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focus

ON COMMERCIAL AVIATION SAFETY

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NATS safety notice

EXT 02/2008 | Minimum and maximum rates of climb or descent in the UK

There have been a number of losses of separation in the UK since 2007 in which a significant contributory factor was the rate of descent of one of the aircraft involved which was not in compliance with the published minimum rate of descent for flights within controlled airspace. There have also been events in which the rate of climb or descent has impacted on the effectiveness of the Airborne Collision Avoidance Systems (ACAS) and ground based safety nets. This notice is to inform operators, pilots and controllers of the minimum rates of climb or descent in the UK.

The following summary of information is reproduced from the UK AIP ENR 1-1-3-1

Maximum rate of climb or descent

In order to ensure the credible interaction of Airborne Collision Avoidance Systems and ground based safety nets, other than aircraft in emergency and certain specific conditions for military aircraft (as detailed in Military AIP and JSP552), all aircraft when operating under normal circumstances, when inside Controlled Airspace within the London and Scottish FIRs/UIRs **should not operate with a climb or descent rate exceeding 8000 ft per minute**.

Division of Safety note: When 'expedited climb or descent' is required, the AIP does not provide dispensation for controllers to instruct aircraft to exceed 8000ft/ min, other than as specified above.

Aircraft when first approaching a cleared flight level and/or when changing flight level in Controlled Airspace **should ensure that the vertical closure speed is not excessive**. It is considered that, with about 1500 ft to go to a cleared level, vertical speed should be reduced to a maximum of 1500 ft per minute and ideally to between 1000 ft per minute and 500 ft per minute. Pilots should ensure that the aeroplane neither undershoots nor overshoots the cleared level by more than 150 ft, manually overriding if necessary.

Minimum rate of climb or descent

In order to ensure that controllers can accurately predict flight profiles to maintain standard vertical separation between aircraft, pilots of aircraft commencing a climb or descent in accordance with an ATC Clearance should **inform the controller if they anticipate that their rate of climb or descent during the level change will be less than 500 ft per minute, or if at any time during such a climb or descent their vertical speed is, in fact, less than 500 ft per minute.**

This requirement applies to both the en-route phase of flight and to terminal holding above Transition Altitude.

Note: This is not a prohibition on the use of rates of climb or descent of less than 500 ft per minute where necessary to comply with other operating requirements.

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NATS external safety notice

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FOCUS is a quarterly subscription journal devoted to the promotion of best practises in aviation safety. It includes articles, either original or reprinted from other sources, related to safety issues throughout all areas of air transport operations. Besides providing information on safety related matters, **FOCUS** aims to promote debate and improve networking within the industry. It must be emphasised that **FOCUS** is not intended as a substitute for regulatory information or company publications and procedures.

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Front Cover Picture: Cathay Pacific B777-300ER

A Safer 2007 but Challenges Remain

by Rich Jones

Well, the aviation safety figures for UK civil air transport operations are in for 2007. With a fatal accident rate of zero for the third year in succession and in a period of a 3% increase in passengers and a 7% increase in distance flown over 2006 figures, a brief congratulatory pause may be in order. Equally impressive safety records can be found amongst the large public transport helicopters and small public transport operators.

However, the fact that there were 7 accidents involving large UK public transport aircraft in 2007, which thankfully only resulted in one serious injury, when a slight change of circumstance or timing in any one of them could well have changed the outcome for the worst, should jolt us out of our brief reflective glow. If 2007 results were impressive, incidents at Heathrow and Biggin Hill in early 2008 alone should rapidly bring us back to reality and the job in hand.

New challenges and opportunities continue to impact on commercial aviation at an ever increasing pace. The cost of fuel is a case in point, where airlines are introducing new ways of operating in order to reduce fuel usage to the absolute minimum, an endeavour which will clearly gain favour with the environmentalists as much as with the financial and commercial directors. But these changes in modus operandi, possibly introduced in haste, in isolation or with significant differences between operators and aircraft types, have the potential to open a Pandora's Box of new threats to flight safety.

For example, many airlines are now moving towards the most economical and fuel-efficient transit speeds, which is resulting in bunching during the en-route phase as well as in the busier terminal areas. No doubt those of you with mature Safety Management Systems (SMS) have engaged their Threat and Error Management (TEM) analysis tools to predict the likely hazards that such changes to procedure could bring and have passed that information on to your crews and trainers to consider. For those who have not, I commend the article on TEM provided by Cathay Pacific in this edition of FOCUS as a useful indicator of the value of this type of proactive approach to any change.

Security at airports is another area of growing concern from a flight safety perspective. Reports of frustration and stress generated in flght crews and engineers by these 'daily facts of airport life' continue to be registered in numerous aviation safety fora. During my own recent engagement with the Security Policymakers at the UK Department for Transport (DfT), they have clearly stated that all who cross to the airside of UK airports will continue to be subject to a stringent search regime, the requirements of which are laid down for the responsible airport authorities to apply.

In terms of flight safety, the issue is not the policy itself, but its practical application which needs to be addressed. In essence, it is the approach and attitude, the human factors in other words, of all involved in enacting the policy which requires further work. The ultimate aim should be to establish mutual respect between the security teams and their 'customers' through dialogue and training and to reach a common understanding of each others perspective

The popularity and the waiting list for the UKFSC Flight Safety Officers' Familiarsation Course continue to grow. Interestingly, there are several UK and overseas applicants from outside of the traditional sources and organisations wishing to attend. For example, Business aviation and Helicopter Emergency Services representatives have undertaking the course with enthusiasm. It is encouraging to see such aviation businesses so keen to establish themselves and their companies with professional flight safety arrangements and management systems. In recognition of this widening of interest across the spectrum of aviation users and supporters in flight safety, I am seeking to engage with the relevant trade organisation and regulatory bodies in order to familiarise myself with this sector's key areas of concern.

As far as the future of the UKFSC is concerned, another encouraging sign is expressions of interest and a wish to contribute to our work from the less traditional sources in the industry. There is no doubt that the UKFSC Standing Committees and Working Groups have served the UKFSC and its reputation well over many years, but significant changes in airlines created by pressure to reduce manpower and financial resources are making this voluntary approach no longer be viable.

The airline industry of today has to be both 'lean and mean' to survive; knowledgeable people and cash are in short supply and companies demand their pound of flesh from their investment. Accordingly, the UKFSC must seek support from and partnership with other centres of current knowledge and experience through widening its network within its ranks. Equally, we must enter partnerships with other professional aviation bodies, aviation support and service companies and carefully selected consulting organisations, in order to exert influence and provide the Membership with the value they expect.

focus ON COMMERCIAL AVIATION SAFETY

To ERR is human

by Steve Hull, British Airways

With the rising cost of fuel and with that the increased pressure on airlines to reduce costs, staff and activities, how do safety departments encourage the moneymen to continue to focus on safety? It is a fact that if organizations do not continually improve safety, then the risk of having an accident increases significantly.

Many airlines and indeed many major companies have felt the cost of not being totally committed to safety. Indeed there are many examples in history of companies that tighten their belts, reduce their safety focus and suffer the consequences.

What are the steps that are needed to ensure an airline is safe even in times of financial caution. Firstly, it is fundamental to appreciate the significance of the establishment of an appropriate safety culture, the importance of an Integrated Safety Management System and also to appreciate that people will break rules.

A positive safety culture is of paramount importance in any transport company and the introduction of an Integrated Safety Management System is slowly becoming the way forward, but the more interesting point is, why people break rules.

I do not know of a pilot, engineer or air traffic controller who sets off to work believing they would make a mistake. Professionals usually start the day with the understanding that they will do their best. Generally mistakes are made due to procedures not being followed. Often this is because the procedures are incorrect, unclear or burdensome. Or more commonly it has become the way of doing things or the task cannot be completed without breaking the rules.

The majority of people break rules and cut corners for what they see as good reasons, this is often in an attempt, with the best will in the world, to get the job done. Nevertheless it is often problems with the procedures, rather than the attitude of the individuals that form the major reason for rule breaking. These problems affect the ability of people to adhere to the rules or procedures, and may create a culture in which rule breaking becomes an accepted practice; this is called commonly normalization of deviance.

So we have established that errors will happen and that people will break rules so how do we prevent this from happening?

At first sight, human error appears to be quite complex and highly unpredictable. As a result, many managers surrender to the apparent inevitability that errors will happen and opt for the easier solution of allocating blame, which is the simplistic way of dealing with a difficult problem. Blame places the responsibility for an error with the individual making the error. This removes the need to understand why the error occurred, since it is believed future errors can be prevented by punitive measures against the unfortunate individual. If the error was system induced, as most errors are, then this solution to the problem will always be unsuccessful. The defective system will remain uncorrected and it is only a matter of time before another error occurs by the next unfortunate person who happens to be exposed to it. But, more importantly, all systems must have defences and safeguards, so when an event occurs, the most important issue is not who made the mistake, but how and why the defences failed. This is not to say that there is no place for blame. Clearly there is, but the important point is that the blame is attributed where it is deserved. There will always be cases where the individual making the error deservedly attracts some blame. There may be an element of carelessness, inattention, negligence or deliberate violation of procedures that must be dealt with. However, it is important that this is addressed as a secondary issue subservient to a thorough investigation of the possible systemic causes of the error.

On many occasions the individual targeted for blame, is blamed before the investigation has been completed. 'It is their fault, they signed for it.' Ritual hanging and leaving the body for all to see stopped hundreds of years ago, but the mentality remains. In the desire to make processes work quicker, expediency wins the day. It may not be right but it is to our advantage.

All airlines, in fact all businesses must appreciate that human error is unavoidable and that it is the responsibility of an organisation to effectively manage that error.

UK FLIGHT SAFETY COMMITTEE OBJECTIVES

- To pursue the highest standards of aviation safety.
- To constitute a body of experienced aviation flight safety personnel available for consultation.
- To facilitate the free exchange of aviation safety data.
- To maintain an appropriate liaison with other bodies concerned with aviation safety.
- To provide assistance to operators establishing and maintaining a flight safety organisation.

Overruns Overview

A review of BAe 146/Avro RJ landing overruns by Russell Anley, Aerodynamics Engineer

As part of Regional Aircraft's commitment to flight safety, a detailed review of BAe 146 and Avro RJ (146/RJ) overrun occurrences during the period 1986 to 2005 has been undertaken by BAE Systems. The review was to assess the risk to the 146/RJ as compared to these other types, and to determine if any common factors contributed to the overruns. As the two more recent 146 overruns are still the subject of investigation it would be inappropriate for us to comment on these events, and so they were not included in this review. A landing overrun is defined as when an aircraft is not able to stop within the landing distance available.

In addition to internal BAE Systems safety data, the overrun statistics were obtained from several databases and different perspectives. It was concluded that some aircraft types had suffered more overruns and some less than the 146/RJ, and that, on balance, our fleet was no more at risk than any other. The BAE Systems review has also been discussed with the UK AAIB.

Worldwide the Flight Safety and Regulatory Bodies continue to report the high proportion of occurrences that occur whilst landing. During the period 1996 to 2005, 46% of accidents to the worldwide fleet of Western built transport aircraft occurred on landing, and landing accidents caused the most hull losses. Data available for the period 1980 to 2005 reveals that the frequency of overruns is about three to four per month, and one in every 15 overrun accidents results in a fatality.

The average overrun rate during 2005 was 3.3 occurrences per month (40 Western built transport aircraft 38 of which were jets, overran during the year). In most cases weather was a factor (Over 70% of FAA Part 121 overrun accidents investigated by the NTSB during the period 1994-1998 occurred on wet runways). In addition most overruns did not generally involve a system or component malfunction. Overruns usually occurred with fully serviceable aircraft with fully qualified alert crews, and they should have been avoidable.

'Overruns usually occurred with fully serviceable Aircraft with fully qualified alert crews and they should have been avoidable'

Analysis of BAe 146/ Avro RJ overruns

Table 1 opposite highlights the contributing factors to each overrun investigated. A blank cell indicates that the condition was not a causal factor, and "N/A" indicates that it is not known whether the condition was a causal factor. The highlighted cells indicate that the following conditions could have been a contributing factor:

- **Landed long:** highlighted if the aircraft landed long (touched down 450m or more beyond the threshold for 146-300 and all series of Avro RJ, and 360m for 146-100 and 146-200).
- **Runway condition:** highlighted if the runway was wet or contaminated.
- **Wind:** highlighted if there was a tailwind.
- **Landed fast:** highlighted if the aircraft touched down with a speed equal to or greater than Vref (The target speed for touchdown based on Vref at the threshold should be Vref - 7kt).
- **Runway length:** highlighted if the runway length was 1,500m or less.
- **Weather:** highlighted if there was any precipitation, cloud base was 1,000ft or lower or visibility was less than 3nm.
- **Spoilers:** highlighted if the spoilers were not deployed or were deployed late.
- **Runway slope:** highlighted if the runway had a downhill slope.
- **Braking technique:** highlighted if the braking technique was specified as incorrect or specified that maximum braking was not initially applied.
- **Approach:** highlighted if the approach was not stabilised by 500ft above runway threshold elevation (arte).
- **Technical problem:** highlighted if there was a reported technical problem with the aircraft.

Table 1 displays the overrun cases which have information on each contributing factor. Each case involved a significant number of factors, which are totalled in the final column, and a summary of the data is provided in Table 2. Due to lack of data the information in table 1a was not used for analysis, but is included for completeness; even with incomplete data it can be seen that more than one contributory factor is usually present.

If any one or two of these factors could be removed then the overrun might have been avoided. Each of these contributing factors is discussed in the following paragraphs.

Discussion of BAe 146/Avro RJ overruns

The analysis on the previous page shows that the majority of overruns were caused by operational, rather than technical problems with the addition of some of the various other factors. Individually these factors were minor, but in combination they lead to an overrun. So it is important to understand how these factors can combine and cause an overrun after what otherwise might seem like a "normal" approach and landing.

'A landing overrun occurs when an Aircraft is not able to stop within the landing distance available'

Event No.	Hull loss	Landed long	Runway condition	Wind	Runway 1500m or less	Weather	Landed fast	Incorrect braking technique	Spoilers	Runway slope	Approach	Technical problem	No. of contributing factors
1													5
2													5
3													4
4													5
5													5
6													7
7													6
8													6
9													4
10													6
11													5
12													5
13													5
14													4
15													6
16													5
17													7

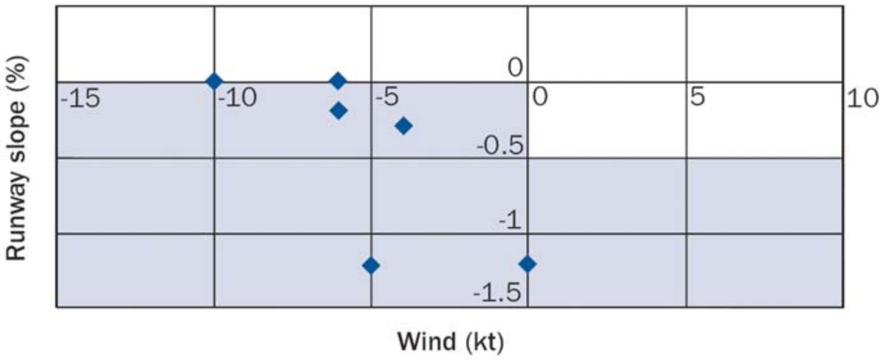
Above: Table 1, contributing factors to BAe 146/Avro RJ landing overruns (1986 to 2005)

Event No.	Hull loss	Landed long	Runway condition	Wind	Runway 1500m or less	Weather	Landed fast	Incorrect braking technique	Spoilers	Runway slope	Approach	Technical problem
1		N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A
2			N/A	N/A			N/A	N/A	N/A	N/A	N/A	N/A
3		N/A	N/A	N/A			N/A		N/A	N/A	N/A	
4		N/A	N/A				N/A			N/A		
5		N/A	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	
6				N/A		N/A	N/A	N/A	N/A	N/A	N/A	

Above: Table 1a, contributing factors to BAe 146/Avro RJ landing overruns (1986 to 2005) where insufficient data is available to draw conclusions

Least number of contributing factors	Most number of contributing factors	Average number of contributing factors
4	7	5

Left: Table 2, number of contributing factors to each BAe 146/Avro RJ overrun



Above: Table 3, wind and runway slope combinations in contaminated runway overruns

Landed Long

Landing long was a contributing factor to more overruns than any other factor as the distance available for the ground roll is reduced which, on limiting runways, can easily result in an overrun.

Speed should be accurate and touchdown carried out at the right place - do not allow the aircraft to float as deceleration is far better when the wheels are on the ground. On some runways there is a designated 'last touchdown' point, on others the aircraft should be landed within the first 10% of the landing distance available.

Runway Slippery or Wet

Table 3 below shows that the landings are not permitted for combinations of reported wind components and runway gradient lying within the shaded area, as found in the JAR-OPS

Above: wet runways reduce braking action

Contaminated Runway Appendix of the AFM of the BAe 146/Avro RJ (excluding American and Canadian manuals, which are with the regulator for approval). This information was published in 2003 and since then there have been no overruns on contaminated runways.

The individual points of Table 3 represent the runway slope and wind condition of the landing overrun incidents that occurred on a contaminated runway.

The table also shows that in four overruns a landing was performed outside the limits now published in the AFM. The remaining contaminated runway incidents occurred in marginal conditions. It must be emphasised that the contaminated runway information does not currently include a safety factor, and the information published in the FCOM only includes a 1.15 safety factor.

Wet runways reduce braking action, and in some occurrences the runway condition may have been worse than the aircrew expected. It is likely that sufficient braking had not been applied initially, but when more braking was applied at a later stage it could not prevent an overrun. In these cases it was a combination of the wet runway (which should have been accounted for in performance calculations) and inappropriate braking technique.

Landing with a Tailwind

Landing with a tailwind may be unavoidable due to air traffic considerations but, especially when combined with adverse surface conditions, the performance penalty of a tailwind may not be fully understood by aircrew. Using RJ70 figures from the AFM a 15kt tailwind increases the landing distance required by about 1000ft or 305m, with this number being fairly independent of weight. On a performance limiting runway an unplanned or incorrectly estimated tailwind could quite easily result in the possibility of exceeding the LDA.

Landed Fast

The AFM of both the BAe 146/ Avro RJ all series states that the landing distance required is increased by 2% per knot above a threshold speed of Vref + 7kt. Of the eight incidents, in all but one case a fast landing was accompanied by a long landing, possibly due to the aircraft floating or an extended flare being performed to bleed off airspeed. In many cases more than the recommended 7kt of airspeed was bled off between the threshold and touchdown, supporting the theory that extended flares may have been performed. Landing long has a larger influence on the landing performance rather than having to stop from a higher speed. In addition, in two cases late deployment of spoilers resulted due to "wheel barrowing" (nose wheel on ground with main wheels off ground or lightly loaded), which can often be attributed to the high landing speed. Therefore emphasis must be placed, by operators, on achieving a stabilised approach as correct approach speeds reduce the risk of a long landing. If in doubt, go around!

Runway Length

The pie chart shows that the overruns occurred over a range of runway lengths. Although a short runway increases the risk of an overrun, the chart also shows that overruns have been fairly independent of runway length and therefore other factors have a more significant effect. Hence, overruns do not only occur on limiting runways.

The most probable reasons for an overrun on a runway longer than 1500m are that the aircraft had landed long, the runway condition was poor and/or there was a tailwind. All of which effectively reduce the landing distance available.

'The BAe 146/Avro RJ is no more at risk of an overrun than any other Aircraft type'

Late or Non-Deployment of Lift Spoilers

Non-deployment of spoilers can increase the landing distance required by 40%, and if combined with other factors could result in a runway overrun.

Half the overruns where late or non-deployment of lift spoilers was a contributing factor were due to "wheel barrowing" delaying the weight on wheels signal and the rest were most probably due to incorrect selection. There were no reported problems with the system prior to or subsequent to the event.

The likelihood of both a green and yellow spoiler system failure is very low, with an incorrect or late selection of spoilers being a more significant risk, but overruns cannot be attributed to spoiler late or non-deployment alone.

If all other parameters are correct, non-deployment of spoilers should be absorbed within the 1.67 safety margin contained in the AFM landing distance figures. Therefore the priority should be on confirming correct selection and achieving maximum braking.

Braking Technique

In a small number of cases maximum braking was avoided so as to increase passenger comfort. The AFM states that maximum braking should be applied on short runways or when at or near maximum landing weight for the distance available.

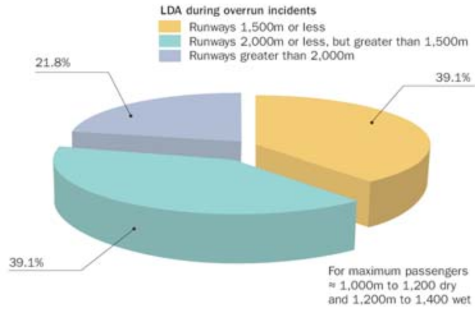
The use of cadence braking (i.e. pulsing/pumping of the brake pedals) and alternating between braking systems must be avoided as this prevents the anti-skid from functioning properly. The adaptive feature of the anti-skid keeps the wheels on the verge of a skid to maximise braking even on low friction surfaces. When excessive anti-skid activity is detected the base pressure about which modulation occurs is adjusted so as to improve overall braking efficiency. This adaptive process takes sometime to optimise braking, with this time taking the longest when the anti-skid senses a very slippery runway or when the system is being initiated at the commencement of braking. If a pilot alternates braking systems or pumps the brakes it disrupts the adaptive process.

Technical Problems with Braking System

Two overruns involved a reported failure of the braking system (a problem with the green braking system and a loss of braking). Care must be taken not to confuse a spoiler non deployment with brake failure. Comments provided during events where the spoilers were not out show that this can easily be mistaken as brake failure. The MOM states that landing distance may be increased by 60% if anti-skid is not operative, and also advises that extreme caution should be taken during braking without anti-skid, especially if the lift spoilers are not deployed. Again these cases also included a number of other contributing factors. Therefore if other factors are managed correctly then, even with a brake problem, overruns can be avoided.

Weather

If the weather was unfavourable it has been cited as a causal factor. The extent that the weather had an influence on the outcome is often difficult to ascertain. It is reasonable to assume that low cloud, poor visibility and precipitation may have had an effect on the outcome. However, weather was probably the least influential contributing factor, and so the concentration should be on flying accurate stable approaches.



Above: landing distance available in each overrun

Conclusion

Every year the industry suffers overruns and the ensuing bad publicity. As can be seen from the article, most overruns are the result of more than one adverse factor, and overruns do not only occur on short runways. Increased vigilance at every stage of the approach and touchdown is the key to avoiding an overrun. If all approaches are carried out to stabilised criteria, and all landings are carried out at the correct speed with the touchdown in the right place, the chances of overruns are minimised. In limiting conditions do not attempt to correct errors late in the landing - it's not wrong to go around! The safe outcome of the ground roll can be enhanced by ensuring that the spoilers have been selected to out, weight is on the wheels, and that the appropriate amount of brake up to maximum is applied using the correct braking technique. Early application of brake at high speed is more effective in stopping an aircraft than a late application - so brake for effect not for comfort. Braking, up to maximum if necessary, should be applied and maintained until stopping within the landing distance available is assured. The next simulator session is an ideal opportunity to refresh on the use and feel of the brakes, especially when anti-skid is operating. It is easy to become complacent and to view approach and landing as routine: the time from touchdown to off the runway will be in the order of 30 seconds. Look at your watch, and try and imagine what you could do in this time to recover a poor landing. Very little! On short runways, or in limiting conditions, if in doubt go around before touchdown. Once down apply and maintain max braking until assured of stopping within the runway available.

- A good landing starts with a good approach.
- Think before accepting a downwind component.
- Get the speed and position correct at touchdown.
- If in doubt go around.
- Trust the systems and brake for effect.
- Don't let landing on limiting runways become routine.
- Don't eat in to your margins.

Effective Communication in Aviation Environment: Work to do

by Anne Isaac Ph.D, Head of Human Factors Integration in Safety, NATS

Effective communication is a basic human requirement and in the aviation environment an essential pre-requisite to safety. So why do we continue to get it so wrong? - and we do get it wrong about 30% of the time. In a recent radio telephony survey it was found that 80% of RTF transmissions by pilots were incorrect in some way. However pilots are not the only ones in the communication process, and there are some startling statistics from the air traffic controllers as well:

30% of all incident events have communication errors which rises to 50% in airport environments.

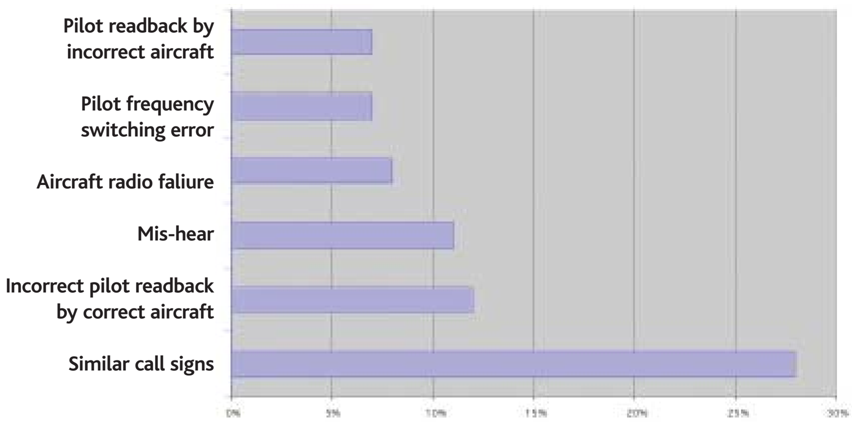
23% of all level bust events involve communication error

40% of all runway incursions also involve communication problems.

None of these statistics are surprising when we realise the demand we place on the verbal communication process, and most of us know some of the obvious traps: call sign confusion, the problems with native language, the use of standard phraseology and the increasing traffic and complexity leading to frequency congestion and overload, as well as a high percentage of technical failure of the communication system itself. However what might not be so obvious is the complexity of effective communication and the aviation culture which reinforces operational staffs' trust in other colleagues.

The following graph indicates the most numerous problems, however this only illustrates half the story.

Perhaps more importantly we should ascertain the most serious issues caused by these activities and the context in which they are likely to create increasing risk for the system.



The leading events, which encompass some of the above issues are:

mis-hearing information over the RTF, often caused by incorrect pilot read-back of information (but by the correct pilot) and transmission and/or recording of incorrect information by either the pilot or controller. In all cases the problems are embedded in the complexity of the communication process itself. In order to transfer information, both the person sending and receiving the information must be able to formulate, listen, hear and interpret correctly the message as well as verify the information for completeness, and at any of theses stages things could go wrong.

The most risky situation is when one of the parties does not identify or recognise an error, since then they are unable to recover from the situation themselves. Some of these risks are embedded in the way we ascertain information from equally qualified colleagues.

We tend to ask confirmatory questions to solve a problem when we are unsure in these situations. The example below is taken from the Danair 1008 air accident at Tenerife:

Co-pilot:	gosh, this is a strange hold, isn't it?
Captain:	yes, it doesn't……, it doesn't parallel the runway or anything.
Co to Engineer:	it's that way isn't it?
Engineer:	that is a 3 isn't it?
Co:	yes, well, the hold is going to be there, isn't it?
Captain to Co:	did he say it was 150 inbound?
Co:	inbound, yeah
Captain:	well, that's……, I don't like that
Co:	they want us to keep going all around, don't they?

Another very risky situation, in terms of the above issues, are conditional clearances. Conditional clearances are used on the understanding that both parties are assured of the message they hear. Since most of the information which is found in the conditional clearance information is standard and known by both parties, it is very rare one of the parties would question part of this communication. Usually you will hear the person receiving the message say, "Oh he must have said that, or she must mean this". This situation is made more risky when the actual communication is correct but incomplete. Almost all runway incursion incidents which involve conditional clearances are also the result of incomplete communication strings. This is a double risky problem for both parties since an incomplete transmission is not so easy to pick up as an incorrect transmission.

Another example regarding communication and feedback to colleagues within the aviation industry, is the issues of seniority and expertise. Air traffic control assistants as well as cabin crew believe that it is not their place to question or challenge a colleague who is more qualified or in a position of seniority. The following example illustrates this and had fatal consequences.

On March 9th 1989, an Air Ontario Fokker F-27 was getting ready to take-off from a small airport in Northern Ontario. Take-off was delayed as the tower waited for a small private aircraft to land. It had been lost in a spring snow storm. Whilst the aircraft waited for take-off clearance, several passengers took note of the accumulation of snow on the wings. One of them brought it to the attention of the flight attendant, who assured him that there was nothing to worry about. Many of the aircraft's occupants were concerned about the snow, but no one, including the flight attendants, thought it appropriate to say anything to the flight crew. When asked about this during the course of the investigation, the one surviving crew member, a flight attendant, stated that she did not feel it was her job to inform the pilots of a potential problems. She had never been trained to question an area that in her mind was clearly a pilot responsibility.

Moshansky, 1992.

Since then both the development of Crew and Team Resource Management activities have enabled clarification and challenge to be an acceptable part of this working environment.

One of the most prevalent errors in all aviation communication is mis-heard or not heard information. The reasons for this are again many and varied and it is for this reason that ICAO and National Air Navigation Service Providers train their operational staff to use standard radio telephony. So why don't we stick to these rules? Research would indicate that there are several human traits which make following rules more problematic. Firstly people, even controllers, assistants, pilots and aerodrome drivers never believe they could be involved in a serious incident or accident. The fact that these events, compared to the number of aircraft movements is a relatively rare events, continues to perpetuate this belief. This trait is not exclusive to aviation professionals, we all believe the best when we step outside into the hazardous world, not appreciating we could be the victim of many and varied serious incidents.

Secondly, having developed standard phraseologies, individuals as well as Centres, Units and even National Providers and Airlines believe, because they are different, they need to apply for an exemption or change to the rule. These changes are rarely associated with a study to establish the reason for the changes and the best consequent solutions. Again it is rare that procedure specialists would ask the advice of the human performance specialists about how humans process both written and spoken information. This often leads to the use of incorrect phraseologies being delivered in the wrong order. Some of these risky words and phrases have been identified as follows:

- *In turn* – intended sequence is unclear
- *Next exit* - who's next are you referring to
- *Pull forward* – clearance is not clear
- *One hundred and eleven hundred* – as in flight level
- *Three digit numbers ending in zero* – heading often confused with flight level
- *Similar sounding letters and numbers* - B,G,C, D and 3
- *Made a* ... interpreted as Mayday
- *Holding position* interpreted as hold in position
- *Climb to, two thousand* – action, followed by qualifier

Many other errors are made because of the problems of expectancy. Because we use standard phraseology, we often expect to hear a particular request or reply in a familiar situation. If the message we receive is distorted in some way, such as due to other noise or cut off, it is easy to assume we heard what we expected to hear instead of confirming the message. Hearing what we want to hear guessing at an insignificant part of the spoken message, and filling-in after the fact, are commonplace. We also reconstruct parts of messages unintentionally- and we do so with the utmost confidence that we hear what we actually reconstructed, not what was said.

Another reason for the prevalence of mis-heard or not heard information is associated with interruption and distraction. Usually a verbal message or phone will interrupt almost any activity, and by the time we realise that this interrupt message is of little importance, it is too late to retrieve the activity we were doing as the message or phone started. This results in the two tasks, whether they were verbal (receipt of a message) or another action (scanning, writing) being incomplete. When two activities compete for our limited working capacity we usually end up losing all the communication channels, and have to start again.

This problem is particularly obvious when working under a high task load. Task load is dependant on work load (the sheer volume and complexity of traffic) and contextual conditions such as:

- Weather
- Experience
- Fitness
- Time on position
- Stress

Task load is a personal experience, different for everybody and depending on many things. The limitations of the human information processing system are first observed in our ability to communicate. Overloading this system inevitably leads to less effective communication due to tunnel vision (and tunnel hearing), reduction of scanning cycles, less investment in time to execute feedback and a rising temptation to fall for the trap of expectation bias. This results is more incorrect information which leads to further incorrect communication, and finally decisions and actions which are error prone. We all have a tendency to dismiss the necessity for investing time in effective communication when it is most needed; under high task load.

The main issues which have been identified during incident investigation and safety trend analysis are the following:

- Pilot reads back incorrectly and the controller does not recognise and correct the error, often since it is from the correct pilot
- Pilot reads back correctly, however this is followed by an incorrect action on the flight-deck.
- Pilot reads back correctly however the controller records the information incorrectly resulting in a subsequent error.

Statistics would also suggest that controllers can often pick up errors in communication more quickly than pilots. Cardosi, in her 1997 study, recorded the fact that Controllers correct 50% of pilot read-back errors on ground control frequencies and 89% on en-route frequencies. The reason for this is possibly because not only do controllers have more and varied R/T communication to deal with, but also because they are constantly tested for their proficiency in these skills.

Well having explored some of the traps that cause humans to make errors, what are the solutions? These, like the traps themselves, are not easy to manage and implement since the communication process itself is highly complex. However here are some tips for both pilots and controllers which may help:

- Use clear and unambiguous phraseology at all times; challenge poor RTF;
- Try to avoid issuing more than two instructions in one transmission;
- Be aware that you tend to be less vigilant when speaking in your native language;
- Always insist on complete and accurate read-backs from pilots;
- Set the clearance given, not the clearance expected;
- Both pilots should monitor the frequency whenever possible;
- On frequency change, wait and listen before transmitting;
- ATC instructions should be recorded where possible;
- Use standard phraseology in face-to-face telephone coordination;
- Monitor all read-backs, try to avoid distractions – especially the telephone;
- When monitoring messages – write as you listen and read as you speak;
- If you are unsure, always check!

New EU Regulation on the Rights of Disabled Passangers Enters Into Force

by Lorraine Wilson, BLG

Europe: improved rights for the disabled and those with reduced mobility when travelling by air (EU Regulation 1107/2006)

In Europe, around 10% of the population are estimated to require some form of assistance in using air transport. EU Regulation 1107/2006 seeks to open up passenger air transport to all. A second stage of measures which came into force on 26 July 2008 impact on airport operators and air carriers.

Community airports

All community airports with passenger movements exceeding 150,000 a year are now obliged to provide comprehensive assistance to passengers falling under the Regulation. Assistance must be offered to those arriving at, departing from and in transit at community airports. Whilst airports are expressly prohibited from charging passengers, they may (and likely will) levy a charge on carriers, calculated in proportion to the number of passengers carried to/from the relevant airport by an individual air carrier.

On board passengers assistance

Obligations under the Regulation extend to community and extra-community carriers alike departing from community airports. The provisions extend also to community carriers departing from third country airports to community airports. As with airport provided assistance, there is a prohibition on levying a charge on passengers. From 28 July 2008, air carriers are obliged:-

- To make all reasonable efforts to arrange seating to meet the needs of individuals with disability or reduced mobility on request, subject to flight safety requirements;
- To carry recognised assistance dogs in the cabin (subject to national regulations);
- To carry carriage of medical equipment and up to two pieces of mobility equipment per passenger including electric wheelchairs (no weight limit is specified in the Regulation) subject to advance warning (48 hours) and possible limitation of space on board the aircraft;
- To communicate essential flight information to passengers in accessible formats (e.g. large print and brail); and
- To provide, if requested, assistance on board in moving to toilet facilities.

The Regulation does not itself provide for monetary compensation for passengers. Depending on the circumstances of alleged breach, some may found claims for compensation under the EU Denied Boarding Regulation. In the UK, others may look to the Disability Discrimination Act 1995. The Act provides protection for disabled persons in respect of the provision of goods, facilities and services in the UK. Whilst the Act does not apply to services provided on board aircraft, it does apply to the provision of UK-based airport facilities and to flight booking services.

So is the industry in the UK expecting a significant volume of claims? Likely, the answer is no. Since 2003, the UK aviation industry has been encouraged by the government to follow a voluntary code of practice with respect to the provision of assistance to passengers (Access to Air Travel for Disabled People, published by the Department for Transport). In large part that code (updated as at July 2008 to reflect changes resulting from the regulation) was already adhered to.

NATS | On behalf of the airline industry

EXPECT 270 KTS FROM TOP OF DESCENT INTO THE LONDON TMA

The benefits

1 Environmental/Commercial
2 Reduced holding
3 Consistent speed

NATS is trialling a new initiative to reduce fuel burn and emissions. Pilots inbound to the London TMA can expect 270kts in the descent, unless instructed by ATC. Published speed limit points still apply.

Please refer to AIC 49/2008.

www.customer.nats.co.uk

Approach and Landing – TEM Analysis

Peter Simpson, Manager Air Safety, Based on material published by the Flight Safety Foundation

This article reviews the threats and errors that could lead to a landing overrun. It provides guidance of how to manage threats and errors, thus how to avoid an overrun accident. Threat and Error Management (TEM) is an active process that involves avoiding the threats and opportunities for error, detecting new threats or errors and mitigating their effects, and finally managing the consequences of any threats and error. Avoid - Trap - Mitigate

Threats

Threats are those contingencies that add complexity to the operation, and thereby increase the potential for error. Threats can be:

- overt, subtle or hidden (latent) - eg late runway change, inaccurate flight plan winds, incorrectly-coded navigation database.
- expected or unexpected - eg inclement weather, operational pressures, unusual or demanding ATC instructions.

Unrecognised, unmanaged or poorly managed threats significantly increase the potential for error - as detailed in several incidents in this edition of Kai Talk.

Threats are effectively managed by crews who:

- Anticipate the threat,
- Are vigilant for threats,
- When uncomfortable, acknowledge & respond to their own mental **'Master Caution'** and identify the cause of the concern,
- Work together to develop threat management strategies.

An analysis of worldwide landing overrun incidents reveals that an overrun is likely to be characterised by:

- Fast approach and landing in excess of Vref + 15kts
- High approach, exceeding the 50ft threshold crossing height
- Aircraft is 'floated' or is held off the runway for smooth touchdown
- Touchdown point is deep
- Runway surface is wet or contaminated
- Tailwind component

The analysis shows that these incidents were by no means confined to landings onto 'limiting' or 'critical' runways.

The manufacturer's minimum landing distance is based on;

- Crossing the threshold at 50 ft at the landing reference speed (Vref).
- The runway is dry, with known friction coefficient.
- Maximum braking is applied after touchdown.
- Certified landing distances have additional safety factors to account for operational variability and runway conditions.

This distance should be regarded as a theoretical minimum, requiring a high level of pilot skill under favourable conditions, and using a level of braking that may be considered excessive from a passenger comfort point of view.

The minimum landing distance is increased to obtain the various Flight Manual (FCOM 2) landing distances. These factors account for the operational variability that can be expected in day-to-day operations, (wet runways, excess approach speed, etc). This distance depends on landing weight, aerodrome altitude, temperature, runway slope and forecast winds.

Plan Ahead

Carefully review the expected landing performance during the approach briefing. The pre-planned data uses forecasts and predictions made at the time of dispatch. Recheck these and consider:

- Runway choice - available length, surface condition, dry/wet/contaminated.
- Wind - tailwinds can significantly increase landing distance.
- Maximum landing weight allowed - note the considerable differences in allowable landing weight headwind and tailwind conditions.
- Check how close (%) the actual landing weight is to the allowed landing weight; adjust the planned braking level accordingly.
- Consider any effects of nonnormal operations (eg., MEL).
- Carefully recheck the preplanned performance when landing at alternate or diversion airports.

Approach Threats

The most significant threats during the approach are:

- Fast approach air speeds in excess of the planned value
- High ground speeds, not appreciating wind effects
- High or steep approach above the desired flight path

High energy is the combination of these conditions; early control of energy can reduce these threats.

Plan and brief the approach; use 'approach gates' that define the distance or height where the correct airspeed and height (energy) must be achieved

Consider the effect of any speed correction for gusting wind and windshear. Recheck the landing distance required and adjust the planned braking level according to the ground speed.

Landing Flare

A fast approach or excess height above the threshold are threats to a safe landing:

- The speed element of energy is the most critical variable: **Energy ~ Mass x Speed^2**
- An extended flare can lead to a deep landing. Aim to touchdown within the relevant fixed distance markers.
- Downhill slopes may give a long touchdown.

Aim for a 'safe' landing, not always a 'soft' landing. Remember that aircraft decelerate quicker on the ground than in the air.

Amber threats
For every 10 ft excess height at the threshold, an additional 200 ft of runway is required

Control on the Runway

As soon as the aircraft is safely on the runway, commence the deceleration; brakes, spoiler, thrust reverse. Effective landing distance available may reduce due to:

- Delayed lowering of nosewheel.
- Late application of brakes or reverse thrust.
- Failed or late application of spoilers.

When the aircraft is at its highest ground speed, any delay in deceleration uses significant landing distance.

100 kts uses 169 ft of runway every second – that's 1000ft in 6 seconds

Managing Deceleration Threats

Do not delay lowering the nosewheel. Braking depends on ground reaction, which requires all wheels on the runway.

- Automatic spoiler/brake may depend on 'weight' switches.
- Make a firm touchdown especially on a wet or contaminated runway.
- Be prepared for aquaplaning with ground speeds above: **9 x √tyre pressure (psi)**

Although, Boeing have stated that aquaplaning can occur at any speed on a wet runway.

- Anticipate increased rudder input to control any crosswind effects.
- Monitor spoiler and thrust reverse deployment.

Passenger comfort and brake wear considerations often induce a reluctance to utilise the aircraft's full braking potential. This is acceptable in favourable conditions (eg., braking action is good, the runway is long, a long roll-through may be required, etc.). However, reduced braking will result in the reduction of the safety factors built into the landing distances and is not appropriate where the margin has been eroded for other reasons.

Amber threats
For every 1 kt excess speed above Vref, an additional 1-2% of runway is required

Landing on Contaminated Runways

A runway should be considered as being contaminated when it is covered with ice, snow, slush, or more than 3 mm of standing water. Attempts to land on contaminated runways involve considerable risk and should be avoided whenever possible. Ideally, if the destination aerodrome is subject to these conditions the departure should be delayed until conditions improve, or an alternate used.

Advisory data in the FCOM 2 and FCTM concerning landing weights and techniques on slippery or contaminated runways should be used to determine whether there is an adequate margin above the normal Landing Distance Required.

The main threats to stopping the aircraft is the lack of braking effectiveness, this depends on:

1. Level of braking
   - Plan and use of the required level of braking for the conditions.
   - Commence braking at high speed, dissipate energy early.
   - Use full braking when required; safety before comfort.
2. Runway friction
   - Wet runways have much lower friction levels than dry runways.
   - The friction depends on the runway surface, materials, and condition.
   - Contamination (water, slush, snow, or ice) reduces friction to very low levels.

Level of braking: Brake for safety not for comfort

Landing Threats

- Fast; above Vref+15
- High at the threshold
- Long/Deep landing
- Wet Runway

Landing Threat Management

- Plan – self briefing, crew briefing
- Stabilised approach – through the gates
- Adjust braking levels – wet runways, tailwind

Investigation Report
December 2005, A Southwest Airlines B737-700 landed at Chicago Midway Airport in snowy conditions, overran the runway, departed the airfield and rolled across a road, killing a child in a car. At the time braking had been reported as poor, and there was a tailwind component of 8 kts.

The NTSB determind the contributory factors as not managing the landing threats:

- Slow response to use reverse thrust,
- Improper use of autobrakes,
- Failure to calculate landing distance required,
- Faliure to divert despite poor braking and tailwind conditions
- (the airline's) faliure to include any margine of safety in the arrival assesment to account for operational uncertainties.

Be aware of additive values

(figures for guidance only):–
Fast + 15%
Tailwind + 15%
No spoiler + 20%
Long flare + 25%
High + 25%
Wet + 30%

Errors

We have to acknowledge that humans make errors and that everything does not always proceed as expected. Crew error is defined as an action or inaction by the crew that leads to deviations from intentions or expectations. Operationally, errors tend to reduce the margin of safety and increase the probability of accidents.

Error Management

It is human nature to make errors, thus error management is a vital safety device - the process is similar to threat management:

1. Identify & avoid situations that could lead to errors.
2. Identify and trap the error.
3. Mitigate the error - take corrective action.

Errors are managed by:

1. **Resistance** from system defences provided by hardware & formal procedures eg TCAS, EGPWS, checklists, SOPs.
2. **Resolution** through crew nontechnical and technical skills.

Crew are the final defence and the last filter in preventing the consequence of error becoming an Undesired Aircraft State (UAS).

No two landings are the same. No matter how many times you've landed in HKG, expect a new 'problem' each time.

- The smallest change in conditions may overcome the plan. Monitor the environment, the aircraft and crew for changes or errors in the plan.
- Do not tolerate SOP deviation (even for training flights). Avoid short cuts or thinking that you know better. Avoid hazardous, error provoking situations.
- It is OK to Go-Around

Avoiding Situation Awareness Errors

Situation assessment errors can be of several types: situation cues may be misinterpreted or ignored, resulting in a wrong picture; risk levels may be incorrectly assessed; or the amount of available time may be misjudged.

Use the following questions as a checklist:

Situation Awareness Checklist

- What are the plane, path and people doing now?
- What is likely to be the state of each later?
- Consider all the "what if" possibilities for each.
- Focus attention on details while keeping the big picture;
- Anticipate, stay ahead of the airplane, consider contingencies, have a plan for the "what if situations";
- Pre-brief who will monitor what in busy times;
- Have a plan for handling distractions, especially malfunctions;
- Use all your team members for awareness;
- Create reminders.

Situation cues provide a mental model of what is happening; cues have to be sought out and understood. See to understand; deliberately scan the situation to gain information and compare this with the expected or the normal parameters. Know what to see and when to see it; focus attention on landing threats and opportunities for error. Don't just judge the situation off one parameter such as airspeed, altitude, runway length, surface conditions, wind, etc
Important situation cues for landing are:

- The aircraft's actual approach path and airspeed in comparison with the ideal flight path and the target air speed
- The runway conditions, friction, and the required level of braking
- The landing distance required for the surface conditions, wind, and aircraft weight, speed and configuration

Compare the landing gates, stabilised approach, speed / height over threshold with the SOP and with the plan you briefed.

- Anticipate the next part of the plan
- Go-around if unstable, if missing a gate, or fast at the threshold
- Beware of bad habits - do not deviate from the plan or SOPs
- Change the course of action if a rule is violated

Consider the consequences: Most overruns are accidents, with fatalities, injury and damage. At the very least the overrun results in disruption and delay, consequential cost and dented pride.

Continuing an approach after missing a stabilised approach criteria is not the correct course of action. It's OK to go-around

Make the decision YOUR decision

- Don't depend on previous aircraft landing reports; braking effectiveness varies with aircraft type, equipment availability, and use of brakes.
- Don't have an accident by helping someone else. It is OK to say 'No' to ATC, 'unable to comply'.
- Make time. Reduce speed early; 180 kts is approx 3 NM/min (900ft/min), whereas 120 kts is 2 NM/min (600 ft/min)

Summary

To avoid a landing overrun.

1. Identify, avoid, and trap threats and errors.

- Maintain good situation awareness: airspeed, runway surface.
- Have a plan, give a briefing: compare the situation with the plan.
- Knowledge of 'no-go' areas: flooded, icy or contaminated runways.
- Speed above Vref+15, long landings, strong tailwinds.
- Follow SOPs: use approach gates, speed/height.
- Do not tolerate violations, beware of bad habits.
- Resist peer pressure.
- Training is NOT a valid reason to violate procedures and limits.
- Brake for safety not comfort.

2. Manage the consequences of error

- Revise the plan – **it is OK to go-around.**
- Make time.
- A safe landing is more important than an on-time landing.

How heavy is the aircraft?
How long is the runway?
How fast is the aircraft?
How wet is the runway?
Head / Tailwind?
'On Speed'?
Stabilised approach criteria?
Height over the threshold?
How much braking to use?

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THE INTRODUCTION OF TCAS/ ACAS II INTO EUROPEAN LEGISLATION

By Captain Tim Sindall, FRAeS

The mid-air collisions that involved passenger-carrying aeroplanes at San Diego in 1978 and at Cerritos in 1986 proved powerful motivators for the development of suitable collision avoidance systems. The emergence of TCAS (Traffic Alert and Collision Avoidance System), a successor to BCAS (B for Beacon), came to the attention of non-US air safety authorities generally about the time that the FAA made known its intention that certain passenger-carrying aeroplanes operating in or through US mainland airspace in accordance with FAR Parts 121 and 129 (i.e. non-US registered) would be required to carry and operate TCAS II.

The UK developed TCAS II carriage requirements for large aeroplanes (both passenger and cargo-only) only when version 7 defined as ACAS II (Airborne Collision and Avoidance System – a generic title adopted by ICAO) became available. UK law then reflected both JAR-OPS 1 and Eurocontrol implementation policies.

The Early Years – 1986 to 1988

In 1986 the UK Civil Aviation Authority (CAA) formed a multi-disciplinary working group to assess the capabilities of TCAS, to identify its strengths and weaknesses, to develop means of educating and informing flight crews and air traffic controllers, and to consider what changes might be required to existing legislation.

As the flight operations inspectorate member of that working group, my primary interest was to understand how the equipment might be used by UK flight crews so that they could be provided with operational instructions supported by suitable training before they would be required to use it (eg in US airspace).

As part of my brief, I was invited by the FAA to observe TCAS II being operated in a Boeing 727-200 'N857N' operated by Piedmont Airlines, preceded by a session in a flight simulator that enabled me to get some 'hands-on' experience. My post-visit report dated March 1987, of which I still have a copy, records that 'more than eight years of engineering and testing' had resulted in FAA approval for in-service trials.

Amongst the observations I made following my visit were: that complying with a resolution advisory (RA) without disconnecting the autopilot resulted in a manoeuvre that was too sluggish to comply with performance expectations; that hand-flying pilots responding to RAs tended to apply elevator movements that were too large, resulting in rates of climb or descent that exceeded the nominal 1,500 ft/min ('if 1,500 ft/min is good, then 3,000 ft/min must be better/give greater clearance' – NO!); that a full-time display of adjacent aircraft symbols would be highly desirable (the trials equipment display appeared for only 15 seconds after being triggered by proximate traffic unless a spring-loaded 'TCAS Tracks' selector was operated – Piedmont crews used chewing gum to hold it in the latter position to obtain a permanent display); and that a separate trials programme to be managed by UK authorities would seem necessary in order to develop 'UK methods of supervising airworthiness and operational standards and procedures'.

In July 1988 I was back again in the USA as a guest of the FAA, first to observe in Boeing 737 'N9006U' flying between Washington Dulles and Manchester New Jersey recent developments with the Bendix TCAS II. These now included a full-time display, 'eye-brow' lights on the vertical speed indicators (VSI), and enhanced (brighter) symbols. Second, I was invited to fly with the FAA out of Atlantic City to obtain 'hands on' experience in their TCAS III-equipped Boeing 727 'N40' in arranged 'conflicts' with the Administration's Convair 580 'N39'. The TCAS III equipment was a 'breadboard' version, but it produced advisories for climb, descent, turn left and turn right. The question was whether TCAS II, limited to advisories in the vertical plane, would be adequate, or whether enhanced capabilities would be necessary. In the event, TCAS II has shown itself to be adequate. Of interest to me, whilst hand-flying the Boeing through one of the encounters with the Convair, were unplanned additional conflicts with two general aviation aeroplanes that just happened to be in the vicinity. My notes record that within the space of some 15 to 25 seconds I received the following sequence of RAs: 'Turn Right', 'Don't Climb', 'Go Left', 'Descend', 'Descend and Turn Right'! Compliance was straightforward.

UK Trials – 1989

TCAS II version 5 had been proposed for the 1989 UK trial, but this was replaced by version 6 (possibly 6.0) which became available in time for installation in a Boeing B737-200, 'G-BGDK', operated by British Airways. The full trial report is contained in CAA Paper 92011, which contains full details including results, conclusions, and recommendations.

The Paper also included: implications for airlines (nuisance traffic advisories, Mode A traffic advisories (TAs), and training), implications for ATC (potential disruption to traffic patterns and an increase in RT leading to an increase in controller workload), and implications for the CAA's Safety Regulation Group (SRG) (further development of the system was needed before its performance might be termed satisfactory, and the incompatibility of Mode A transponders – no altitude information).

I had produced draft guidelines to assist British Airways with training its crews and so later obtained feedback regarding the guidelines' scope and clarity. In my own contribution to the trial report, I noted the inadequacy of the quality, reliability and accuracy of displayed data; the high incidence of 'nuisance' advisories; and doubts concerning the ability of the equipment to operate reliably and efficiently. I stated that, 'there should be no recommendation (at this time) to require carriage of this equipment in UK-registered aircraft'. This, of course, did not mean that UK air operators should not install TCAS II to enable them to comply with FAR Part 129, only that improvements were needed before the CAA could reasonably seek approval to mandate its carriage in UK-registered aeroplanes.

Non-mandated TCAS II Installation in UK – Registered Aeroplanes – 1991 to 1999

Whilst the need for large aeroplanes to comply with TCAS II mandates prescribed by the USA was leading to the progressive installation of version 6.02 in US and some non-US registered passenger-carrying aeroplanes (the US mandate did not include cargo-only aeroplanes), in the UK I was able to get Civil Air Publication (CAP) 579 'Airborne Collision Avoidance Systems (ACAS): Guidance Material' published in March 1991. Publication was before any UK-registered aeroplane had TCAS II installed and approved for line operations, and so enabled the six or so UK air operators whose aeroplanes would require installation for flights to and within the USA to provide standardised flight crew training that included all aspects we (the CAA) considered to be important.

Specifically, we required the use of interactive training devices 'that are capable of creating encounter situations that have to be resolved in real time'. Two UK companies took up the challenge, one developing a fairly sophisticated type-specific computer program, the other a generic PC-based program. In each case, the pilot would be looking at an artificial horizon (AH), altimeter and airspeed indicator (ASI) plus, of course, the VSI depicting the TCAS symbols of any traffic within range. Following a TA, an RA would be posted, whereupon the pilot had to initiate a climb or descent, as appropriate, by means of striking the up or down arrows on his keyboard. Each strike produced a half-degree change of pitch on the AH followed by a consequential change of vertical speed and IAS. Clearly, the higher the IAS at initiation, the more pronounced the vertical speed would become – the target being notionally 1,500 ft/min. Any delays in responding to the RA, or an incorrect or excessive response, or any unreasonable delay in returning to the initial altitude following 'Clear of Conflict' being posted, would result in the display 'freezing' and a placard appearing stating what should have been done (positive feedback). CAP 579, updated and reissued in March 1994 to include ICAO Standard RT Phraseology to be used when informing ATC of responses to RAs, included examples of the limitations of TCAS II, what Operations and Training Manuals should contain, and – critically – action to be taken upon receiving TAs and RAs.

Due to the absence of any clear understanding and not a little misgiving amongst the UK air traffic control community as to what effects TCAS II-equipped aeroplanes flying in UK airspace might have on the discharge of their duties, extensive efforts were made to educate and inform them about the equipment and its displays/advisories. Information coming from the USA, where early versions of TCAS II were in use, had led to a level of concern that needed to be addressed. As a matter of record, at about this time there was only one reported incident of the pilot of a UK-registered aeroplane initiating a turn on receipt of a TA (he should not have altered the flight path in any direction at this point, and there was no need for him to have done so). The reason was that he had not been trained in the use of TCAS. Although his airline was progressively installing the equipment, it had planned a 'switch-on' date when all aircraft in the fleet had been equipped and all pilots trained. Unfortunately the relevant circuit-breaker had been pushed in, the display was alive and the pilot reacted when he observed a symbol representing an approaching aircraft! This makes the point, perhaps, that responding inappropriately to TCAS information can be potentially more disruptive – and possibly more hazardous - than having no TCAS at all.

Around about this time, ICAO began developing training guidelines for aeroplanes equipped with TCAS II and published these in a State Letter. These guidelines, which reflected in part the contents of CAP 579, were later taken by the JAA as the basis for Temporary Guidance Leaflet No 11 published in 1998 for voluntary adoption by all JAA Member States.

For the avoidance of doubt, the UK published in May 1999 an Aeronautical Information Circular (AIC 54 Pink 194) that linked an RA with an emergency manoeuvre, which a pilot might execute at any time, 'for the purpose of avoiding immediate danger'. Thus, following an RA that resulted in the aircraft departing from an air traffic clearance in UK airspace (subject to specific conditions) was deemed to be lawful.

Pilots of UK-registered aeroplanes who experienced an RA were asked to report this to the CAA by using a specific form. From this, the Authority classified each event 'genuine' (the equipment worked to specification and the advisory was considered necessary), 'nuisance' (the equipment worked to specification but the advisory was not thought necessary) or 'false' (something failed within the system, or the information used by the processor was erroneous). The data thus recorded showed consistently some 3% to 5% of RAs were 'false', and some 86% were 'nuisance'. Despite the high incidence of 'nuisance' RAs, pilots reported following the advisory on more than 90% of occasions. The feedback that was received enabled the CAA's Flight Operations Department to publish two bulletins, each of which highlighted critical operational and training points.

When TCAS II version 6.04A was released to service, the number of reports received by the Authority actually fell, this being a testament to the improvements associated with the new software. Soon after this, the number of UK-registered large aeroplanes equipped voluntarily (at some considerable expense, it must be said) with TCAS II increased rapidly despite the fact that many would never have to cross the Atlantic, and the number of reports increased again, but slowly, as new pilots 'bedded in' with the system.

Mandating Carriage of ACAS II / TCAS II Version 7 in Europe – 2000

It was the function of the JAA and of Eurocontrol to act as facilitators for the development of legislation that their respective Member States in Europe would then implement through national legislation. Acting in concert, each organisation agreed both an equipment standard and a timescale for implementation. The equipment was to be TCAS II version 7, henceforward to be known as ACAS II. This meant that the earlier versions would not meet this specification. The JAA was responsible for aeroplane safety equipment policy and Eurocontrol with airspace policy (ie to apply ACAS II carriage requirements to all subject aeroplanes of all nationalities passing through European Civil Aviation Conference airspace, aka European airspace).

Both organisations were developing their respective requirements on the back of the UK's proposals that included a two phase approach, each phase defined by two sets of discriminants. A task force assembled within the CAA (Safety Regulation and Airspace Policy) to develop the new legislation had decided that there was justification in requiring all large aeroplanes (heavier than 15,000 kg or capable of carrying more than 30 passengers) to install ACAS II, and that at some future date – undetermined – it might be justifiable, subject to research and analysis, to extend the requirement downwards (and this was speculation at the time) to aeroplanes heavier than 5,700 kg or capable of carrying more than 19 passengers.

Shortly afterwards, both the JAA and Eurocontrol adopted both sets of discriminants without reservations. They published required implementation dates of 1 January 2000 for the first phase and 1 January 2005 for the second. Latterly, research did in fact confirm that the second set of discriminants could be justified.

It should be noted that JAR-OPS 1 (Joint Aviation Requirements – Operations, applicable only to aeroplanes operated for commercial air transport) was first published on 22 May 1995. JAR-OPS 1 contained Requirements that JAA Member States undertook to implement through their own national legislation. The first Change (amendment) to this document, dated 1 March 1998, introduced through JAR-OPS 1.668 the ACAS II Requirement described above.

No interest has been shown in mandating TCAS I, which posts only TAs, since the weather in Europe can so easily and so frequently become Instrument Meteorological Conditions (IMC). The absence of RAs could quite likely lead an unsighted pilot of a TCAS I-equipped aircraft to manoeuvre in any direction, and never in a complimentary manner with a TCAS II-equipped aeroplane, thus creating a risk of conflict between both. In the UK, some helicopters, for example in police and emergency medical services, have TCAS I, but as these operate almost exclusively in Visual Meteorological Conditions (VMC), the limitations described above are acceptable. The benefits of being alerted to the presence of military and general aviation aircraft on random flight paths are appreciated.

In order that UK legislation might be enacted in time, the letter of consultation (LoC) was published on 4 February 1998 and the letter of intent (following responses to the LoC) on 18 September 1998. This gave all those affected by the text that follows below two years in which to plan, budget, obtain and install ACAS II. Of course, many UK-registered aeroplanes already had TCAS II version 6.04A installed with their crews and maintenance organisations experienced in its operation, but for the others the time for implementation was just adequate. All would need training or retraining in what ACAS II now offered. The new insert to the Air Navigation Order read: 'On and after 1 January 2000 all aeroplanes registered in the United Kingdom, wherever they may be, and all aeroplanes wherever registered when flying in the United Kingdom, powered by one or more turbine jets or turbine propeller engines and either having a maximum take-off weight exceeding 15,000 kg or which in accordance with the certificate of airworthiness in force in respect thereof may carry more than 30 passengers (would require ACAS II).' AICs were published to ensure that all non-UK operators would know of this legislation. (The UK and the JAA do/did not have a FAR Part 129 equivalent.) Subsequently, the ANO was amended further to incorporate the second phase requirements. EU-OPS prescribes a requirement for the carriage of ACAS II (OPS 1.668) and how it is to be used (OPS 1.398).

Unlike some States that did not apply ACAS II requirements to cargo-only aeroplanes, the developers of European laws saw no reason to excuse the latter from compliance. One reason was that cargo-only aeroplanes would have similar performance characteristics to the passenger aeroplanes, thereby flying in the same airspace and posing similar risks (of generating threats). Another was that the flight and other crew (eg loadmasters, security guards, ground engineers) carried in cargo aeroplanes deserved no less protection than the flight crew, cabin crew and passengers carried in any similar ACAS II-equipped passenger aircraft. In essence, it was the operating environment that mattered.

Eurocontrol continues to promote safe operating procedures for flight crews to practice using information gleaned from events to support advice published in a series of bulletins. The JAA's TGL 11 was updated to reflect ICAO's revised guidelines that can be read in PANS-OPS Volume 1. The reliability history of ACAS II has placed more emphasis on the need that pilots initiate promptly the manoeuvre posted by an RA. The pilot still has the right not to comply with the RA if he considers it hazardous to do so, but must never manoeuvre in a sense opposite to the RA!

Conclusion

For the UK, the acquisition and implementation of ACAS II was – at that time – the most expensive aeroplane modification programme ever required, and it is a tribute to all UK air operators who installed it that the process went so smoothly and that their crews rarely encountered problems when using it.

Tribute should also be paid to those in the UK who at various stages helped to develop and improve the equipment, expose it to trials, draft advice and information, educate flight crews and air traffic controllers, prepare draft legislation, and promote sound operating practices. Amongst these, it would be especially apposite to mention Les Ford and Ken Carpenter of what was at one time RRE Malvern, without whom TCAS would never have been developed so successfully into ACAS II and become the highly-valued safety assurance equipment it is today.

Tim Sindall flew as a captain with Laker Airways before joining the UK CAA in 1982 where he was tasked – in addition to his flight operations inspector duties – with helping to draft guidance for flight crews in the use of GPWS/TAWS as well as ACAS/TCAS. He was a member of the JAA Operations Committee, the UK nominee to the ICAO Operations Panel, and a former head of both the Flight Operations Inspectorate (Aeroplanes) and Flight Operations (Technical). He is currently a Trustee of CHIRP and he sits on both the Air Transport and Cabin Crew Advisory Boards.

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Practical implementation of an Integrated SMS

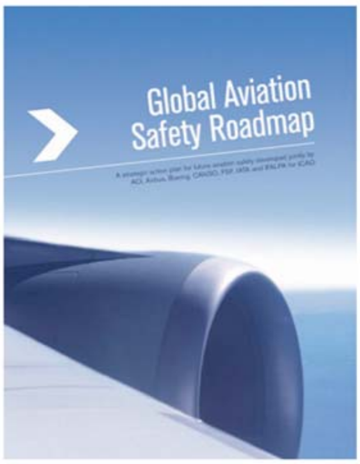
David Mawdsley, Aviation Safety Advisor to Superstructure Group

Leadership in Safety requires an understanding of the situation, an acceptance of responsibility, a commitment to action and clear strategies and targets. The attainment of a safe system is the highest priority in aviation. The moral imperative for action to reduce the accident rate still further is self evident, the operational benefit is immense, and the business case highly compelling.

The Roadmap to Integrated SMS

I wrote the above statement as the opening paragraph to the Global Aviation Safety Roadmap, widely known as the "Safety Roadmap" which is now essentially the ICAO's Global Aviation Safety Plan. The Safety Roadmap points to the key "roads" focusing on SMS, and the reporting and analysis of errors and incidents. It urges that these roads be followed in a new government and industry partnership aimed at reducing the global accident risk in commercial aviation.

Set more deeply in the Safety Roadmap are some profound objectives for mitigating risk which are as relevant to the Boardroom as they are to the safety, security, quality, environmental and enterprise risk managers in the organization. One such objective is the need to define interface points between industry focus areas and to develop a plan for SMS integration across all interfaces.



SMS with its safety reporting culture is now locked in to the "Safety Roadmap" for the next decade, so we had better get down to it. I am talking about implementing the silo busting kind of SMS, the one which is integrated across all interfaces.

Corporate Performance Expectation

The Roadmap rightly declares safety as a performance expectation. From its former negatively orientated, reactive stance, which relied on accidents and incidents to let the organisation know where threats existed, SMS has moved to a systems approach. Risk assessment and management concepts have been adopted. Operational safety has teamed up with Quality Assurance and unleashed the power of data and process to address system errors. This requires that organisational management, not just the safety officer, take responsibility for the company's safety programme with clear accountabilities for safety mapped out across the organisation. The system must be fully documented with clear performance criteria established. A robust SMS must have targets and metrics against which performance can be measured.

As a CEO or Accountable Executive, if you do not preside over a robust SMS then you are vulnerable.

In the United States the Sarbanes-Oxley and Basel II rulings have reinforced corporate officer accountability for both financial and operational results along with accurate reporting to investors. An even more stringent performance bottom line is the UK's new Corporate Manslaughter and Corporate Homicide Bill which took effect on 6 April 2008. It supersedes a statute that tasked juries to consider if corporate actions were 'so negligent as to be criminal'. The new law threatens to penetrate further and questions whether the conduct of management 'falls far below what could reasonably have been expected'. This sends a clear message. When it comes to safety management and practices in the UK no company can afford to be below average. Clearly Safety is a performance expectation, not only morally and operationally but legally too!

Undoubtedly the accountable executive has the dilemma of balancing the resources required for protection and production, or those required to minimize the risk of catastrophe and bankruptcy – Professor James Reason's so called Maximum Resistance Space. A crucial part of this resistance is the SMS and the effective use of data to inform risk management decisions.

Data Driving SMS

Like many of my counterparts in the airlines, I believe that the key to effective SMS is a generative safety culture employing a voluntary employee reporting system which analyzes data and shares information. The process of unlocking the value in the data and turning it into useful information is largely achieved by having the right tools and the expertise.

Today's powerful data management systems enable the risk exposure to be mitigated not only in the operational safety arena but across the aviation enterprise as a whole. Such data-driven integration is vital to the implementation of an SMS. It reduces complexity, crosses organizational boundaries, improves business efficiency, reduces costs, and saves lives.

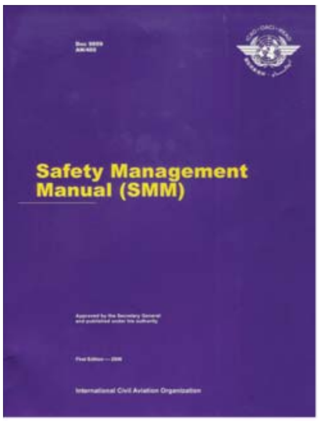
Before being appointed Director Safety at IATA I was Head of Corporate Safety at Cathay Pacific Airways. Not only did I gain the practical experience of helping to develop one of the world's most admired airline safety management systems but as Director of

Safety at IATA I launched the STEADES (Safety Trend Evaluation Analysis and Data Exchange System) programme, a global air safety reporting system involving some 60 airlines. From this platform I worked closely with the airlines on the development of SMS implementation guidance material aligning with the operational safety and risk management expectations of IOSA - the IATA Operational Safety Audit.

Now, as Aviation Safety Advisor to the Superstructure Group I am committed to contributing more deeply to the industry wide implementation of SMS in the data analysis and sharing arena in accordance with the ICAO plan and IATA best practice both at the regulatory and service provider level. Additionally, I teach SMS at Cranfield University and I am pressing to ensure that the right message of "integration" during SMS implementation is communicated from the safety training arena.

SMS Requirements

There is no excuse for not knowing what is prescribed for States and service providers in terms of SMS requirements. This has been set out in the ICAO Safety Management Manual Document 9859 issued in 2006 and in SMS documentation produced by leading Regulatory Authorities. Whether the word "should" or "shall" is used to communicate the need to have an SMS in place, there is undoubtedly a strong expectation amongst the regulators of the world that 2009 will be a year for implementing SMS and the pressure is on.



Accompanying the much increased top down focus on safety oversight, airlines and their supporting enterprises will not only be expected to "implement" SMS but they need to ensure that it is "integrated" with the business as a whole. 2009 is therefore a time for implementing and integrating SMS and for leaders to understand how this might best be done.

In 2009 the aviation community will continue to shift holistically from a prescriptive approach to aviation safety to implementing the performance based "integrated" SMS.

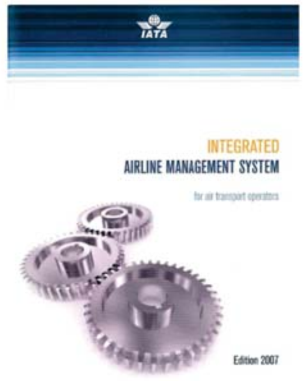
Implementation

To provide guidance on SMS implementation IATA has issued two documents, the first of these in 2005 entitled: "Safety Management Systems – the Senior Airline Manager's Implementation Guide". The second guide was released in 2007 and entitled "Integrated Airline Management System for air Transport Operations". The latter work, which is rather ahead of its time, employs an interactive toolkit which advances the "integrated" management system (iAMS) approach applied by IOSA.

This is essentially an integrated SMS for airlines and IATA has therefore helped to set the bench mark for the performance of SMS around the world by "mandating" IOSA for all of its 260 airlines. This integrated SMS concept embraces not only SMS but Risk, Quality, Security and Supplier management thinking. Some excellent guidance material has also been released by the leading regulatory authorities including Transport Canada, the UK CAA, the Australian CAA and the FAA. Overall, however, it is the experience of actually installing and resourcing a performance based, integrated SMS, complete with its software tools, which is still rather limited and where there is scope for further guidance of a more practical kind.

Integration

With implementation comes the need to integrate. An air carrier organization is composed of a "system of systems" which are integrated and intra-supportive. Airlines and their supporting enterprises will not only be expected to "implement" SMS but they will need to ensure that it is "integrated" with the various cultures in their operations and support areas, and indeed at the wider interfaces such as the CAA, Airport Authorities and ATC Service Providers.



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Such an approach may suggest an increase in the complexity of implementation. But by phasing the implementation of enterprise risk management in manageable steps and building on that which is already in place it is possible to execute the changes efficiently. The choice of software tools with the capability and flexibility for integration is vital. Most importantly, the changes must be backed by clear corporate communication and the whole process supported by guiding actions from the top.

It is the silos and power struggles which have the greatest potential to increase complexity. I have found the best way is to integrate on a basis of equal partnership and respect. For the medium and small airlines especially, I strongly recommend an early transition to the integration of the different risk-related cultures (safety, quality, security, environmental, etc) and the business as a whole. The need to data-drive all risk-related activities across the enterprise is of paramount importance. This for me is the primary means by which a static, perhaps cumbersome SMS becomes efficient, responsive and dynamic.

The plans and integration templates of others should be used with caution. They are potentially helpful to look forward to assess where, for example, integration of data management systems may best be applied but it is for the organisation as a whole to decide which components of an integrated SMS should have priority for introduction, and always with the aim of keeping it simple.

SMS implementation is taking place in a new era of enterprise risk management and here again, we had best understand this approach, and get on with it.

Enterprise Data Management

With these remarkable changes taking place in safety management the reporting process along with its performance measurement indicators will need to be sufficiently smart and compelling to influence the decisions and indeed the behaviour of all accountable executives concerned with risk mitigation in the company. Not only will it be necessary to capture data from the traditional safety arenas but also from the other risk-related activities in the enterprise as a whole. I therefore urge implementers and integrators to design their SMS with the data requirements of enterprise risk in mind. I have seen volumes of prescriptive SMS documentation, indeed some of which profess to point the way to SMS implementation, which ignore the technology for data capture, analysis and sharing across the enterprise. I maintain that this is the key to not only SMS data management but also to projecting efficiently and speedily the corporate risk management dashboard representing all of the risk-related activities in the enterprise.

Leadership in Integrated SMS Implementation

Leadership in Integrated SMS Implementation At a time when there is major concern in the industry about managing growth and operational complexity, I see the task of SMS implementation and integration as very much a leadership challenge. Leading airlines point to SMS as a simple concept and urge that it is not allowed to lose its way in a world of processes and rigid regulatory requirements. Managing safety ultimately comes down to managing risk. There are very few airlines, certainly amongst those in IATA, that do not manage their safety risk. Most already have an SMS or at least the principal elements of an operational risk management system in place. There is a natural tendency to point to the gaps when the pressure comes on to implement and the transition can become very negative and complicated all too quickly. It is for the leaders to execute this change demonstrating a clear commitment to the SMS implementation plan.

If enterprises are not to be overwhelmed by the plethora of SMS policy and guidance, leaders at the sharp end from the CEO down must themselves make the time to "understand the situation" and the way in which SMS is being implemented and integrated in their organization.

A Vision for Integrated SMS

My vision is for "integrated" SMS processes to be applied not only in the enterprise itself but in a global data knowledge framework. I refer to the intelligent proactive and predictive data driven solutions now available to the enterprise which are also able to provide the knowledge framework for an integrated global information sharing system. I am deeply committed to applying the power of process and risk management through integrated SMS support software, such as that provided in Superstructure Group's AQD safety and risk management system.

Simplifying the business of SMS

I am currently preparing an integrated Safety Management System Guide which, unlike any of its predecessors, takes a very practical approach and goes deeper by capturing the experience of colleagues in the industry who are using AQD to implement and integrate their SMS. The integrated SMS approach recognizes that an airline or aviation enterprise comprises management systems that are complex and inter-related. Therefore, the simple, straightforward, and practical integration of these management systems is essential to both mitigate safety hazards and realize financial benefits from enhanced operational efficiencies. The Guide aims to capitalize on the experience of implementing and integrating SMS while harnessing the capability of AQD to simplify the business of SMS.

Unlike other prescriptive material addressing the "what" of SMS, the Guide will focus on the performance aspects of an SMS and the role which the AQD integrated safety and risk management software plays in addressing the "how", an aspect which is so vital to understanding the practical dynamics of an integrated SMS.

The Guide will be launched at the Flight Safety Foundation International Air Safety Seminar (IASS) in Hawaii on October 28th 2008 and a series of local implementation workshops and training events will also be scheduled to provide advice on building effective integrated SMS solutions.

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