GroundEffects

Reporting Maintenance and Groundcrew Error Reduction Efforts

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Editors Note: Our feature article this issue once again comes from Australia, Alan Hobbs from the Bureau of Air Safety Investigation.
(BASI) has written an excellent article on maintenance error. In the article he describes what maintenance error is and offers some suggestions on how to reduce these errors. Think about it, Do any of the following problems exist in your organization?

Maintenance Mistakes & System Solutions

Human factors is not just about people: it is also about improving systems. While the focus of this article is on airline maintenance, there are also lessons for general aviation.

Ask someone about the threats to the airworthiness of an aircraft and they will probably mention mental fatigue, corrosion, excessive wear of components or other results of ageing and use.

Yet today, as aircraft become increasingly reliable, we have reached the point where the actions of the maintainers themselves lie at the heart of many airworthiness problems. According to Boeing, around 15% of major aircraft accidents involve maintenance error.

Human errors, and the frustration, sleepiness, misunderstandings and memory lapses which produce them, are powerful forces affecting the quality of maintenance and hence the airworthiness of aircraft.

There is now a worldwide effort to understand more about the human side of maintenance problems. This article deals with just a few of these issues.

Maintenance errors can have a significant impact not only on safety, but also on the financial performance of large and small operators alike. A single in-flight turn-back of a Boeing 747, with the need to accommodate passengers overnight, can easily wipe out $250,000 of profit. It has been estimated that in the USA, maintenance error could cost airlines one billion US dollars per year!

The term 'human error' is used throughout this article in recognition of the fact that most aviation accidents do involve human error at some point in the chain of events. However, we need to recognize that these errors (or unsafe acts) tend to be just one link in a chain of events. A useful framework to use when considering human factors issues is the Reason model of accident causation outlined below *(see fig. 1).*

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Thirteenth Annual Symposium a success!

Thirteenth Annual FAA/CAA/Transport Canada Symposium on Human Factors in Aviation Maintenance & Inspection held February 16 & 17 at Daytona Beach has to be considered a success. Nine workshops were offered to the over two hundred delegates who attended from all over the world. These workshops represented a monumental task in coordination and the biggest complaint to be heard was that the delegates had difficulty deciding which two they would attend.

Another monumental task would be to try to adequately describe the material covered in the scope of this article. Instead here is a very brief synopsis of a historical event.

Jean Watson, FAA on whose shoulders the success of the symposium rests, welcomed the delegates. ***John Stelly***, often thought of as the grandfather of human factors training for maintenance personnel, then acted as a very capable master of ceremonies (OK, Moderator). The balance of the day was than spend attending one of the nine workshops in the morning and a second in the afternoon. The hotel was first class with views of Daytona Beach for all

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MARSS

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Help us to prevent accidents before they happen!

Photo 1

GroundEffects (ISSN 1094-0146) is the official newsletter of **MARSS** and is published four times per year to discuss issues affecting maintenance safety. We offer practicable solutions to maintenance managers, regulatory authorities, and unions charged with improving safety and reducing costs.

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registrants. The luncheon was very good and the luncheon speaker, member ***John Goglia***, NTSB spoke, as always, from the heart when he once more stressed the vital importance that everyone provide the required training to assist their maintenance personnel in avoiding making a maintenance error.

The second day saw, under ***John Stelly***'s guidance, each of the workshop leaders give a brief de-briefings of their workshops to the assembled delegates. ***David Hall***, CAA gave an excellent presentation on the progress they are making in the human factors field. The CAA is at present, the only country which has filed a difference with ICAO re the Annex 6 requirement to require human factors training for maintenance personnel. This means that the remaining other 180 countries are now complying with ICAO's requirement. The CAA fully intend to comply but require more time as they feel that JAR 145 will provide a common guidance for all of Europe and they will assist in the development and comply with the completed standards.

Art Columb of Air Transport Association gave a rundown of their human factors subcommittee accomplishments including ATA Specification 113 for Maintenance Human Factors Program Guidelines. This is available from their website *www.air-transport.org* free of charge and is worth looking at.

Brian Whitehead, Transport Canada outlined the revised and updated Human Performance in Aircraft Maintenance workshop which is being developed. The new workshop incorporates Reason's Model and will be the Transport Canada standard once completed.

Leroy Keith provided an Asia-Pacific Airlines report which outlined progress made by various airlines in the region.

Barbara Kanki provided an update on the progress of various FAA-NASA Safety Programs.

Closing remarks to a very successful symposium were then provided by ***Ava Mims*** of the FAA Flight Standards Service.

The nine workshops consisted of the following:

Workshop #1 Designing Documents for Maintenance was delivered by ***Colin Drury*** University of Buffalo and ***David Driscoll***, US Airways. They provided convincing evidence of how properly worded documents which relate to the job at hand can significantly reduce errors. Tips such as the use of flow charts to assist the AMT in visualizing the complete task were one of the many useful suggestions. Their is little doubt that

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properly designed workcards will reduce maintenance error.

Workshop #2 Conducting a Human Factors Audit in Maintenance Organizations; delivered by ***Bill Johnson*** Galaxy Scientific Corporation and ***Andy Shaw,*** BM Engineering. With two very experienced persons leading the workshop, the participants were introduced to various models they could use and then guided into developing their own checklist. They identified that in any audit, problems will be found and immediate remedies implied but that the audit must find the root causes to be truly effective.

Workshop #3 Training for Inspection; *Anand Gramopadhye*, Clemson University and ***Sony Copelan***, Delta Airlines. The workshop centered around developing a computer based inspection simulator to aid inspectors in upgrading their skills. Since 90% of inspection is visual, the FAA funded study concentrated on improving the inspectors visual skills. The study went from the task card write up to lighting to a simulated inspection using a computer. The advantage of this form of Computer Based Training (CBT)is it is controlled and consistent compared to on the job training.

Workshop #4 Airline Safety/ Ground Damage; ***Nick McDonald***, Trinity College Dublin and ***Paddy Sullivan***, Aer Lingus. The workshop discussed a Safety Course for Airport Ramp Functions (SCARF) program which when applied resulted in a dramatic drop in workdays lost; However, when a pause in training occurred their was a significant drop in the safety climate. It would appear that training can not be just a one shot application but must be ongoing.

Workshop #5 Working Confined Spaces in Human Maintenance; *David DeClue* Canadian Airlines While this workshop was cancelled David provided an interesting and informative presentation to the delegates. The presentation graphically illustrated the need to consider all health and safety requirements when working in aircraft fuel tanks. The cost of not taking the human's safety into full consideration can be fatal.

Workshop #6 MRM Training in the Classroom and Over the Internet; *Terry Chandler, Ben Sian,* Galaxy Scientific Corporation. Fresh from the completion of a World Wide Web MRM training session, Terry was able to give the workshop participants the results of the FAA funded experiment. The challenging seminar saw persons from around the world sign up to take the interactive instruction. The results were generally very positive. The SMART center from where the instruction originated can be found on the web at *www.hfskyway.com*

Workshop #7 Accident/Incident Analysis From a Human Factors Perspective; ***Gordon Dupont*** Transport Canada and ***David Deveau***, Charlie Dunstan Air Nova. This workshop attempted to show where accident/incident analysis fits into the complete human factors picture. In wrap up the participants viewed a video and analyzed the error depicted on it.

Workshop #8 Developing a Human Factors Training Program for Your Airline; *Peter Pope*, Air Britannia and ***Manoj Pantakar*** San Jose State University. This workshop reinforced the concept that successful human factors training requires more than a classroom and instructor. To be successful it has to have management commitment and become part of the company safety culture..

Workshop #9 Maintenance Error Data Analysis and Reporting; *Robert Sargent*, Boeing and ***Tommy Smith***, BF Goodrich Aerspace. It is becoming more important than ever to record and analyze incidents before they become accidents. MEDA (Maintenance Error Decision Aid) has become an industry standard and BF Goodrich has taken it one step further. Look for this data analysis to become more important in years to come.

Highlighting a new book for maintenance excellence!

Airline Maintenance Resource Management – Improving Communication

By J.C. Taylor and T.D. Christensen

SAE Press, 1998 (ISBN 0-780768-002317)

Taylor and Christensen's book is about communication and how necessary it is to protect professionalism in aviation maintenance. They make the case early and clearly, that the world of aviation maintenance has become more complicated. That complexity, they say, requires maintenance people to get in touch – and stay in touch—with managers, with coworkers, with vendors, with pilots and flight attendants, to provide the company and the public with safe and ready flying machines.

The book has twelve short chapters. Each adds to the case for open communication being the heart of professionalism, and professionalism being at the heart of error reduction. These chapters are crammed with real case descriptions, and with plenty of direct references to other books and articles. Perhaps most importantly, nearly every chapter describes recent research and the proof it provides for the connections among communication, maintenance professionalism, and safety.

As the forward describes, most of the book's examples are drawn from North American experience, but the "lessons apply to maintenance operations everywhere."

(Con't from page 1, Aircraft Maintenance...)

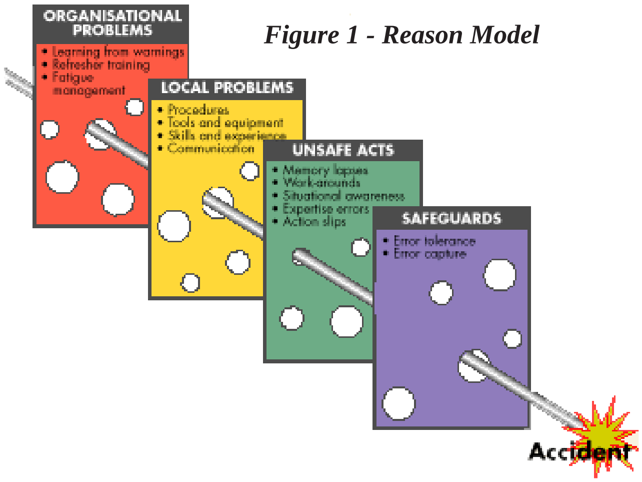

Figure 1 - Reason Model

Unsafe acts are not just problems in their own right, but can be seen as *symptoms* of wider problems. For example, in March 1994 the number one engine and pylon of a 747-200 rotated downward during the landing roll and contacted the runway (see photo 1, page 2). There were no injuries to passengers or crew. The aft fuse pin on the pylon diagonal brace had migrated from its fitting and was found loose in the pylon structure. The type of pin fitted to this aircraft was normally secured in place by two retaining devices, but on this occasion, neither of these retainers could be found.

Approximately 10 hours after the accident, the missing retainers were found in an unmarked cloth bag on a work stand near where the aircraft had recently undergone a C-check. The C-check had included an inspection of the diagonal brace fuse pin lugs on the two outboard engines.

It was never established who had made the errors that culminated in the accident: however, finding the people responsible may not have helped prevent future accidents. The most important lessons learned from this accident were not about individuals, but about the way maintenance was organized and carried out.

The US National Transportation Safety Board (NTSB) identified a range of system problems including an error-producing work environment, potentially dangerous scaffolding, poor lighting, inappropriate storage of parts, a lack of training in company maintenance policies and inadequate oversight by the US Federal Aviation Administration (FAA). Addressing each of these upstream problems would not only reduce the chance of the same errors happening again, but should also help to prevent a host of other quality problems.

UNSAFE ACTS: WHAT GOES WRONG?

In order to understand the types of errors made by maintenance engineers, the Bureau of Air Safety Investigation (BASI) has collected information on over 120 maintenance unsafe acts from interviews with airline engineering personnel and from incident reports received during a study of the regional airline Industry. Most of the unsafe acts were corrected before the aircraft flew, or resulted in only minor consequences.

Over 80% of the unsafe acts of maintenance mechanics fell into one of five types.

1. Memory lapse: 24%

Memory lapses do not generally happen randomly, but often occur when a person is interrupted to go and do something else. Juggling maintenance tasks on several aircraft is a common situation which can lead to a memory lapse.

2. Work-arounds: 23%

Typically, work-arounds involve preforming a task without all the necessary equipment, or in a more convenient manner than in the approved procedures. However, some are more serious, as in the case of workers faced with time pressure who decide not to document their actions or decide not to perform all the required steps in a task. On their own, work-arounds may not necessarily result in an incident, but serious problems can result when other people are not aware that someone has taken a shortcut, or when a work-around is followed by an error.

It was a Friday afternoon and I was about to knock off for the weekend. I decided to do one last minute job and tightened the nose-wheel steering cables on a twin-engine aircraft. Not having an appropriate flagged rig pin I used a bolt through the aircraft floor to hold the rudder pedals in neutral. It got dark and everyone was anxious to go home and I was holding them up. At the end of the job I signed the Maintenance Release but forgot to remove the bolt. On the Monday, I was asked if the aircraft was ready and I said "yes". The aircraft was flown for a whole day checking out a pilot with landings every 20 minutes. If they had feathered an engine or there had been an engine failure they would have been in real trouble, as the limited rudder movement was from this bolt flexing in the floor structure.

- De-identified incident report

Maintenance mechanics are often faced with the pressure of being informed by companies to follow the procedures, but at the same time are encouraged to get work done to deadlines. One mechanic summed it up this way: "Management tell us to follow up the procedures to the letter, but then they tell us not to be obstructive and to use common sense". A recent European study

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found that a third of maintenance tasks involved a deviation from official task procedures.

3. Situational awareness: 18%

Situational awareness errors occur when the mechanic starts work without first gaining an accurate picture of the situation being dealt with. Often, they don't realize that the situation is different from normal, as when a mechanic activates hydraulics without noticing that cockpit controls have been moved while the hydraulics were off. In other cases, an engineer may not be aware of work being done by other workers on the same aircraft.

4. Expertise: 10%

Errors of expertise happen when someone doesn't have the knowledge, skills or experience to do all aspects of their job. As might be expected, errors of expertise tend to involve less experienced workers. The fact that 10% of errors are of this kind could indicate deficiencies in training.

5. Action slips; 9%

Action slips occur when someone accidentally does something unintentionally. Slips tend to occur on routine, highly familiar tasks.

A mechanic accidentally put engine oil into the hydraulics system of an aircraft. Oil and hydraulic fluid were stored in nearly identical tins in a dark storeroom.

-De-identified incident report

Local problems: Why do things go wrong?

The BASI analysis of maintenance incident reports found that for incidents which had airworthiness implications, the most common factors in the work area at the time of the incident were:

1. Confusion or misunderstandings or differences of opinion about procedures

It is not unusual to find that workers have a fairly limited understanding of a company's formal policies and procedures and instead follow informal practices developed on the job. Older, experienced workers will sometimes develop their own practices, which may be different from the approved procedures. Unworkable or inconvenient procedures prompt the sort of work-arounds described earlier.

2. Communication breakdowns between people

In a recent survey, senior US maintenance mechanics were asked to describe what they felt was the hardest part of the job, the most common answer was 'human relations or dealing with people'. Performing in a team requires more than technical know-how, and we often overlook the need to develop these important communication and people skills.

3. Pressure of haste

Since the early days of aviation maintenance personnel have faced pressures to get aircraft back into service. However, as aircraft become more complex and operators strive to reduce the amount of time that aircraft spend in maintenance hangars. A particular risk is that engineers faced with real or self-imposed time pressures will be tempted to take shortcuts to get an aircraft back into service more quickly.

Maintenance systems have built-in safeguards such as independent inspections and functional tests designed to capture error-capturing safeguards generally occur at the end of jobs, at exactly the time when pressures to get the aircraft back into service are likely to be greatest and the temptation to leave our or shorten a procedure is strongest.

In the recent BASI survey, 32% of mechanics reported that there had been an occasion when they had not done a required functional check because of a lack of time. At the time, such a decision may have seemed safe and reasonable; however, decisions made under pressure do not always stand the test of hindsight.

4. Inexperience

Younger personnel need to know about the traps lying in wait for them, yet too often they are allowed to discover these for themselves.

5. A lack of tools, or equipment, or spares

Many work-arounds occur in response to a lack of appropriate hardware or spares. It is understandable that airlines will try to reduce their stocks of expensive spares; however, in some cases relatively inexpensive spares such as O-rings are nil-stock items. Furthermore, a lack of major spares can lead to increased cannibalization of parts from other aircraft, which in turn doubles the disturbance to systems and increases the potential for human error.

A common theme underlying these problems is that maintenance personnel may need training in human factors areas such as communication, supervision, and dealing with pressure and frustration.

The great benefit of human factor training is not only that people change, but that people can see the opportunities to change the systems in which they work. For this reason, managers, who have the most power to change things, should not be excluded from human factors training.

My company ran a human factors course for all mechanics in 1996. It was very informative and I learned a lot of things I hadn't even thought about before. As a result I have changed my attitudes and actions to increase my personal safety and awareness. This course should be given to all apprentices or new hires. It is invaluable.

-Survey comment

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Organizational factors: What are the weaknesses in the overall system?

Maintenance incidents can reflect a range of organizational problems. Three of the most important of these are dealt with below.

1. Lack of refresher training

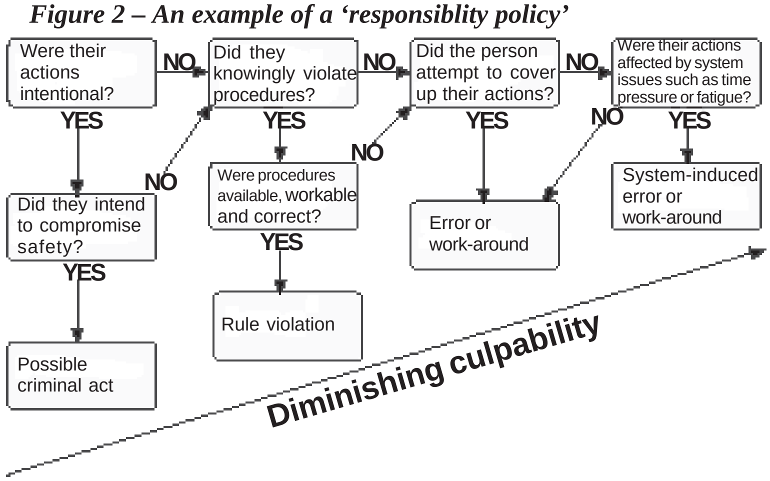
The regulations state that maintenance personnel must receive 'proper and periodic instruction'. However, in reality, a few maintenance engineers receive refresher training once they have gained their licences. Without such training, nonstandard work practices can develop or engineers can lose touch with changes in regulations or company procedures. One senior airline manager put it this way: 'Maintenance engineers are like torque wrenches: they need to be re-calibrated from time to time.'

2. Lack of learning from incidents

The conventional wisdom among safety experts is that for every accident there may be 30 or more previous minor incidents. When BASI interviewed maintenance engineers about incidents, it became apparent that before a serious quality lapse occurs, there are usually earlier incidents which could have acted as warnings of a problem.

Unfortunately we do not always learn the right lessons from these "warning incidents', sometimes because they are never reported. It is never easy to admit a mistake; however it is even harder when an origination punishes people who make honest mistakes perhaps by docking pay or placing notes on personnel files. A punitive culture within the company or the regulatory authority creates an atmosphere in which problems are quietly corrected and places barriers in the way of learning from our mistakes. In the recent BASI survey of maintenance personnel, 66% of respondents reported that they had corrected an error made by one of their colleagues without documenting it, in order to avoid getting into trouble.

Figure 2 – An example of a 'responsiblity policy'



One action which managers can take to ensure that they hear about the 'warning incidents' is to have a clear 'responsibility policy', which outlines how the organization will respond to maintenance incidents. Figure 2 illustrates how a responsibility policy might work, although every operation will need to tailor such a policy to its own requirements. Needless to say, no policy such as this can be expected to function if the regulatory authority penalizes those who report their mistakes.

Until the regulator's inspectors move away from the blame culture that is currently implemented, maintenance defects and incidents will always be covered up and hidden.
- Survey common

Once an incident has been reported, the focus of an internal investigation should normally be on identifying system problems, not on identifying personal deficiencies of individuals.

There may be rare times when incidents are related to intentional acts of malice, but the great majority of maintenance mechanics do their jobs with diligence and integrity and most incidents reflect system problems which go beyond individual workers.

An internal investigation that only related to intentional acts of malice, but the great majority of maintenance mechanics do their jobs with diligence and integrity and most incidents reflect system problems which go beyond individual workers.

An internal investigation that only results in recommendations directed at the level of individuals, (such as reminders to engineers to 'be more careful' or to "follow procedures more closely') are sure signs that the investigation did not identify the system failures which led to an occurrence. There are now structured methods to help managers identify system failings in maintenance, such as the Boeing maintenance error decision aid (MEDA) system.

3. Fatigue

There is probably no way to avoid the need for maintenance to be done at night; however, this does not mean that fatigue levels cannot be managed. Unfortunately, almost all night-shift workers suffer from a lack of quality sleep.

Recent Australian research has shown that moderate sleep

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deprivation of this kind experienced by shift workers can produce effects very similar to those produced by alcohol. After 18 hours of being awake, mental and physical performance on many tasks is affected as though the person had a blood alcohol concentration (BAC) of 0.05%. Boring tasks which require a person to detect a rare problem (like some inspection jobs) are most susceptible to fatigue effects. After 23 hours of being continuously awake, people perform as badly on these tasks as people who have a BAC of 0.12%

One in five of the engineering personnel who responded to the recent BASI survey claimed they had worked a shift of 18 hours or longer than 20 hours at a stretch. There is little doubt that these people's ability to do their job would have been degraded. An important point to note is that like people who are intoxicated, fatigued individuals are not always aware of the extent to which their capabilities have degraded.

At a time when the dangers of fatigue are being recognized in areas as diverse as medicine and road transport, we must ask why there are no regulations to control the risks of fatigue among aircraft mechanics.

Safeguards:

Reducing the consequences of maintenance errors

Minimizing the consequences of errors vs 'working without nets'

Functional checks and independent inspections are examples of safeguards designed to capture errors before they cause harm.

However, there is another approach to managing error which is sometimes overlooked. This is to acknowledge that errors will occur from time to time and that we need to design procedures and systems that can minimize the consequences of such errors. Special maintenance precautions applied to extended-range twin-engine operations (ETOPS) are an example of such an approach. When an aircraft is being maintained in accordance with ETOPS procedures, the performance of identical maintenance actions on multiple elements of critical systems is avoided whereever possible. Engines, fuel systems, fire-suppression systems and electrical power are examples of ETOPS critical systems on aircraft such as the B767 and B737.

However, these precautions are not generally applied to aircraft with more than two engines, or to twin-engine aircraft which are not being maintained in accordance with ETOPS maintenance program.

For example, in 1995, a European-operated Boeing 737-400 was forced to divert shortly after departure following a loss of oil quantity and pressure on both engines. Both of the aircraft's CFM-56 engines had been subject to boroscope inspections during the night prior to the incident flight. High-pressure rotor drive covers were not refitted on each engine and as a result, nearly all the oil was lost from the engines during the brief flight.

Several months after the incident a similar overseas incident occurred on a Boeing 747-400. Shortly after departing on an over-water flight, the crew noticed reducing oil quantities on the number one and number two engines. The aircraft was turned back to its departure point, where is arrived safely without any need for the engines to be shut down in flight. After landing, oil could be seen leaking from the engines.

Boroscope inspections had been carried out on all four of the GE CF6 engines. This inspection normally involves removing and then refitting the starter motors from each engine, and in fact the starter motors were removed from the number one and number two engines in preparation for the job. Because the tool to enable the engines to be turned by the starter drive could not be found, the starter motors for engines 3 and 4 were not removed and all engines were turned by an alternative method. A lack of spares had led to a practice of not replacing O-rings when refitting starter motors. However, on this occasion a mechanic did comply with documented procedures and removed the O-rings from the number one and two starters.

The workers who refitted the starters apparently assumed that the situation was 'normal' and did not notice that the O-rings were missing - a 'situational awareness' error.

This incident had a variety of causal factors, such as informal procedure which had evolved to work around the frequent 'nil stock' state of spares, poor lighting and inadequate leak check inspections. However, an important point is that because the aircraft had four engines, it was not protected by ETOPS standards. In essence, the mechanics were 'working without nets'. Had the job proceeded as originally planned, the starter motors would have been removed from all four engines, with serious consequences.

The extension of some ETOPS precautions to non-ETOPS operations would help to contain such maintenance-induced problems.

Boeing has encouraged operators as a general practice 'to institute a program by which maintenance on similar or dual systems by the same personnel is avoided on a single maintenance visit'. BASI has also published the following suggested safety action: "Where possible, the simultaneous performance of the same maintenance tasks on similar redundant systems should be avoided, whether or not the aircraft is an ETOPS aircraft.

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Conclusions

Unfortunately, advances in aviation technology have not necessarily been matched by improvements in the way we organize the work of the people who maintain aircraft.

The remarkable aspect about maintenance incidents is that many of them share similar features. A relatively limited number of unsafe acts, such are work-arounds, memory lapses and situational awareness errors typically occur in the context of problems such as unclear or poor procedures, a lack of equipment or spares, communication breakdowns, time pressure and fatigue. Because unsafe acts are generally symptoms of wider problems, human factors is not just about focusing on people but on the systems within which people work.

This article concludes with just five system-level improvements that may help to ensure safer maintenance.

1. Introduce refresher training, particularly on company policies and procedures.
2. Introduce a clear 'Responsibility Policy' to remove barriers that discourage people from reporting incidents.
3. Introduce a fatigue management program. This will almost certainly involve ensuring that workers get adequate sleep opportunities. If 12-hour shifts are being worked, a ban on extending shifts with overtime may be necessary.
4. Introduce human factors training for management and workers.
5. Minimize the simultaneous disturbance of multiple or parallel systems.

While striving for perfect performance by those maintaining aircraft, we should recognize that making mistakes is an unfortunate but unavoidable consequence of being human.

Human Factors In Aircraft Maintenance Facilitator's Workshop

The Maintenance And Ramp Safety Society (MARSS) will be hosting a one and one-half day workshop on May 13 and 14 (Thursday and ½ Friday) in Richmond, BC.

The purpose of the workshop is to learn from each other and come away with a better understanding of what are some successful approaches to facilitating human factors training to aviation maintenance personnel.

This workshop will be open to all facilitators of human factors training (maintenance and otherwise) and persons interested in becoming human factors facilitators.

The workshop will be facilitated by Gordon Dupont, Transport Canada Special Programs Coordinator and Bill Foyle Consultant, retired.

The workshop program will consist of the following:

1. Welcome and introductions.
2. What do you hope to get out of this workshop?
3. What makes a good facilitator? (Group discussion((GD))
4. What should the long term human factors (HF) commitment consist of? (GD)
5. What material should a good workshop contain? (GD)
6. What are some of the common pitfalls to watch out for in HF training? (GD)
7. What are some of the methods of maintaining the awareness HF training can provide?(GD)
8. What are some sources of HF information? (GD)
9. What needs to be done in the future? (GD)
10. Recap of material covered.

Each participant will receive a binder with material for the workshop and a copy of the material covered in the workshop.

One of the most valuable contributions of the workshop will be the opportunity to meet fellow facilitators and learn what is happening in other companies.

Cost to attend, which will include a get together is only $195.00 to members of MARSS and $225.00 for non-members.

Contact John Braund at **MARSS** (604) 207-9100
Fax:(604) 207-9101
Email: marss@marss.org

The Maintenance And Ramp Safety Society (MARSS) is pleased to offer the Human Performance in Maintenance (HPIM) Part 2 Workshop

When?

It will be held April 26 and 27 (Monday and Tuesday), 1999. Start time, both days is 0800.

Where?

The workshop will be held at Canadian Airlines training room at Vancouver Airport.

What?

The workshop is the follow on to HPIM part 1 and like Part 1 is very interactive. It covers topics like Attitude, Communication the written word, Company Culture and Norms. It also has case studies.

Each participant will receive a workbook

Who?

Anyone who has taken Part 1.

Why?

This follow on to Part 1 reinforces lessons learned in Part 1 and brings in new information on how to avoid making a maintenance error.

What Others Have Said

"Better than Part 1", "Once again it was serious and entertaining at the same time for me", "Can't wait for the next one", "One of the most valuable workshops ever presented to maintenance people".

Cost?

The cost to attend is $195.00 Cdn for members and $225.00 for non-members. This will include the workbook and all coffees

A special hotel rate of $79.00 per night has been arranged with the Executive Inn for anyone from out of town. To reserve a room call 1-800-663-2878 (604 278-5555)

More Information?

Contact John Braund at **MARSS** (604) 207-9100 Fax:(604) 207-9101
Email: marss@marss.org

To Register?

Name …………………………………. **Company** ……………………………………

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Email …………………………………. **Method of Payment** ……………………

"Too Many Cooks!"

The following case study is part of the video "Too Many Cooks" distributed by the Maintenance And Ramp Safety Society MARSS. Copies of this case study may be made to support this video. To receive an original copy or the video, contact MARSS at Phone: 604 207-9100 Fax: 604 207-9101 Email: MARSS@MARSS.org

The official cause of this accident states "The improperly secured cannon plug of the N1 tachometer generator became disconnected" But lets look deeper at what the real cause factors are. There was no intent not to secure the cannon plug and the AME, in good faith, felt sure in his mind that he had secured it.

So what happened? Look carefully at all the circumstances, figure out the links in the chain that added up to an error and look carefully at the safety nets that were not in place or could have been in place to prevent the accident.

Synopsis

The pilot and four passengers, who were all senior company employees and experienced helicopter pilots, departed Coldwater Airstrip for Johnson River. About four minutes after the takeoff, while in normal cruise at 2,000 ft. above sea level(asl), the engine-out audio warning horn sounded. The pilot made a perfect autorotational landing into the ocean. All aboard escaped uninjured and the helicopter was recovered from the water by a heli-logging Super Puma, before it sank.

Inspection of the helicopter and engine after the accident found no cause for the engine to have failed but the cannon plug to the N1 tach-generator was found disconnected and undamaged.

The Night Before

The helicopter had undergone a 100 hour inspection the previous day during which time the N1 tach generator had been replaced. The engineer who had done the work felt sure that he had installed and tightened the cannon plug but he was at a loss to explain how it could have come off only one day after he had installed it.

A careful review of the circumstances at the time the work was done revealed that the AME was the only person working on the aircraft. He was at the end of the inspection when he replaced the tach gen. He was running late and he had an important social engagement that evening. The telephone rang as he was finishing up and he rushed to answer it. It was part of his job to answer the telephone when no one else was around, as it could be a customer looking for a helicopter to charter. The phone call was from his wife who wanted to know why he wasn't home getting ready for their dinner date. After a rather one sided discussion, he promised that he would be home shortly and returned to finish up the 100 hourly. It had been a very long two days getting the machine in shape but it was going to be ready to work the next morning.

The AME completed the paperwork the next day due to his haste to get home and forgot to inform the pilot that he had changed the N1 tach generator.

Company Policy

The company had a policy that the cannon plug, which had provisions for lockwiring, did not have to be lockwired because a tightened cannon plug never comes lose.

The Pilots

The pilot flying the accident helicopter was the lowest time pilot in the aircraft. When the engine-out warning system activated, he immediately lowered the collective and initiated an autorotation as he had been taught many times before on check rides. On check rides he would also automatically roll off the throttle in order to simulate an engine failure.

He was told to head for the nearest shoreline (which he was). He was told to radio a MAYDAY which he did. At the same time he was being asked where the life jackets were and to call for another helicopter on another frequency, The chief pilot, with over 10,000 hours flying experience, asked the pilot if he was sure that the engine had failed. The pilot pulled up on the collective again and noting the rotor rpm starting to decay, relowered the collective. He was asked to try an inflight relight but the N1 wouldn't come off zero. The pilot made a gentle autorotational landing in the water but found it difficult to get the blades to stop when he rolled the machine on the water.

The Manufacturer's Safety Net

Bell had issued a Technical Bulletin (#206-82-71) which states that "*failure of the engine N1 tachometer generator causes the engine out audio warning horn to signal an erroneous engine failure, which has occasionally confused the pilot, causing an improper control response. In several*

(Con't from page 9, Too Many...)

recent cases, the N1 tach generator failed and the engine-out warning horn activated. The pilot hearing the horn, surmised he had an engine failure and elected to go with emergency landing procedures. The aircraft autorotated into undesirable terrain." The Technical Bulletin goes on to suggest that the fix for the problem is to deactivate the warning horn and placard the instrument panel, with a decal they will provide, that informs the pilot that the engine out warning horn is deactivated.

The Results

This bulletin had been carried out to two months earlier on an aircraft belonging to a different company. This company, within a week of the warning horn deactivation, lost a pilot and aircraft when the engine failed as the pilot was lighting controlled fires by drip torching. With his head out the window, the pilot did not realize the engine had failed until it was too late. The helicopter came down in the fire he had just lit. He died 16 hours later of his burns.

The Super Puma which rescued the survivors and saved the helicopter from a watery grave, crashed less than a month later, killing both pilots when the "barbecue plate" which holds the transmission failed from cracks which maintenance had failed to detect before the "plate" failed catastrophically.

To The Editor

I encourage all of you to please write to me, the editor with all you questions, suggestions and ideas. I appreciate any feedback that I receive.

-Renée Dupont

From the Editor!

Welcome to the 12th issue of ***GroundEffects.*** In this issue we will hear what MARSS has been up to, we will also hear about possible solutions to maintenance error and hear the conclusions and overviews of the Thirteenth Annual Symposium in Dayton Beach.

As described in our feature article, fatigue plays a greater role in the making of a maintenance error (for that matter, in any error) than most of us realize. Many nurses and doctors work two 12 hour day shifts, followed by two 12 hour night shifts then proceeded by 4 days off. Ask anyone who is performing these shifts and they will tell you that they are continuously tired and have many times fallen asleep while carrying out critical tasks at night. The potential for error frightens shift workers but they are still unable to overcome the effects of fatigue. This is nothing when you compare it to interns who are on duty for 24 hour stretches. Imagine what these people feel like after working over 20 hours? Would you like someone in whose hands your life depends on, working to save your life after being awake for 23 hours or so? This is no different from many maintenance mechanics who work hours of overtime to get the plane out the door on time. Can you start to picture how maintenance mistakes can be made?

Alan Hobbs states in his article that a person being awake for 23 plus hours has the same ability as a person with a blood alcohol level of 0.12%. Take a moment and think about that!

As to date I have heard nothing in response to my recent letter to the FAA. I will keep everyone informed if anything is heard.

Please remember to mark your calenders for May 13, 1999 as we will be holding our MARSS first Annual General Meeting. This is a great opportunity to get involved and ask all those questions that you are too afraid to write in and ask. Hope to see you all there.

Take care in your profession and remember that accidents happen buy most can be avoided.

Notice of Annual General Meeting

The Annual Meeting of the Maintenance And Ramp Safety Society will be held at the Executive Inn in Richmond, B.C. on Thursday May 13th 1999 at 1900. This meeting will see the election of officers as well as the short and long term goals being set. Nomination forms are being sent out to all members and a ballot will be mailed to all members in good standing 30 days before the annual meeting. The Annual report will be mailed to all members as well as the minutes of the annual meeting. Look for the minutes to be posted on the MARSS website. Anyone is invited and welcome to attend.

Bob Rorison

President

GroundEffects

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THE HUMAN ELEMENT IN AVIATION

Our Programmes are designed to create a strong foundation for good communications by increasing trust and cooperation within the management group, within the flight operations team, within the maintenance team and between them all. They are ADAPTED TO YOUR NEEDS - scheduling, location, budget - and take into account your specific objectives and the particular circumstances prevailing in your group

TEAM EFFECTIVENESS IN THE MAINTENANCE DEPARTMENT: This programme helps create a solid psychological base for safety measures within the maintenance department, and **enhances safety, performance, and well-being.** It provides team members with practical concepts to explain personality and interaction, and their impact on the workplace: on safety, on the quality of communications, on the appropriate use of authority, and on stress. The programme **increases mutual support, open and comfortable communication,** willingness to give and to receive both appreciation and construction criticism among peers and across levels. Current relationship problems are addressed, as are **ways to improving operational effectiveness.**

THE SAME PROGRAMME IS AVAILABLE TO THE FLIGHT DEPARTMENT AS A WHOLE.

TEMPERATURE-TAKING: A short (two or three-day) process designed to provide information on how the talents and energy of the members of the department are being well utilized or dispersed, and how they perceive the climate and working environment of the department. **Individual meetings** with each member, followed by **feedback to the group** of the consultant's perception of the areas of satisfaction and frustration in the group, their strengths, their effectiveness in dealing with pressure and priorities, their amenability to appropriate change, and so on. This is a low-cost, low-risk intervention which is complete in itself.