical item,
- Provision of parts direct to the technician from the operator, thereby bypassing the goods-in process,
- Pressure put upon maintenance staff to not 'look too hard' or 'snag' too much.

All of these 'minor' transgressions ultimately lead to a change in the degradation rates or the economic basis of the Maintenance Programme. Reliability, based upon analysis of data and maintenance findings, should detect trends and yet if defects are being 'let go', then the validity of the data is flawed, undermining the trends, and the effectiveness of the overall Maintenance Programme. Quite simply, the system assumes (i.e. is predicated upon) the Maintenance Organisation fulfils its responsibilities; that is, to the contract and to the standard. If the operator requires a different standard to be applied this must be

reflected in its Maintenance Programme, thus putting the responsibility in the right place. Bring into the equation the organisations that manage lease hand-backs on behalf of the operator and the need to understand the basics becomes even more evident. The UK event in 2009 involving a 737 on a post maintenance check flight appears to highlight this need adequately. During the hydraulic power off test, which was required due to elevator tab adjustments having been performed, the aircraft entered an unexpected descent, achieving at one stage a descent rate of 21,000ft per minute. The final identifies a loss of control within the interfaces between the Operator and Maintenance Organisations involved, which was managed by a third party (the lease hand-back organisation), could have been handled more effectively. Would a more comprehensive understanding of the principles of "the system", by the personnel and organisations involved, have influenced behaviour and therefore the outcome?

IN CONCLUSION - HOW CAN WE CLOSE THIS GAP?

Many options appear open to industry, for example the aircraft maintenance licence requirements could be enhanced to include an 'Airworthiness' module that explores the approval system, the concepts of Airworthiness, the responsibilities and how these are achieved. Similarly, degree courses could include the very same to capture people entering the industry via the academic route. For existing members of industry, Maintenance Organisations and Operators could include such a module in their induction training and certifying staff could be captured either through continuation training or at authorisation issue/renewal. AMC/Guidance Material could be developed to highlight the fact that the technical representative fulfils a Continuing Airworthiness function and any maintenance bias needs to be tempered. Hence it would appear that there is plenty of room for manoeuvre to be able to bridge this gap between Airworthiness and Maintenance, and the personnel/organisations involved.

FOOTNOTE

The introduction of Part-CAMO and more specifically the requirements for the Management System, now mirrored in Part-145 too should direct organisations to control these issues, collaboratively, with much improved effectiveness. If these organisations not only comply with the regulation, but fully embrace the intent of the changes we should see less of these events. Time will tell.

About Baines Simmons

We are specialists in aviation regulations, compliance and safety management and partner with the world's leading civil and defence aviation organisations to improve safety performance. As trusted advisors to businesses, armed forces, governments and regulators across all sectors of aviation, we help to advance best practice, shape safety thinking and drive continuous improvement to safety performance through our consulting, training and outsourced services.