When Poor Aircraft Maintenance Costs Lives

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WHEN POOR AIRCRAFT MAINTENANCE COSTS LIVES
AGENDA

• Human Error in Aircraft Maintenance
• Maintenance Related Accident Statistics
• Case Studies
• Current Situation in South Africa
• Do we continue with the status quo?
HUMAN ERROR IN AIRCRAFT MAINTENANCE

• Maintenance is:
  – Essential & Integral part of aviation industry and to date is still performed by humans.

• Thus
  – Maintenance errors are likely to occur just like in flight crew related errors.

• Aim is to:
  – Minimise the risk of maintenance related accidents / incidents
HUMAN ERROR IN AIRCRAFT MAINTENANCE

FINANCIAL IMPLICATIONS

• The average cost of an in-flight engine shutdown is R5 454 374.48;
• The average cost of a flight cancellation is R545 784.97;
• The average cost of a return to gate is R163 735.49.
The International Air Transport Association (IATA) stated that Maintenance “events” contributed to 10% of the 432 accidents investigated between 2009 and 2013, while 29% involved some kind of aircraft malfunction. In other cases, shoddy maintenance procedures were identified as a “latent” factor contributing to the outcome.
MAINTENANCE RELATED ACCIDENT STATISTICS

SOUTH AFIRICAN STATISTICS

• Accident and Incident statistics from 2005: In 1262 accidents and 548 serious incidents only 553 had been released to the public, of these 24% show technical probable causes and 2% direct maintenance related probable causes. As a contributor only 1% technical component and 3% direct maintenance related.
Case Study 1

- Boeing 737-300 Cargo haul flight. The aircraft flew from ORT to Cape Town International. On arrival at Cape Town, the pilot was advised by ground crew that the number one main outboard wheel assembly was missing. Despite this, the pilot had not felt any adverse vibration on take-off or landing. However, the aircraft had sustained damage to the inner left aft flap.

- The investigation concluded that an incorrect bearing had been fitted to the wheel assembly. As a result, the bearing failed during take-off, causing catastrophic failure of the outer main wheel bearing and associated nut. The outer main wheel bearing failed, causing the wheel assembly to depart from the axle.

- The disintegration of the bearing produced shards, which pierced the left flap.
Case Study 1

- The aircraft sustained minor damage on the bottom of the left flap.
Case Study 1

It was found that the incorrect bearing had been fitted to the wheel assembly during workshop assembly. At the time that the wheel assembly had been assembled, only one person had been in charge of the tyre section and he was working under extreme pressure. In addition, the wheel bearings at the time were fitted by an unskilled worker.
CASE STUDY 2

• The pilot accompanied by a passenger flew the RH44 helicopter on a commercial game or livestock cull flight. The pilot reported that he suddenly felt a severe vibration accompanied by a grinding/growling noise from the helicopter. The pilot decided to execute an emergency landing in an open field the main rotor blades struck the tail boom and severed it. The helicopter sustained substantial damage in the impact sequence. The pilot and passenger survived the occurrence without sustaining injury.

• The RH44 helicopter was imported to the Republic of South Africa (RSA) as a new product from United States of America (USA). After arriving in the country, the helicopter was assembled and then registered on the civil aircraft register. The SACAA then carried out a certificate of airworthiness (CoA) issuance inspection on the helicopter and approved it for use on special operation - game or livestock cull.

• The RH44 helicopter was used on special operations from June 2007
CASE STUDY 2

- Parts Failure: During the wreckage investigation, the evidence shows that a mechanical failure had occurred during the flight. It was discovered that the forward intermediate flex plate (forward end of tail rotor driveshaft) which connects the engine output to the tail rotor transmission input within the drive train had failed.

- The forward flex plate was severely deformed during the failure. The flex plate had fractured adjacent to one of the four fixing holes. The tail rotor drive shaft end had separated from the flex plate. It was removed from the wreckage and taken for metallurgical examination. The metallurgical report concluded the following:
  (i) The flex plate had been severely deformed during the failure.
  (ii) The flex plate fractured adjacent to one of the four fixing holes.
  (iii) No metallurgical or material defect or deficiency was found which have caused initiation.
CASE STUDY 2

(iv) The origin of the fracture was a small thumb-nail shape crack showing clear indications and features typical of fatigue which initiated underneath the reinforcing washer.

(v) The surface of the initial crack was discoloured, indicating that it had been present for a significant period of time

(vi) The four threaded fasteners were also examined. It was observed that no fretting was present on the shank surface, indicating that the fasteners were correctly tightened and had not been moving relative to the plate.

• Robinson Helicopter RH44 Maintenance Manual requires that the tail rotor drive shaft should be supported when conducting tail rotor drive shaft installation and/or removal.
A survey was carried out amongst the South African approved Robinson Helicopter Aircraft Maintenance Organisations (AMO’s), to determine what maintenance procedure they use to support the tail rotor drive shaft during installation and/or removal.

The evidence found shows that each AMO were using their own developed different method to support the tail rotor drive shaft.

The manufacturer did not give a detailed explanation of the method how to achieve the support. The maintenance process is being interpreted in different ways by the AMO’s using different specially developed procedures as a means of compliance.

Robinson Helicopter Corporation: The metallurgical report with the information of flex plate failure was forwarded to the State of Design and Manufacture. The response received back was the following:
CASE STUDY 2

• “After reviewing the reports on the flex plates with our engineering department, our
• initial thoughts are that the failures are due to a maintenance issue and not a
• strength or durability issue.
• The crack appears to have initiated at the edge of the washer. If the driveshaft is
• allowed to move beyond its normal range of motion (up & down, left & right), the flex
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• plates will of course exceed their intended range of motion and the area near the
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Current Situation in South Africa

• In the South African airline sector as well as the General Aviation environment, the aircraft maintenance industry is showing three key developments, all products of the increasingly cost-driven nature of the industry, which threaten to undo much of the progress made so far.

• In a time when intense competition is placing pressure on the operators to keep pushing down their operating costs, maintenance has been an obvious first resort for cost-saving, since unlike many other measures, it remains invisible to the passenger unless severely neglected.
Current Situation in South Africa

• This is noticed by for example:
  – The increased amount of maintenance extensions and exemptions received.
  – Amount of maintenance related turn back notifications received
  – Operators operating away from base without maintenance support
Current Situation in South Africa

• The second, more concerning and less easily remedied threat involves the under-investment in developing an adequate skilled workforce to meet current and future maintenance needs.

• This is noticed by for example:
  – Lack of aircraft specific recurrent training;
  – Amount of exemptions received for AME licenses when the requester does not have either the training or the experience as required by the regulations;
  – Lack of trainees at maintenance organisations;
  – Sharing of licensed personal amongst maintenance organisations.
Current Situation in South Africa

• The third, an unwillingness to report defects to the Authority as well as the manufacturer. It is only when it becomes a liability or legal issue that the Authority is notified by such defects and by that time the evidence had been destroyed and no proper investigation can be conducted.
DO WE CONTINUE WITH THE STATUS QUO?

• Industry needs to focus on improving maintenance or expect more disasters.

• Recommendations:
  – Continuous maintenance re-training;
  – Create mechanisms for reporting, investigate reports, and provide legal protections to the people who informed them[SMS];
  – Human factors training for management and technicians/engineers.
TWO WAY APPROACH

ORGANISATIONAL

• Maintenance related accidents and incidents are caused by a breakdown of the organisation processes, decisions and culture
• Maintenance operations are also affected by human input that shows up as weaknesses in organizational processes leading to individual factors

INDIVIDUAL

• Lack of motivation
• Fatigue and stress
• Time pressure
• Misperception of hazards
• Inadequate skills
TWO WAY APPROACH

<table>
<thead>
<tr>
<th>Organisational</th>
<th>Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training and selection of personnel.</td>
<td>Knowledge and skill of personnel.</td>
</tr>
<tr>
<td>Quality of resources as distributed.</td>
<td>Quality of resources on hangar floor.</td>
</tr>
<tr>
<td>Organizational Structure</td>
<td>Work environment.</td>
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<tr>
<td>Opportunities for career development.</td>
<td>Morale &amp; personalities of employee.</td>
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</tbody>
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TWO WAY APPROACH Cont’

• Maintenance errors impose a significant financial burden;
• On airlines, as they are a major cause of flight delays and cancellations;
• Poor aircraft maintenance;
• Maintenance error or maintenance negligence are commonly found to be one of the top three causes of aviation accidents.
CONCLUSION

• At stake is the safety of one of the world's most reliable transport systems;
• Therefore we need to safeguard this industry which on its own has and will continued to provide and look after us.
Thank you!!!