focus

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contents

Taking Advantage of Aviation Expansion in the UK

The recent announcement by the Minister for Transport that additional runway capacity will be provided in the UK and in particular in the South East of the country has been greeted with great enthusiasm by the aviation industry. By coincidence the Freedom to Fly National Conference 2002 was held on the 24th July, the day following the announcement by the government.

Commercial organisations are always enthusiastic about an opportunity to make more profit, after all, that is what business is all about. The chance of expanding the business does not present itself all that often and if the United Kingdom is to maintain its position as the gateway to Europe then there is a real need to grasp this opportunity with both hands.

Wherever the new runways are to be built there is going to be a need for an improvement to the infrastructure. We can not expect the existing infrastructure to cope, most of it is already working at capacity. Road and rail links, terminal buildings, hangar, and other accommodation will need to be constructed. This is all good for the economy and job creation will be welcomed by many but think for a moment about the following issues.

The environmental lobby has over the years become very active and the delay in the construction of Terminal 5 at Heathrow is proof of how they slow down new developments. Every environmental activist in the country will be jumping on this bandwagon.

The national railway infrastructure is currently in a less than good state and will be expected to provide resources to build new railway lines and facilities at any new or currently un-serviced sites chosen. If this work is contracted to private organisations they will have to recruit trained staff. Where will they come from? Will this requirement draw staff from the existing railway organisation? Who will train new staff if recruited?

More runway capacity inevitably means more aircraft operating in our airspace. This will require additional air traffic controllers. We are told that there is already a shortage of trained and experienced air traffic controllers and that the recruitment of new staff is not keeping pace with the current demand. Where will the additional staff be found and where will they be trained?

The downturn in passenger traffic following the 11th September 2001 disaster meant the airlines and supporting services shed staff in order to try to balance their books. These folk have by now found work in other industries and are unlikely to return to aviation because there is an upturn in the industry. Who is going to train additional aircraft engineers and supporting ground staff?

Adopting a positive attitude to this potential expansion is very necessary and could well have a long term affect on the future of aviation in the UK. It does however require both the government and the aviation industry to play their part in this complicated process.

Firstly, we need to see the government provide the necessary infrastructure for the development of the selected areas. To this end there will be a very real need for it to exercise its so called “joined up thinking” so that all the involved departments plan adequately and deliver their promises on time and to budget. Recent history has shown that we will need to try much harder if we are to achieve this.

Secondly, there is a need for the operators and service providers including air traffic control to ensure that they train sufficient people, to the correct standard, in a timely manner in order that we can take advantage of this opportunity. This may mean that operators take a more active role in staff training of their service providers. Failing to do so would mean that the United Kingdom would lose its “Gateway to Europe” status and the benefits that accrue from it.

UK FLIGHT SAFETY COMMITTEE OBJECTIVES

- To pursue the highest standards of flight safety for public transport operations.
- To constitute a body of experienced aviation flight safety personnel available for advice and consultation.
- To facilitate the exchange of urgent or significant flight safety data.
- To maintain a liaison with all aviation authorities on matters affecting the safety of the flight-crew, ground-crew, the aircraft and passengers.
- To provide assistance to operators setting up a flight safety organisation.

Conflict

by John Dunne, Airclaims

"The Russians were at fault" was the initial speculative response of the media and the aviation "experts" to the tragic events over Southern Germany on 1st July 2002. The loss of 71 lives in the mid air collision between the DHL Boeing 757 and the Bashkirian Airlines Tupolov Tu 154 was a stark reminder of the complexity and vulnerability of the aviation safety chain. As the professional Air Accident Inspectors moved in and began their task of sifting through the data and wreckage a different tale of the causal issues involved in the mid-air collision have begun to emerge.

The similarities between this tragedy and the extremely close call between two JAL aircraft over Tokyo on 31st January 2001 should serve as a catalyst to a soul-searching debate within our industry. Both events have uncovered serious shortcomings in the system; the opportunity to address those issues should not be missed.

The why's and wherefores of why the system safety net defences (in the form of identifying the aircraft when they initially enter the controller's sector, a switched off short-term conflict alert system, one person in the control room, a busy telephone line, operating the 4-5 aircraft in his sector on two different screens on two different frequencies) were stripped away on the night in classic "Reason Model" style will no doubt be explored and reported on in detail by the Accident Investigation team. This area will no doubt be the focus of effort as these safety nets should prevent us ever getting to a Traffic Alert and Collision Avoidance System warning scenario.

But once those system safety nets were breached the controller and the two crews were placed in a situation where no one person actually had the total picture of the unfolding scenario. In those last seconds did the controller and the two crews actually make the "right" decision based on their own limited perspective of the scenario as they saw it? The controller does not know if "his" aircraft are TCAS equipped, if the TCAS is functioning and if the crew are responding correctly to any TCAS warning. The crews of both aircraft appear to have responded to the situation in a manner aligned to their different training and SOP philosophies. The controller also only has a schematic plan view of events with a digitised "label" providing the transponder data. In close conflict situations this "label" information from the two aircraft can merge causing a blurred image depriving the controller of a significant part of the overall conflict picture. Coupled to that is the refresh rate of the controllers screen which can be 2 – 5 seconds behind the actual aircraft position.

If we started today with a clean sheet of paper and were tasked with designing a robust safety system from scratch perhaps we would consider addressing some of the following points:

- ATC and TCAS separation are two independent and non-complementary systems. What guidance should ICAO provide about which separation system has the final authority, at what point would this authority become absolute and how will that guidance be disseminated and implemented?
- Can TCAS tell us what the aircraft is about to do or is it limited to telling us what the aircraft is actually doing at that moment, i.e. is it a predictive or a responsive system?
- TCAS is the final safety net and it comes into play when all the other system defences have been breached. Should the official guidelines reflect and reinforce this aspect?
- If we do elect to rely solely on TCAS what have we done to ensure the systems integrity prior to each and every departure. After all we still see accidents involving crossed flying controls so how do we ensure that the TCAS system "sense" is as per the design intent and keep Murphy at bay?
- Can TCAS adequately differentiate between high rates of decent and rapid closure to cleared altitudes and avoid false or erroneous TCAS alerts.
- How can we ensure that the players all have the same mental picture of the activities in their immediate vicinity?
- RVSM allows aircraft to fly more accurately to barometric references. Does this barometric accuracy (by default) potentially increase the risk of collision by placing aircraft at the same vertical reference point in the sky?
- Is the TCAS Resolution Advisory avoidance manoeuvre the optimum? Currently it's a mirror-image pitch manoeuvre. How does a mirror image roll manoeuvre compare in both evasive and passenger safety terms?
- How much traffic is predicted over the next 40 years, how can we develop a system that can tolerate that much traffic and at the same time tolerate our own human idiosyncrasies? Is automatic en-route guidance appropriate?
- How should the air lanes be laid out to optimise traffic flow rates?

Recent CHIRP reports have discussed the perceived pressures on the system. Let's not forget that our safety systems are only as good as the weakest link in that safety chain. Can the system cope with the weakest link?

Preventing Hard Nosegear Touchdowns

FIGURE 1 DAMAGE TO FORWARD FUSELAGE

In recent years, there has been an increase in the incidence of significant structural damage to commercial airplanes from hard nosegear touchdown. In most cases, the main gear touchdowns were relatively normal. The damage resulted from high nose-down pitch rates generated by full or nearly full forward control column application before nosegear touchdown. Flight crews need to be aware of the potential for significant structural damage from hard nosegear contact and know which actions to take to prevent such incidents.

Hard nosegear landings can produce heavy loads on the nosegear and its support structure. The resulting high stresses in the forward fuselage upper crown and between the flight deck and wing front spar can cause the fuselage structure to buckle. Appropriate actions by the flight crew can help prevent such incidents. Understanding which actions are appropriate requires a discussion of the following:

1. Incidents of hard nosegear landings.
2. Structural design requirements.
3. Airplane control during landing and derotation.

1. Incidents of hard nosegear landings

Recent incidents of hard nosegear touchdown share two characteristics. First, a relatively normal main gear touchdown is followed by full or nearly full forward control column application, which results in overderotation and hard nosegear contact. Second, the resulting airplane damage is significant and requires lengthy and expensive repairs. (The location and type of damage depend on the particular model of airplane.)

Three representative incidents of structural damage incurred from hard nosegear contact with the runway are described below.

An airplane was on approach to a relatively short runway in gusty conditions. The airplane experienced a normal main gear touchdown, but the full forward column movement applied by the flight crew caused very hard nosegear contact with the runway. Resulting damage included displaced nosegear, bent axles, and a buckled and cracked fuselage structure (fig. 1). In addition, the cockpit door, forward lavatory doors, and forward passenger doors were jammed closed.

FIGURE 2 DISTORTION AND AFT ROTATION OF NOSEGEAR

FIGURE 3 NOSEGEAR COLLAPSE ON LANDING

An airplane returned to the departure airport following an in-flight engine shutdown. The airplane landed firmly on the main gear. Recordings by the digital flight data recorder ended abruptly because of damage from the nosegear contact; however, the last data point showed that considerable forward control column movement had been applied. The nosegear was rotated aft and to the left of its normal position, resulting in damage to the lower fuselage and nosegear wheel well area (fig. 2).

An airplane landing in strong crosswinds and turbulent conditions touched down on the main gear firmly, but not abnormally for the conditions. The airplane bounced, full forward column movement was applied, and the nosegear contacted the runway very hard, causing the nosegear to fail and rotate upward in the aft direction. The nosegear wheel assembly penetrated the electronics bay and caused considerable damage (fig. 3).

2. Structural design requirements

Boeing first recognized that heavy loads on the nosegear could damage the fuselage structure during the 727-200 flight-test program in the 1960s. Flight-test data from various landings with high nose-down pitch rates led Boeing to enhance design requirements. These new requirements enabled the nosegear and fuselage structure to withstand harder nosegear contacts. All Boeing-designed airplane models meet these requirements.

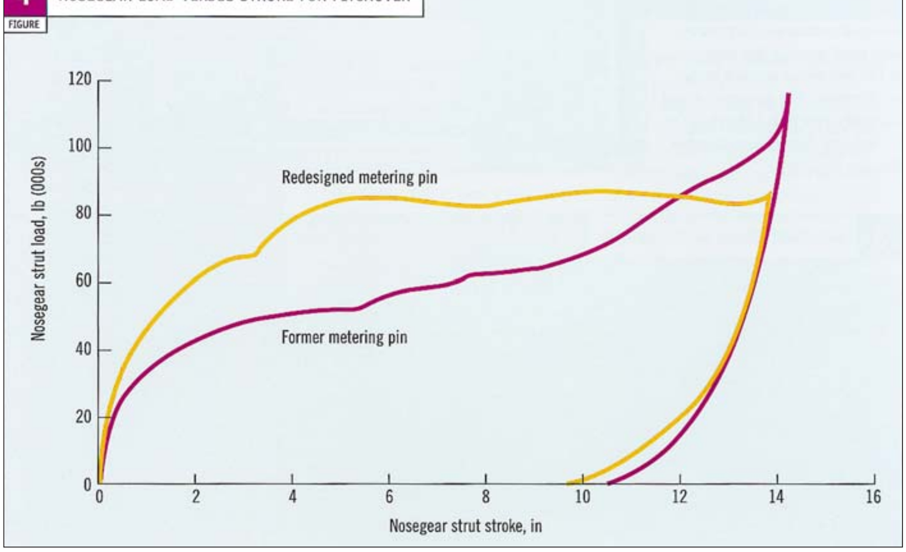
The most recent design enhancements involve the 767. The 767-300 nosegear metering pin has been further optimized to absorb the energy produced during overderotation events, thereby lowering the load on the nosegear (fig. 4). The metering pin device controls the flow of hydraulic fluid within the nosegear oleo strut. The design enhancement was incorporated into production airplanes in August 1994 and is available for retrofit on earlier 767-300s.

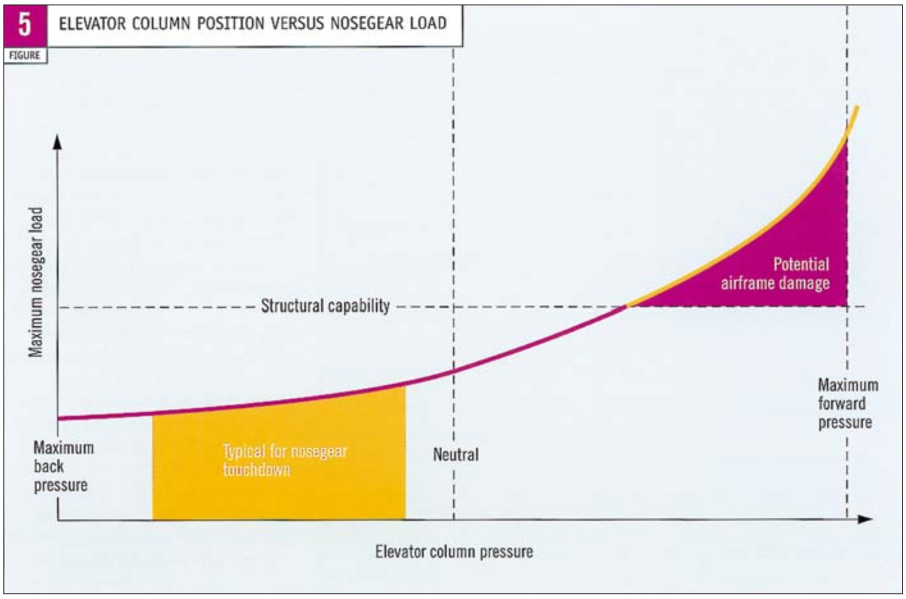
In addition, the upper crown stringers on the forward fuselage of the 767-300 have been strengthened in the area where buckling often occurs following overderotation. This design enhancement was incorporated into production airplanes in January 1995. No retrofit is available for this design enhancement.

3. Airplane control during landing and derotation

In the last several years, there has been an increase in the incidence of airframe damage from hard nosegear contacts. Examination of airplane flight recorder data from these incidents revealed that, in

FIGURE 4 NOSEGEAR LOAD VERSUS STROKE FOR PITCHOVER





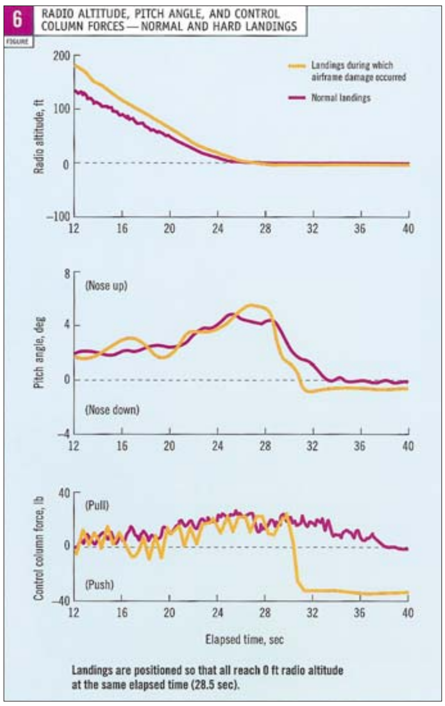
each case, full or nearly full forward column movement was applied between the time of main gear contact and nosegear touchdown. Figure 5 shows that enough nose-down elevator authority exists to damage the airframe structure if the airplane is rapidly derotated following main gear touchdown. This is possible because the maximum nose-down elevator authority is designed to control go-arounds, which require considerably more longitudinal control than the landing maneuver.

In response to recent incidents, Boeing has produced a training video to increase flight crew awareness of the potential for both nosegear and airframe damage as a consequence of overderotation. Based on a successful training effort in 1994 and 1995 that significantly reduced hard nosegear landings worldwide for several years, the video serves as a refresher for flight crews. The nine-minute video has been sent to all Boeing airline customers. (For information on how to obtain additional copies, refer to the editor's note at the end of this article.)

Many factors influence a successful landing and derotation. First, the approach must be stabilized, as defined by the Flight Safety Foundation (table 1). If these criteria are not met at any time before touchdown, the flight crew should initiate a go-around.

On approach, the speed-brake lever should be armed for landing and the autobrakes should be set for the runway surface conditions. The landing derotation should be performed so that the flight crew immediately starts flying the nosewheels smoothly onto the runway when the main wheels touch down.

Flight crews can accomplish this by controlling the airplane pitch rate while relaxing aft column pressure. When heavy brake applications are needed, with and without autobrakes, increased aft column pressure may be required to slow the



derotation rate. Flight crews should not hold the nose up in the touchdown attitude or allow the nose to rise because either could result in a tail strike. Control column movement forward of the neutral position should not be needed. Figure 6 illustrates this smooth relaxation of column force as the nose is lowered. The figure compares the radio altitude, pitch angle, and control column forces for both normal landings and landings during which airframe damage occurred.

With the nose down, spoilers up, and thrust reversers deployed, the airplane is in the correct stopping configuration. This should be established as soon as is practical during landing. Forward column movement should not be applied to lower the nose rapidly in an effort to improve landing performance or directional control. The rudder provides the required directional control until the airplane is at a relatively low speed, then rudder pedal nosewheel steering is used to complete the landing rollout. Large forward column displacement does not improve the effectiveness of nosewheel steering and may reduce the effectiveness of main-wheel braking because it reduces the amount of weight on the main gear.

If the airplane bounces, the flight crew should hold or reestablish a normal landing attitude and add thrust as necessary to control the rate of descent. Thrust need not be added for a shallow bounce or skip. When a high, hard bounce occurs, the flight crew should initiate a go-around.

Summary

Flight crews can reduce the chances of airplane damage from hard nosegear contact by avoiding high derotation rates and excessive forward column inputs. In the event of a hard landing, the flight crew should report the event to the engineering and maintenance departments so that the airplane can be inspected for potential structural damage.

Editor's note: A Boeing training video, "Airplane Derotation: A Matter of Seconds," covers the material presented in this article. Copies of the nine-minute video have been sent to all commercial airplane customers. Additional copies are available from the director of Flight Technical Services, Boeing Commercial Airplanes, P.O. Box 3707, Mail Code 20-97, Seattle, WA 98124-2207, USA; telephone 206-662-7800. Additional information on hard nosegear contact is available in Boeing Commercial Airplanes Flight Operations Technical Bulletins nos. 757-48 and 767-47, Feb. 1, 1993.

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Elements of a Stabilized Approach

The Flight Safety Foundation suggests that operators consider adopting the following definition of a stabilized approach: All flights shall be stabilized by the 1,000ft height above touchdown (HAT) in instrument meteorological conditions and by the 500 -ft HAT in visual meteorological conditions.

An approach is considered stabilized by the Flight Safety Foundation when the following criteria have been met:

- The airplane is on the correct flight path.
- Only small changes in heading and pitch are required to maintain that path.
- The airplane speed is not higher than Vref + 20kt indicated airspeed and not lower than Vref.
- The airplane is in the proper landing configuration.
- The sink rate is not more than 1,000 ft/min. If an approach requires a higher sink rate, a special briefing should be performed.
- The power setting is appropriate for the configuration and not below the minimum power for approach as defined by the airplane operations manual.
- All briefings and checklists have been performed.
- Specific types of approaches are considered stabilized if they also fulfill the following:

  i Instrument landing system – The airplane must be flown within one dot of the glideslope or localizer.

  ii Category I or II – The airplane must be flown within the expanded localizer band.

  iii Visual – The wings must be level on final approach when the airplane reaches the 500 -ft HAT.

  iv Circling – The wings must be level on final approach when the airplane reaches the 300 -ft HAT.

  v Unique – A special briefing is required.

Source:
Flight Safety Foundation Approach and Landing Accident Reduction (ALAR) Task Force

Table 1

Level Busts – ACEing the hazard

Since September 2001, a UK National Air Traffic Services ACE project team has been examining level busts, searching for their causes, and planning strategies for mitigation. At the 346th meeting of the UKFSC in May 2002, team members gave a presentation, describing the work done to date, and explaining future plans…

Level busts have a real potential to claim lives. The mid-air collision near New Delhi in 1996 killed 349 people, and was the result of a simple level bust. In the UK, there are approximately 300 level busts a year, many of which do not result in losses of separation, though all have the potential for very serious outcomes.

What is a level bust? A level bust occurs when an aircraft deviates from the correct level by more than 300ft. Normally vertical separation between aircraft is 1000ft. This project did not address level busts caused by TCAS events, nor instances of 'late re-clearance' where an aircraft passes through a new cleared level under ATC instruction before stabilising at that level.

Modern ATC equipment, including Short Term Conflict Alert (STCA), high quality radar, well-trained and experienced controllers, and up-to-date aircraft fitted with Traffic Alert & Collision Avoidance System (TCAS) flown by competent crews, should afford better protection. Despite this, a mid-air collision (not, it seems, the result of a level bust) occurred over Ueberlingen, Germany earlier this year. This proves that reliance upon present collision avoidance techniques is not sufficient; accepting level busts and trusting that a collision will be avoided is not enough; new ways of eliminating level busts must be found.

Recognising the nature and potential severity of the hazard, UK National Air Traffic Services set up an ACE (Action for Continuous Excellence) project in September 2001. The Level Bust ACE team, chaired by a Terminal Control Watch Manager, included ATC managers and safety investigators, representatives of Safety Regulation Group, a human factors scientist, and pilots from British Airways and easyJet. The project is sponsored at NATS board level, and has an unrestricted brief. An 'ACE agent' oversees and facilitates the group's work, providing guidance and administrative support, and ensuring the group retains its focus and that effective progress is made.

ACE projects address difficult problems that need to be solved. The process, developed from an analysis of industry best practice in problem solving, uses multi-disciplined teams and a structured approach, focusing on taking action and implementing solutions.

Over a series of one-day workshops, the team carried out a practical analysis of the root causes of level busts, and prioritised these causes, before discussing and identifying forty possible solutions. These solutions were themselves prioritised and matched against causes, in a matrix, before further work to specify solutions for action took place.

Solutions identified for action ranged widely in their simplicity of development and implementation, cost, and potential benefits in addressing issues other than level busts.

Education and Awareness

The most important solution identified is the need for an education and awareness programme for ATCOs and pilots. It became clear that many, if not all, level busts would be avoided if crews and controllers complied with current regulations and 'best practice'. A new working group, incorporating members of the ACE project team, together with ATC training experts, is developing this campaign. The campaign will be rolled out through summer and autumn this year. It is hoped that a concerted effort to improve SOP adherence, RTF discipline, and the use of 'best practice', may bring about a significant improvement in the level bust statistics.

Alphanumeric Callsigns

Data from ATC safety investigations identified that callsign confusion, a significant cause of level busts, is much reduced by the use of alphanumeric callsigns. This solution is being further examined, in order to establish that there are no unknown risks associated with alphanumeric callsigns. Once this is complete, consideration may be given to seeking regulatory action to mandate the use of alphanumeric callsigns.

RTF Phraseology

Much discussion took place regarding some of the RTF phraseology in current use. Whilst it was felt that most communication difficulties arose from poor technique or assumption, rather than from questionable phraseology, some opportunities for improvement were identified. The words 'Flight Level Wun Hundred' have been used in place of 'wun zero zero' on a trial basis for some time, and with success. This phraseology has been extended to other levels (200, 300, and 400). Other phraseology changes, such as the use of the word 'degrees' after headings, in order to differentiate from flight levels, are still under consideration.

The UK air traffic controller's 'bible', the Manual of Air Traffic Services Part One, gives a full account of standard RTF phraseology as used in the UK. Other states use slightly different phraseology. The Manual is available online at www.caa.co.uk/docs/33/CAP493_Part1.pdf, and Appendix E is the appropriate section. The UK AIP also gives relevant information at www.ais.org.uk/uk_aip/pdf/enr/2010103.pdf. CAP413 gives an overview of RTF techniques at www.caa.co.uk/docs/33/CAP413.pdf.

Chart Deficiencies

Many pilots reported level busts as a consequence of mis-reading SID charts. In particular, one chart manufacturer's depiction of step climb SIDs was felt to be unclear. Representations have been made to the manufacturer concerned, and work is ongoing to achieve changes.

FMC Software Modification

Modern aircraft such as the Boeing 737-NG and Airbus family have an alerting feature, which warns crews of climbing or descending through transition altitude without re-setting the altimeters. Investigations have been carried out to ascertain whether the FMC on older aircraft (such as the Boeing 737 EFIS, 757, and 767) could be modified to provide a similar alert. Initial indications are that this is feasible, and presentations will be made to FMC manufacturers in due course. One major operator has found that their Boeing 737 EFIS fleet experiences ten times more level busts with altimeter setting errors as their cause, than their A320 family fleet. (Industry support for this proposal is sought – interested parties should contact the author tim.atkinson@easyJet.com).

Distraction-Free Flight Deck

The project group identified that distraction, causing breakdown of SOPs, was a common factor in level busts, and concluded that a distraction-free flight deck is an environment in which level busts are less likely. Of course this is a matter of discipline, and some companies already operate a 'sterile' flight deck. Most operators are believed to be aware of the issue, and when the security implications of 'locked door' policies were considered, it was decided not to pursue this solution further for the moment.

Risk Analysis

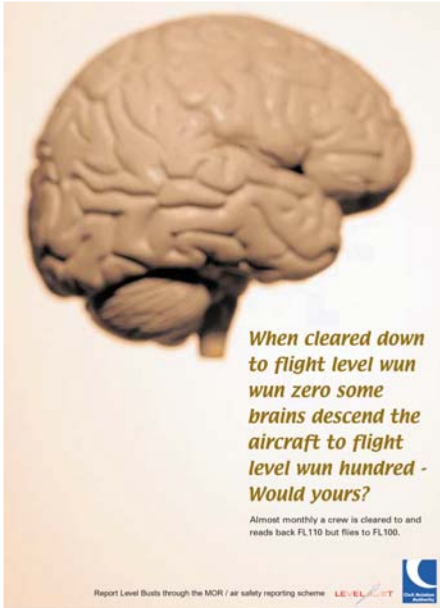
It was decided that further formal risk assessment should be carried out. NATS Safety Analysis experts have studied substantial amounts of radar data, evaluating the possible consequences of level busts involving aircraft passing through or levelling at incorrect levels, this evaluation being carried out for various bands of flight levels. Whilst this work is ongoing, early indications are that the conclusions will enable better prioritisation of mitigating techniques. The work undertaken so far has already identified that some classes of level bust are far riskier than others – some of the riskiest being those involving altimeter mis-setting or mis-read SID charts. This knowledge allows greater priority to be given to eliminating these errors.

Mode S Implementation, and sub-scale setting

Consideration of the manner in which Mode S might help to reduce the level bust risk led to the project group's identifying that Mode S should be implemented without delay. Moreover, it was decided that Mode S selected altitude data could be of considerably more value, if altimeter sub-scale setting were also a down-linked parameter. Although the present Mode S plans do not incorporate sub-scale setting, NATS has expressed a desire that it should.

London TMA Design

The design of the London TMA was often cited as being critical to the number and nature of level busts. In particular, the fact that most SIDs climb under the holding stacks, makes certain types of level bust particularly hazardous. Whilst it is clearly a long-term objective, the project group felt that as changes to the TMA are made any such re-design should have, as its aim the need to avoid the types of interaction



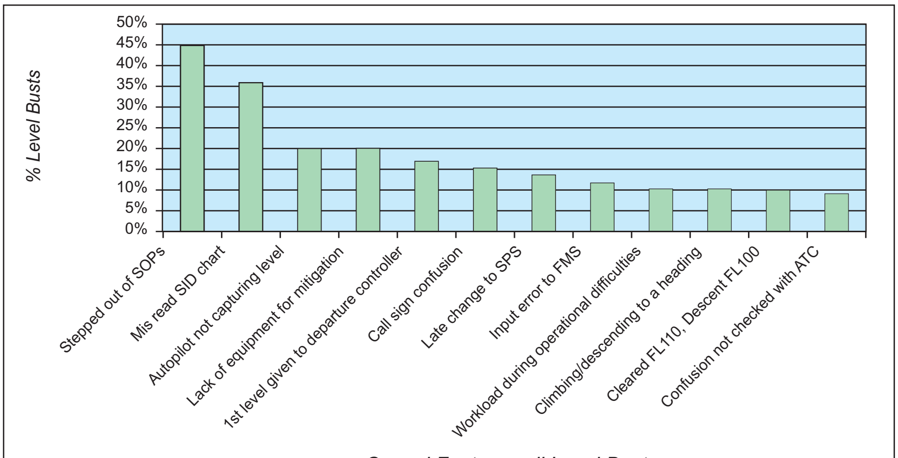
between arrival and departure routes that presently exist. Such a re-design might not reduce the number of level busts, but would certainly reduce the likelihood of a level bust causing a collision.

Datalink Communications

Datalink communications (CPDLC) provide an opportunity to eliminate many human errors in the communication chain. However, other forms of human inter-action with data received by electronic means will take place, and careful assessment of other areas of risk will need to be carried out. CPDLC trials are ongoing in various locations worldwide, and it is hoped that a robust and reliable form of technology will be arrived at. The project team agreed that CPDLC had significant potential.

Transition Altitude

The transition altitude in the UK varies between 3000ft and 6000ft, depending upon location. These different values, and the fact that our transition altitude is relatively low, not only add to the risk of level busts occurring, but make those which do occur, more likely to result in an encounter with another aircraft. For these reasons, the project group recommended the implementation of a 24000ft Transition Altitude throughout the UK FIRs, in compliance with the European Single Skies concept. A further working group will study this issue in due course, and its work will be monitored.



Causal Factors - all Level Busts
(a level bust may have more than one cause)

Conclusions

Level Busts represent a significant hazard. Much of the mitigation relies upon human endeavour – there is no technological remedy. The education and awareness programme mentioned above will aim to ensure that everyone exposed to the level bust hazard has a clear understanding of the problem, and knows how to reduce their risk. This programme, together with the other solutions raised by the ACE team, may go some way to improving the statistics, though greater awareness will also lead to more widespread reporting of non-safety-significant events. The only true measure of success available relates to level busts involving losses of separation, which are almost invariably detected. This statistic will be closely monitored, and will prove a measure of success of the ACE project's work, and other work presently being undertaken elsewhere.

Safety Culture: The Ultimate Goal

by Professor Patrick Hudson

Safety management systems can make a big difference to any business. The benefits of taking a systematic approach to safety are obvious: the hazards of the business are known, understood and demonstrably controlled.

However, the possession of a safety management system, no matter how thorough and systematic it may be, is not sufficient to guarantee sustained safety performance.

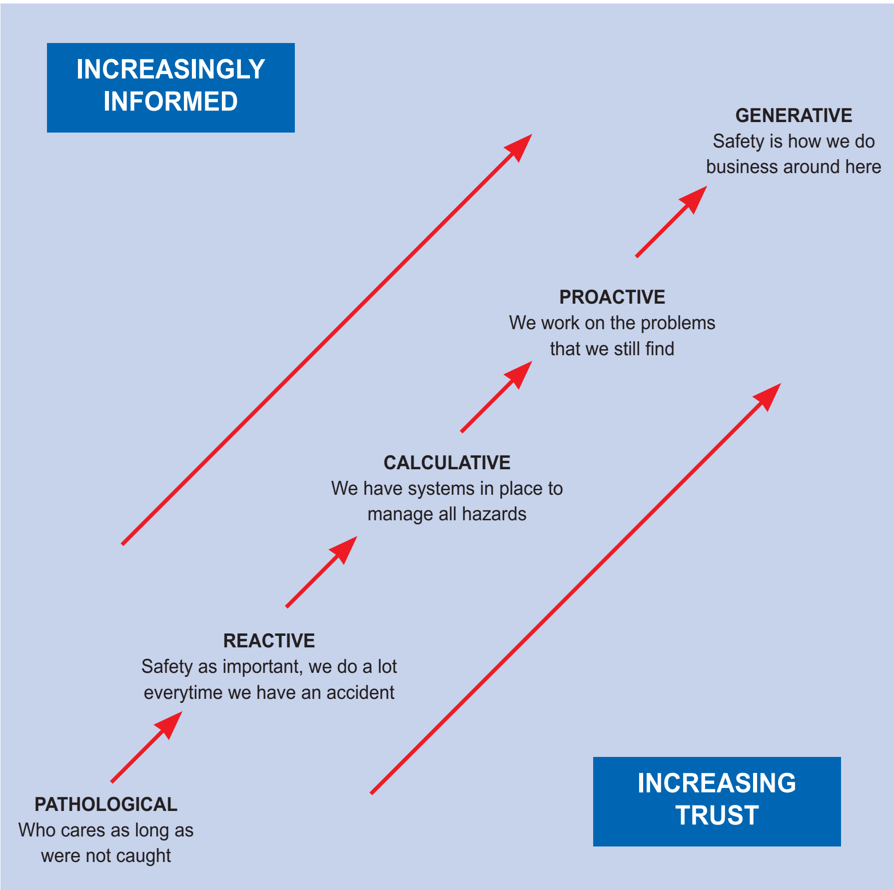
To proceed further it is necessary to develop organisational cultures that support higher processes such as "thinking the unthinkable" and being intrinsically motivated to be safe, even when there seems no obvious reason to do this. What is needed is a safety culture that supports the management system and allows it to flourish.

The bad news is that creating a healthy safety culture and keeping it alive requires effort. The good news is that less effort is required in smaller organisations, and safety cultures are worthwhile, both in terms of lives and profits.

Safety for profit

There is considerable evidence that the most safety-minded companies are also amongst the most profitable.

Safety cultures are characterised by good communication between management and the rest of the company. This not only enhances safety, but can elevate morale and in some cases, productivity. As communication failures are always identified as a source of problems for organisations, having a definitive focus for improving communication can only result in improved performance at all levels.



The other main reason why safety cultures make money lies in the fact that, if one has the safety enhancement that an effective safety culture can provide, then one can devote resources more effectively and take (profitable) risks that others dare not run.

What costs money is not safety, but bad safety management. Once the management of an organisation realises that safety is financially rewarding and that the costs incurred have to be seen as investments with a positive return, the road to a full safety culture is open.

What is a safety culture?

Every organisation has some common characteristics we call its "culture". These characteristics have often become invisible to those inside, but may be startling to outsiders coming from a different culture. The notion of an organisational culture is difficult to define. I take a very general approach and see the organisational culture as, roughly: "Who and what we are, what we find important, and how we go about doing things round here".

In one sense, safety always has a place in an organisation's culture, which can then be referred to as the safety culture, but it is only past a certain stage of development that an organisation can be said to take safety sufficiently seriously to be labelled as a safety culture.

"What costs money is not safety but bad safety management."

From worst to best

Organisations can be distinguished along a line from pathological to generative:

- Pathological: the organisation cares less about safety than about not being caught.

- Reactive: The organisation looks for fixes to accidents and incidents after they happen.

- Calculative: The organisation has systems in place to manage hazards; however the system is applied mechanically. Staff and management follow the procedures but do not necessarily believe those procedures are critically important to their jobs or the operation.

- Proactive: The organisation has systems in place to manage hazards and staff and management have begun to acquire beliefs that safety is genuinely worthwhile.

- Generative: Safety behaviour is fully integrated into everything the organisation does. The value system associated with safety and safe working is fully internalised as beliefs, almost to the point of invisibility.

A safety culture can only be considered seriously in the later stages of this evolutionary line. Prior to that, up to and including the calculative stage, the term safety culture is best reserved to "describe formal and superficial structures" rather than an integral part of the overall culture, pervading how the organisation goes about its work. In the early stages, top management believes accidents to be caused by stupidity, inattention and, even wilfulness on the part of their employees. Many messages may flow from on high, but the majority still reflect the organisation's primary production goals, often with "and be safe" tacked on at the end.

A true safety culture is one that transcends the calculative level. Even so, it is at this stage that the foundations are laid for acquiring beliefs that safety is worthwhile in its own right.

By constructing deliberate procedures, an organisation can force itself into taking safety seriously. At this stage the values are not yet fully internalised, the methods are still new and individual beliefs generally lag behind corporate intentions. However, a safety culture can only arise when the necessary technical steps and procedures are already in place and in operation.

An organisation needs to implement a managed change process so it can develop along the line towards the generative or true safety cultures. The next culture defines where we want to go to, the change model determines how we get there. (See "Change, for safety's sake", in box).

A cultural change is drastic and never takes place overnight. If a safety champion leaves, there is often no-one to take up the fight and the crucial top-down impetus is lost. But even without a personnel change there are two threats to the successful transition to a higher level of safety culture. One is success, the other failure.

In the case of success, effective processes, tools and systems may be dropped, because the problem is perceived to have gone away. In the case of failure, old-fashioned approaches may be retrieved on the grounds that they worked before. But in both of these cases, the new, and often fragile, beliefs and practices may not have become sufficiently internalised to survive changes at the top.

Management has to be truly committed to the maintenance of an advanced culture in the face of success and/or failure, and such commitment is rare.

Change is hard

One final underlying reason why cultural change often fails to succeed is that the new situation is unknown to the participants. If this is added to existing beliefs, such as the belief that the current situation is as good as it gets, then there is little real need to change and failure is almost certain. If these failures are at the level of the workforce, then strong management commitment may save the day. If the problems lie with management, then there is little hope because they will enforce the old situation, which feels most comfortable, on the most proactive of workforces.

A colleague has likened this to learning a new golf swing by changing the grip and the stance. At first the new position is uncomfortable. However, to improve your

Change, for safety's sake

The following model was developed for managing successful change within organisations. Its strength comes from the fact that it is intended to change both the individuals and the organisations they constitute, and realises that changing one without the other is impossible. The model puts together the requirements for change of individual beliefs that are so crucial in cultural development. It can apply to safety, but it can also apply to any other desirable development in an organisation. It gives substance to the oft-heard cries for workforce involvement and shows where and why such involvement is crucial, especially in the later stages of evolution towards a full safety culture:

Awareness

- Awareness: Knowledge of a better alternative than the current state.
- Creation of need: Active desire to achieve the new state.
- Making the outcome believable: Believing that the state is sensible for those involved.
- Making the outcome achievable: Making the process of achieving the new state credible for those involved.
- Information about successes: Provision of information about others who have succeeded.
- Personal vision: Definition by those involved of what they expect the change to be.

Planning

- Plan construction: All people involved in the change create their own action plan.
- Measurement points: Indicators of success in the process are defined.
- Commitment: Staff and management sign up to the plan.

Action

- Do: Start implementing action plans.
- Review: Progress is reviewed with concentration upon successful outcomes.
- Correct: Plan is modified where necessary.

Maintenance

- Review: Management reviews change process at regular (and defined in advance) intervals.
- Outcome: Checks to see whether new values and beliefs have become second nature.

swing you have to trust the pro, do the work and be patient. (One advantage of this metaphor is that managers often play golf and can transfer their experience of learning a new swing to learning to manage an advancing culture. Change agents are like golf professionals: they can help develop a person's game, but they can't play it for them.)

Not too difficult

Given the financial inducements, why don't organisations try and develop the most advanced forms of safety culture? The answer seems to be contained in the type of culture the organisation has at the time.

Pathological organisations just don't care. Reactive organisations think that there is nothing better and anyone who claims better performance is probably lying. They do what they feel is as good as can be done. Calculative organisations are hard to move because they are comfortable, even if they know that improvement is possible. Large organisations will inevitably be heavily calculative unless active steps are taken to counter that tendency.

Small organisations are more likely to be able to develop past the calculative stage and become generative. The greatest single barrier to success for smaller organisations however, is the belief that it is too difficult. On the contrary, in the long term, it is more difficult, and dangerous, not to.

Professor Patrick Hudson is recognised internationally for his work on safety management systems. He is based at Leiden University in Amsterdam and is an active member of the ICAO Human Factors Awareness Group.

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Book Review

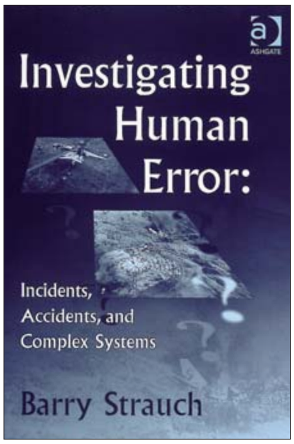
Investigating Human Error: Incidents, Accidents and Complex Systems

by Barry Strauch

Barry Strauch applies contemporary error theory to the needs of investigators and of anyone attempting to understand why someone made a critical error, how that error led to an incident or accident, and how to prevent such errors in the future. Students and investigators of human error will gain an appreciation of the literature, with numerous references to both scientific research and investigate reports in a wide variety of applications, from airplane accidents, to bus accidents, to bonfire disasters. The book:

- includes an easy to follow step by step approach to conducting error investigations that even those new to the field can readily apply.
- summarizes recent transportation accidents and human factors literature and relates them to the cause of human error in accidents.
- provides an approach to investigating human error that will be of interest to both human factors psychology and industrial engineering students and instructors, as well as investigators of accidents in aviation, mass transportation, nuclear power, or any industry that is to the adverse effects of error.

Using his 18 years of experience as an accident investigator and instructor of both aircraft accident investigation techniques and human factors psychology, the author reviews recent human factors literature, summarizes major transportation accidents, and shows how to investigate the types of errors that typically occur in high risk industries. He presents a model of human error causation influenced largely by James Reason and Neville Moray, and relates it to error investigations with step by step guidelines for data collection and analysis that investigators can readily apply as needed.



Hardback 1 84014 9310 £45.00

CRM: Cellular Resource Management

Commercial airline passengers are reminded during every preflight briefing to turn off electronic devices that may interfere with aircraft systems – including cell phones. Now here's a report that suggests what's good for the cabin, is good for the cockpit, too.

The Captain filed the flight plan late so I could not pick up the clearance until just before the passengers showed up. We were issued the SID with transition. I did not have time to look up the SID because the Captain was in a hurry to taxi. He was making calls on a cell phone while he taxied out so I still could not talk to him. Tower put us in position and hold on Runway 30L while I yelled for the Captain to turn off his cell phone. He finally did when they cleared us for takeoff. We never did brief the takeoff or the SID.

Once airborne, the Captain asked me what we were supposed to do. I tried reading the text and gave him some of the instructions as I read them. I got confused at one point about how to join the transition and told the Captain. He turned the wrong way. ATC asked what radial we were trying to join. They told us to turn right 140° to continue the SID and to call Approach once on the ground.

This would never have happened if the Captain had not been in such a hurry to get going, and if he had been paying attention to flying duties while taxiing out, instead of talking on his cell phone.

We're sure this type of event is rare, but it nonetheless illustrates the importance of effective cockpit management skills (and training). In effective CRM, flight crews make flying duties their first priority, and First Officers participate constructively in resolving problems.

With acknowledgement to NASA's Aviation Safety Reporting System. Callback #249, Mar 00

What to do about Maintenance Error Incidents?

by Wing Commander Dave McCormick
SO1 Engineering Policy, Defence Aviation Safety Centre

I know many of you will find this hard to believe, but I started writing this article before the Potters Bar rail accident. Currently, the investigation is underway and, as usual, the media are after a culprit. Initially, they were happy to blame the Secretary of State for Transport; now, they are looking for the rail maintainer who made the mistake. In my opinion, the question that society must ask is summarised below.

Which is the higher priority: preventing recurrence or taking punitive sanctions against the individual who made a human error?

"Maintenance error" is not a popular phrase amongst aircraft engineers. We are the kind of people who live by hard facts, drawings and numbers. Concepts like people making mistakes are easily dealt with by others, but in maintenance we train our personnel and write procedures to ensure that mistakes do not happen. The fact that a competent maintainer following a good procedure could make a mistake is a figment of nightmares to most engineers. However, people make mistakes. It is an inevitable consequence of being a human being! Nothing we do can prevent all mistakes absolutely. Therefore, error tolerance is a basic characteristic of safe systems of work. Despite trying to design error tolerant maintenance systems, maintenance error incidents will occur. This article is about how you might deal with maintenance error incidents. I'd like to start by assuming that this routine maintenance error has not caused a disaster. In that case, other procedures may well be forced on you by the AAIB and, in the worst case, the coroner!

The first problem is finding out that an undesirable incident has occurred. If the incident has significant consequences, I have no doubt that you have a system in place to make you aware. However, most maintenance error incidents could go unreported because the consequences would be mitigated by detection. For example, a failure to seat an electronic box correctly may well be discovered during pre-flight checks and rectified before the departure time. Would you know? Is the reporting system detailed enough for you to find out? Even if it is, would you investigate such an incident? You should because finding out why this incident occurred and preventing recurrence could avoid a more serious incident later. Systems for developing open reporting cultures could be the subject of another article. This article is about a system to deal with reported maintenance error incidents.

Having discovered that an incident has occurred, you must always initiate an investigation. At this stage, the key is not to focus on the individual or the consequences of his action. In almost every case of maintenance error, there will be a sequence of events and decisions leading to the error. It is useful to construct a flow diagram to record what happened and why. The diagram oposite shows the sequence of events leading to a hypothetical maintenance error incident. *(I admit that the hypothetical event is based on a picture and a one line description of a US military aircraft incident, but I have used my imagination to help make a few points.)* The aircraft had come out of deep maintenance some days before and had flown a few trips before the structural failure of an aircraft wing during refuel. I am convinced that, if this was to happen to one of your aircraft, your immediate reaction would be similar to mine: "What was the *pratt* doing the refuel up to?" Instinctively, we tend to blame the unfortunate individual at the scene of the incident. Reality can be very different, as in this hypothetical case, and we must restrain our instinct and produce an accurate sequence of events. In the diagram, boxes portray the events that occurred within the sequence. Always start with the undesirable incident as the first event box. The lines portray the reverse sequence and show the link between events and their causes. In producing your sequence of events, try to apply these 5 rules:

Do not allocate or imply blame within the sequence. This can lead to unreasonable conclusions. So can emotive language, so don't use it. Statements like "the tradesman failed to…" or "the supervisor did not deem to…" add no value to your investigation and colour the readers' views. It would be much better to say "the tradesman did not…" in one box and explain why in the next!

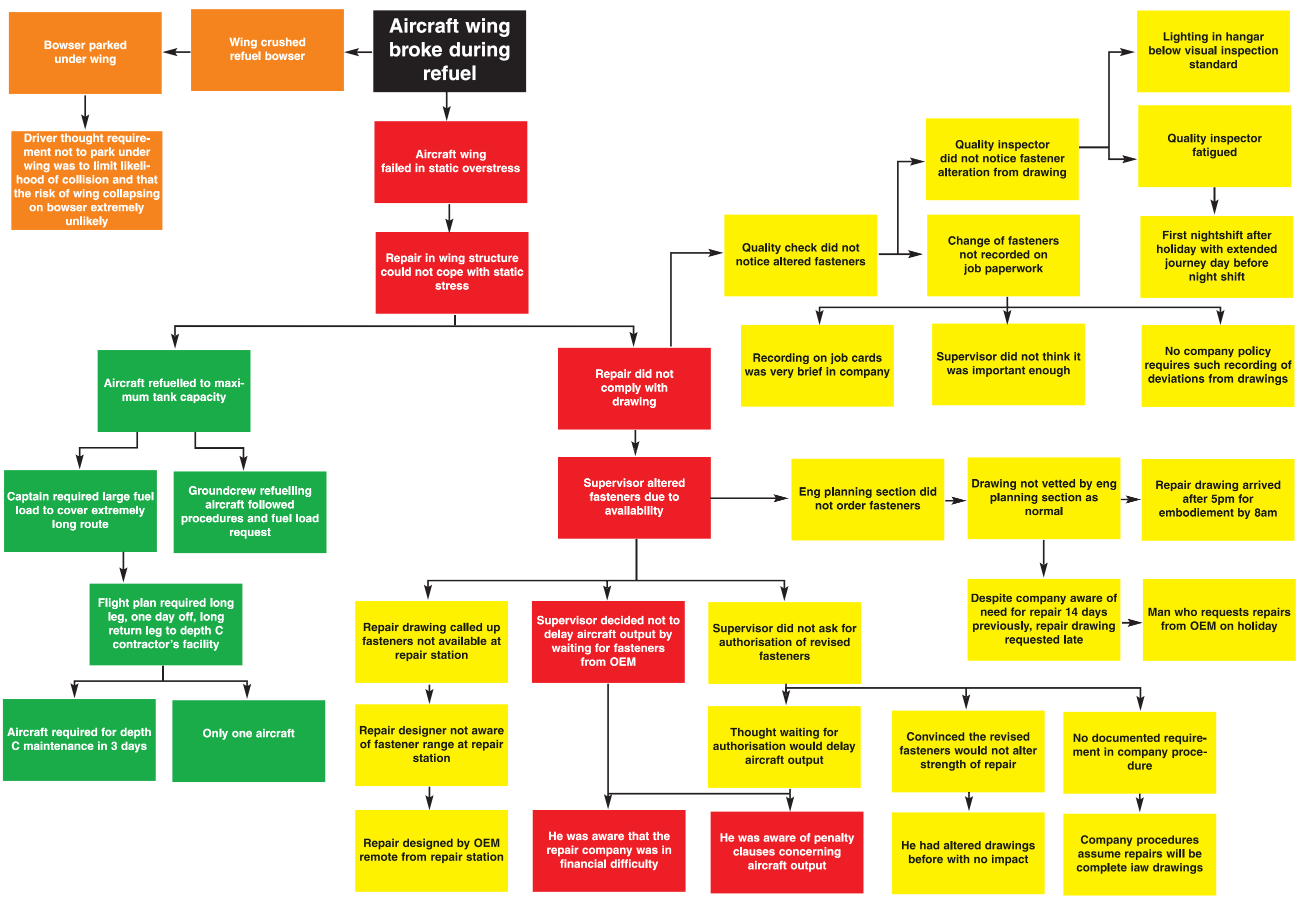
Ensure each link in the sequence is clear and logical. There should be no reason for the most inexpert reader to ask why one event leads to another.

Ensure that the sequence is comprehensive but concise. It is easy to overlook contributions that only aggravate the outcome or are not the prime cause of the incident. Within the constraints of the rules, include only relevant facts. Never use 2 words where one would do!

Ensure that no human error event is at the end of a sequence. In this context, human error includes any failure to follow a procedure. You must always explain fully why the human error occurred. Record the reason of the individual who made the error; not your own reason!

Stop the sequence when there is nothing left to investigate. You may find that the sequence is just recording normal events or comes to a natural end. Do not keep recording the sequence for the sake of it.

Once you have completed this investigation, you should have defined the circumstances of the incident and the reasons for it. Highlight the classification in some way. In the example, I have used the following code:



Serial (a)	Recommendation (b)	Importance (c)	Ease (d)	Priority (e)
1	Company executives must emphasise importance of airworthy product as well as timely output to all staff.	Vital	Easy	**1**
2	Technical staff must have importance of following established work procedures and drawings explained in terms of airworthiness of product.	Very Important	Easy	**2**
3	Continuation training should emphasise the level of recording required on aircraft technical documentation including need for any deviations from established procedures or drawings to be recorded.	Very Important	Easy	**2**
4	Company procedures to include requirement to follow established technical procedures and drawings unless alternative approved by Chief Engineer.	Very Important	Easy	**3**
5	Company policy to define level of recording required on aircraft technical documentation including need for any deviations from established procedures or drawings to be recorded.	Very Important	Easy	**3**
6	Company procedures to require repair drawings to be vetted by engineering plans section prior to issue to production department.	Important	Easy	**4**
7	Company policy and continuation training to include importance of workforce taking responsibility for arriving at work fit for duty in terms of alcohol, drugs, health and fatigue.	Important	Easy	**4**
8	This incident and the lessons identified should be published widely to all departments in the company.	Important	Easy	**4**
9	All staff in engineering planning section to be trained to request repair drawings from OEM so that holidays have no impact on output.	Important	Difficulty	**5**
10	Driver continuation training to emphasise all reasons for not parking under aircraft wings.	Not Important	Easy	**6**
11	Company procedures to require documentation delivered after normal office hours to be held in custody by company security until start of next working day unless alternative approved by nominated managers.	Not Important	Easy	**6**
12	When repair drawings requested from OEM, engineering plans section should specify materials available at the work location and ask for use of those materials if possible.	Not Important	Difficult	**7**
13	Lighting level in production hangars to be improved to achieve HSE published inspection standards.	Not Important	Very Difficult	**8**

The original undesirable event = black with white print.

Normal and acceptable events = green with white print.

The primary causal chain that made the undesirable event occur = red with white print.

The contributory causes that set up the rest of the circumstances for the undesirable event = yellow with black print.

The aggravating causes that made the outcome of the undesirable event worse but did not contribute to it = amber with white print.

Now all you have to do is look at the event box at the end of each sequence and decide what you could do to the organisation to prevent that event from contributing to the incident. For some events, there will be no action that will suffice; in these cases, try the previous event. Again try not to focus your actions on any individual. For example, if a man involved in an incident has an inadequate understanding of how the system works, the same is probably true of other personnel in your organisation. The issue now becomes one of organisational competence requirements and needs to be addressed accordingly.

Once you have recorded all the preventative options, rate them for impact; that is, the ability of the action concerned to prevent recurrence of the final incident. Now rate them for how quickly they could be implemented if accepted. Record them in a table showing priority for implementation based on importance and ease; a table might look like the one oposite for the incident in the example sequence.

You have now done your investigation focusing on preventing recurrence rather than blame. Subject to the appropriate line managers implementing your recommendations, the risk of recurrence of this incident should be significantly reduced.

I should include a "health warning" about malicious acts and wilful negligence. Hopefully everyone will know what I mean by malicious acts. In my parlance, wilful negligence involves and individual being aware that he has a duty to perform a task, being competent to carry out the task and deciding not to carry out the task or carrying out the task without due care and attention. In the case of malicious acts and wilful negligence, I am in no doubt that the company disciplinary policy should be implemented, possibly with employment sanctions. In most incidents, individuals making errors are involved in other behaviour, such as errors of judgement or unintentional negligence. In these cases, organisational cures are more effective in preventing recurrence than sanctions against the individual. Remember, you can not deter an unintentional act! Also, using discipline against an employee to motivate others to take more care only works temporarily and may antagonise your staff.

All this is based on my learning in the last 2½ years. I apologise to Professor Reason, David Marx and many other leading experts in the field of human factors for plagiarising their ideas and for any misinterpretation they perceive; however, it works for me!

The views expressed in this article are not those of the Ministry of Defence, the Royal Air Force or the Defence Aviation Safety Centre, but are the opinions of the author only.

Safe & Sound

by Merran Williams

It only took a moment. Alan turned his back on the trolley he was using to load freight into the wing locker, and the prop-wash from a nearby plane sent the trolley rattling across the tarmac towards another plane that was about to taxi.

Fortunately, he turned in time to grab the wayward trolley and prevented what could have been an expensive incident for Queensland regional airline, Skytrans. If the trolley had crashed into a propeller, the company estimated damage could have cost more than $50,000.

Worried about the possibility of another incident, Alan took immediate action to ensure the trolley was chocked and unlikely to move when loading. He also took his concerns to Skytrans' safety manager, who gave a commitment to resolve the problem and asked Alan to raise the issue at the airline's next safety committee meeting.

Alan did so, and told other members of the committee it would cost only $200 per trolley to fit handbrakes. All were in agreement. For the cost of just $600, the company has potentially saved thousands of dollars in repair bills and lost aircraft time.

According to CASA Aviation Safety Promotion general manager, Mike Smith, Skytrans is an excellent example of an aviation business that has tailored a successful safety management program to fit is needs.

"Skytrans has truly benefited from formalising its safety management system," Smith said. "There are direct cost benefits in both flight operations and maintenance. There is a real sense of ownership which reflects a prospering safety culture."

Skytrans managing director, David Barnard has seen this firsthand. "Having a safety management system for Skytrans has been absolutely great," he said. "It's allowed input from staff into safety and operational matters. It provides us with a positive marketing tool. It helps create business opportunities by providing customers with a known high level of service and safety."

Managing director of Network Aviation, Lindsay Evans agrees. We believe the safety management system we have in place is actually saving us money though better practices," he said. "The people who work for us have a better appreciation of safety in general."

A small business servicing remote areas of Western Australia, Network has been running a safety management system for three years. The company won an Aviation Safety Foundation Australia award this year for safety excellence. New employees spend half a day of their two-day induction program learning how the program works and the contribution they can make to workplace safety.

Positive morale: "We emphasise that staff will not be penalised and no punitive action will be taken if they put something forward that might be a little delicate," Evans said. "That means we've succeeded in having free flowing information up and down the chain."

Chief pilot, Richard Hurd concurs. "The employees now have a lot of trust and believe when they report something that it will be looked at carefully," he said.

Hurd has seen many benefits flow from Network's safety management system, including the development of a comprehensive business plan.

"Having it in place has helped us gain additional contracts, created a positive morale within the company and made it a safer and more enjoyable place to work," he said.

Mike Smith is not surprised at the advantages Network has received from safety management.

"Their system has developed from a reactive one, to one which actively seeks to identify hazards and put in place appropriate solutions."

Smith sees company-wide commitment as the key to successful safety management. "Everyone from the CEO down needs to be involved," he said.

"One of the failings that I see with

systems in some companies is that they have the process to identify the hazard, they have a process to decide what they're going to do about it, if anything. But they don't have good feedback mechanisms that go back to the reporter and the rest of the organisation. This feedback needs to say: We've identified this hazard and have put in place this mitigation for it. Or, we identified this hazard and we are not going to mitigate because re recognise that this is a risk that we're going to accept in the conduct of our business. It is this feedback loop that is vital if staff are going to have an ongoing commitment to the system."

Business information: Smith says businesses might be surprised at what they find when they develop a safety system. "Putting in place a good safety management system gives you a formal process to review the safety of your business," he said. "In doing this you find out an awful lot of other information about how your business is running, such as what things are costing you money and the opportunities for savings."

Smith points out that some companies will only allow their employees to fly with airlines that have a formal safety management system in place.

"The mining industry is one that is keen to see the systems in place, largely because they have them themselves," he said. "The concept of safety management from the oil and gas industry was further developed by the industry following an accident on a North Sea oil rig (Piper Alpha).

"The subsequent inquiry further the view that companies have safety systems in place for the benefit of the organisation, its staff, customers and shareholders, not just the regulator."
Safety management expert, James Reason, sees effective safety management as more about the company's mindset and they way it treats workplace hazards, than about cost.

"If you're a small operator then there is going to be a call upon resources, but it doesn't have to be a call upon money... .You have tremendous advantages if you are small."

"If you're a small operators then there is going to be a call upon resources," he acknowledged. "But it doesn't have to be a call upon money, because you're a flexible organisation – you have tremendous advantages if you are small.

"What you've got to do is build a system that's not something which seems like an extra job to do. It should be integrated into the actual management process.

"Ideally the safety system should be homegrown and full integrated into the current task so that in a year's time it doesn't feel like doing it is an extra job; it's part of how you do your business."

Sunstate Airlines Qantas Link, a regional passenger airline providing services across Queensland, has found this to be the case. It formalised its safety management system in 1996 with the appointment of a flight safety manager. Former flight operations manager and chief pilot, Arch Van Dongen says safety management has become an integral part of managing the airline.

"I don't think you can afford to run a business without managing safety," he said. "I don't think it costs that much. It costs some time and resources but certainly the alternatives aren't very palatable. And once you have the system in place, it becomes easier to manage and gives you a lot of useful information about running your business."

It's about people: Chief engineer, Paul Lee-Horn likes the unity that has developed within Sunstate since the implementation of safety management.

"What I've found is the success of the safety management system has been the ability to bring all the departments of the airline together with a single goal," he said. "That is, to achieve the best safety record possible for this airline."

For Mike Smith, safety management is about people. "It's about making organisations, big and small, value the inputs of their people and actually deal with them in a way that addresses the hazards and safety problems," he said. "Many companies have experience with quality systems and there is a lot of common ground here. I simplify the distinction between a quality system and a safety system by observing that a quality systems is about product and process, a safety system is about people."

He sees integrated safety management as the next big step in aviation safety. "We've concentrated in aviation on not harming our passengers and our crew," he said. "Safety management takes that a step or two further, and the spin-off of improving the integration of a safety system within your business is making savings that flow to the bottom line."

Reprinted with acklowedgement to Flight Safety Australia.

On Track - Pushing your ideas forward and looking for more !!

Since the project got under way late last year the On Track team have been very encouraged by the response from the GA pilot and the ATC community. Some 800 inputs from you by fax, telephone, e-mail and, of course, the 'Your Say' section of our website at www.flyontrack.co.uk which gets a lot of good opinion and some hot air going!! You've come up with some great ideas about the reasons behind infringements, but most important, sound advice from you on how to improve the system and avoid the problem.

While you have been busy suggesting ideas, the team have been running your inputs through the various CAA and NATS agencies, such as the Safety Regulation Group, the Directorate of Airspace Policy and LATCC. We have also been in contact with other companies and agencies such as Garmin and the Australian CASA to discuss products that could be relevant to the solutions you think we need to adopt. Finally we have been spreading the word at symposiums and seminars throughout the country. If we have not come your way yet and you want to see us, please let us know. Because we are independent from the CAA we can delve as deeply as we like into any agency, and it's good to report that we have so far received a most positive response from all our contacts.

Here are some of the main ideas that you have given us so far. Although it's too early for many results we can give you some idea of the response we've had to your suggestions:

LARS

- Dedicated GA LARS controller at each of the major airfields
- US style Flight Following Service (frequency + radar + squawk)
- Specific radar service to cover the notorious Stapleford/Stansted/Luton routing

Progress - Funding for LARS being reviewed – report: www.aviation.dtlr.gov.uk/lars/index.htm.

ATC

- Review Class A airspace for possible downgrade to Class D
- Review base heights of airspace to gain more GA airspace especially Stansted stub
- Review Regional Pressure Setting procedures to avoid vertical infringement
- Improve communication between ATC and the GA community

Response - ATC are aware of the communication problem with GA traffic and are supporting all suggestions you gave to improve this – the initial message suggestion was theirs. They will be reviewing the length of the long message at the next R/T meeting. DAP will continue to review airspace. Stansted will be looked at again!

Maps and Charts

- Strong support for an on-line chart facility – freely downloadable to cover the "hot areas" around London, Manchester and Southampton. The Australian VFR guide and CD ROM suggested as an excellent role model
- ICAO codes and frequencies should be shown on charts next to airfields
- Single sheet (A4) map size to cover London area – freely downloadable
- Specific Mil maps with information only required below FL100 or FL55
- VFR routes (e.g. Note 8 route) should be better marked with downloadable guide & pictures
- Zones and Control Areas should be redrawn so that boundaries follow geographical features
- Circular boundaries for Zones and Areas (easy to read and avoid when using DME)

Result - A very positive response here. A series of prototype charts and other products have already been started.

GPS

- CAA should recognise GPS and issue guidelines for its use and a training syllabus
- Instruction manuals are too complex. Need to be simple and practical
- Ensure all data bases are updated – possible CAA involvement to monitor
- GPS training to be introduced after basic PPL navigation instruction complete
- Pilots should use other navaids (including a map!) in addition to GPS

Result - Flight examiners are in the process of drafting guidelines for approved GPS courses. The next step will be for schools to produce a syllabus. Some schools already do informal GPS training

R/T

- Standard of R/T is poor – a practical training syllabus and a basic PPL R/T Pamphlet are essential
- Sub-standard training in some schools
- PPL confidence level when talking to ATC is low - performance is poor
- Schools should encourage students to use the radio as soon as possible
- Calling ATC - always use the initial R/T message – it gives you a better chance of getting a service
- Long R/T message needs to be shortened

Result - R/T Ground training will be reviewed. PPL R/T pamphlet being pursued.

Navigation

- Review JAR PPL syllabus for basic Navigation training
- Ensure minimum number of MATZ/CTA/CTR crossings are taught
- Formalise navigation ground training- don't rely on self study

Result - Publicity to be given to schools on importance of comprehensive navigation training to teach good basic navigation - particularly to include Zone and MATZ crossings

Communication

- A GA VFR start up pack should be issued free to all new PPLs
- AIC format for Air shows & Rallies need an overhaul. They're too complex and not user friendly. Foreign guides concentrate more on assisting the pilot with colour illustrations / frequencies etc.

Result - CAA has recently introduced a Safety Information Book.

The Australian system showing easier routing information has been adopted by DAP and they will be producing their own version.

So far so good, but there is a long way to go - the On Track team will continue to push forward your suggestions. However, we are still looking for more ideas from you in time for our report at the end of this year.

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