N°**4**

Hind**S**ight

January 2007

CONFLICT DETECTION

"Hindsight"
The ability or opportunity to understand and judge
an event or experience after it has occured.

ANOTHER SUNNY DAY IN SWEDEN
BY BENGT COLLIN
See page 5

THE HUMAN FACTOR COLUMN
BY PROFESSOR SIDNEY DEKKER
See page 7

NEAR COLLISION
AT LOS ANGELES
See page 20

EUROCONTROL

CONTENTS

* In most European countries, national procedures are based on ICAO Standards and Recommended Practices (SARPs); therefore the "Lessons Learned" listed in HindSight follow this guidance. Where national procedures do not follow ICAO SARPs, some "Lessons Learned" might not be applicable.

DO WE REALLY NEED ATC?

By Tzvetomir Blajev

Coordinator Safety Improvement Initiatives and Editor in Chief of HindSight

Imagine what would happen if ATC were to disappear tomorrow! All aircraft would taxi and take off when and how they wanted, fly the most desirable profiles, approach and land unrestricted by ATC on their preferred runway, and taxi to the terminal as free as the wind in any way that took their fancy. That is how it was in the early days of flying, so why not now?

Why not, starting from tomorrow, adopt this efficient and leisurely approach to aviation transport? The answer is simple - *it would not be safe without ATC.* ATC is here to predict, identify and manage conflicts before they turn into accidents - conflicts between aircraft and conflicts with terrain. Conflict detection and resolution is therefore the *raison d'être of ATC* - the real reason why it exists. Efficiency and capacity are just different names for the price we pay to have conflict management.

The air traffic controller arrived on the scene in response to the growing volume and speed of traffic, and quickly assumed a vital role in accident prevention. This role has grown steadily with improvements in communication, and later, the introduction of radar; but the final link in the chain has always been the human factor.

Some people in the industry believe that technical developments will ultimately remove the human operator from the equation. That, however, is a long way off, and today we are still relying on air traffic controllers to identify and resolve conflicts. It is no surprise that the Eurocontrol Safety Improvement Sub-Group has placed conflict detection high on its agenda. The aim is to pool our collective knowledge and learn from each other how to make the processes more robust and less prone to the inevitable human variability. And this leads us on to the next point - conflict detection, just like air-ground communication, is a function of the overall framework of procedures, practices, teamwork and equipment support. The *controllers are already doing their best.* Rather than telling them to go out and detect more conflicts, we could *more usefully spend our time improving the overall system of conflict detection.*

This issue of HindSight concentrates on this area and provides you with the points of view of your colleagues - controllers, pilots and academics.

But this is not the end of the story; it is only the beginning. This magazine is produced by you and for you, and we would like you to continue your support and provide us with your everyday safety stories - stories of failure, but also stories of success.

We hope you enjoy the issue.

ABOUT HINDSIGHT

The main function of the *HindSight* magazine is to help operational air traffic controllers to share in the experiences of other controllers who have been involved in ATM-related safety occurrences. In this way, they will have an opportunity to broaden their experience of the problems that may be encountered; to consider the available solutions; and so to be better prepared should they meet similar occurrences themselves.

Material contained in *HindSight* falls into three distinct classes:

- Editorial
- 121.5 - Safety Alerts and
- The Briefing Room - Learning from Experience.

On page 2, you will find a table of contents listing articles under these three headings. Editorial material, such as this article, needs no explanation but a few words on the other two classes may prevent any misunderstanding.

121.5 Safety Alerts

From time to time EUROCONTROL issues Early Warning Messages and Safety Reminder Messages to draw the attention of the ATM community to emerging safety issues. The messages are intended to encourage discussion on the prevalence and seriousness of the issue and on the most appropriate reaction to them. Summaries of some recent messages are included.

The Briefing Room - Learning From Experience

The majority of *HindSight* is taken up with articles concentrating on specific safety issues. These usually comprise a study of an actual accident or incident(s) together with a summary of lessons learned. These articles are coded to reflect the subject material.

Some incidents relate to the performance of ATCOs or the ATM system, while others illustrate pilot errors which can arise from incorrect interpretation of ATC instructions, or other unpredictable situations.

The incidents fall into two categories:

- **Summaries of accident and serious incident reports**

The full report usually runs to many pages, so these reports must be summarised and simplified, concentrating on the ATM-related aspects and passing quickly over (or even ignoring) other issues which have no direct relevance to ATCOs. A reference to the original report is always supplied.

- **Dis-identified accounts of other ATM-related incidents**

Typically, the original reports are not in the public domain; however there are important lessons to be learned from them. The identifying features of the reports are altered without changing the substance of the reports in order to preserve the confidentiality of the reporter.

Lessons Learned

In the articles that follow, only the lessons learned from the featured accidents and incidents are listed.

Knowledge Base

We intend to compile a Knowledge Base of all types of ATM-related safety reports, which may be accessed by persons carrying out research on particular subjects. This is a long-term project but we plan that the HindSight magazine should be integrated with it from the outset.

Coding of Subject Matter

To aid identification of subject matter, each article is coded and marked by a coloured icon which appears at its head.

Loss of Separation	
Level Bust	
Runway Incursion	
Controlled Flight into Terrain	
Airspace Infringement	
Wake Vortex Turbulence	
Human Factors	
Other	

ANOTHER SUNNY DAY IN SWEDEN

By Bengt Collin

Bengt Collin is an ATC Operational Expert at EUROCONTROL Brussels. Previously he spent some 25 years as a TWR & APP controller at Stockholm-Arlanda airport, including four years as the Tower Operational Manager.

THE OLD MAN

It was another sunny day in Sweden, it was July and a quiet period, many people were already on vacation. The man was wearing brown trousers and a white shirt. His tie was old-fashioned in a way that almost became modern again - blue with discreet grey stripes. The jacket was well-worn but made him look a respectable man in his best years; although he was well over seventy he looked younger and made a sharp but sometimes dizzy impression. He was driving his light-blue Volvo at a more than modest speed, and he had to admit to himself he was lost. Since he moved a couple of years ago he sometimes got lost, normally he got away with it, but this time it was a bit annoying; he had an appointment for the yearly technical inspection of his car in ten minutes.

THE CONTROLLER

The controller was planning for the weekend ahead. He was also planning a barbeque later the same day. The evenings at this time of the year were nice and warm, not too warm like last summer, just warm enough for a nice evening with a couple of friends. During this time of the year the traffic was real low, it was easy to get carried away in your own thoughts; who would blame you, it was understandable and so far the management had failed to read his mind (for how long, he wondered).

THE FOD INSPECTOR

The vehicle driver was the first person to react. He was checking the taxi-way system for FOD when he saw the Volvo at a slow but steady pace heading for the runway. He managed to make the other car stop and alerted the tower by his radio.

It could never happen to me - could it? This is a true story about an old man who managed to get lost and without intending to, entered a Swedish airport, drove on the airside roads, and finally a taxiway leading to the runway. He was stopped just before the runway threshold, avoiding a runway incursion.

OK - this was probably once in a lifetime; the entrance should have been guarded but one person left it unattended for twenty seconds and just at that time the old man arrived and passed.

THE MORAL OF THE STORY

This story is not about that. It is about how easy it is to miss conflict detection. I know very little about human factors but for me lost conflict detection happens either when you are working hard and just miss one conflicting aircraft or vehicle, or like the example above, when you just relax and do not detect the unexpected. Especially when you have next to zero traffic, let's say one aircraft, it is easy to start doing other things and not focus on your prime area, the traffic. I guess (please correct me if I am wrong) air traffic controllers are recruited to cope with high traffic loads. The problem is that when there is a quite period, well sometimes it is a quite period non-stop. As a controller you want something to do. If the traffic does not keep you busy, it is easy to fill the hole with other activities or thoughts.

This article is intended to raise awareness of the problem, perhaps to start discussion with a wider perspective. If we are aware of the problem, how should we prevent it? I have heard of one centre merging sectors to maintain controller workload at an acceptable level. Should working positions be kept open under all circumstances, or not? Are strict rules the way forward? What to do at smaller airports? How do you detect the onset of a wandering mind in yourself, or your colleagues; and once you become aware of it - what can be done to re-focus on the job at hand. Send your comments and/or suggestions on how to tackle the problem to Tzvetomir.blajev@euro-control.int . The floor is yours...

FRONT LINE REPORT: INTEREST OF CONFLICT

By Bert Ruitenberg

Bert Ruitenberg is a TWR/APP controller, supervisor and ATC safety officer at Schiphol airport, Amsterdam, the Netherlands. He is the Human Factors Specialist for IFATCA and also a consultant to the ICAO Flight Safety and Human Factors Programme.

I don't think there are many professional cyclists in the Tour de France who are interested in reading an article about how to keep your balance when riding a bike. Similarly I doubt that there are many air traffic controllers interested in an article (let alone a whole magazine) about conflict detection. Yet there can be no argument that keeping one's balance while riding a bike is essential, just as detecting conflicts is essential for an air traffic controller. My point is that once you are a professional cyclist you have passed the stage where keeping your balance was the only thing that mattered, and the same goes for the qualified air traffic controller vis-à-vis conflict detection.

By making the above observation, I'm not trying to imply that conflict detection is not important as a subject in the Air Traffic Services (ATS) environment. I just want to make it clear that within that environment the subject may hold more importance for some groups than for others. For qualified air traffic controllers the ability to detect conflicts is a prerequisite, something they can do by definition - otherwise they never would have qualified as controllers. Yet for those groups within ATS that are involved in selection and training, the conflict detection aspect has a quite different significance. They are the people who have to determine how candidates are doing in detecting conflicts, and/or train them how to detect the conflicts in a timely and consistent manner, to the point where it becomes second nature. And of course there is also a group of people who spend their time trying to automate the air traffic control profession as much as possible; to them conflict detection probably is a big issue too (but all I'm going to say to them is: good luck!).

With the production of this issue of HindSight it would appear that the editorial team also qualifies as one of the non-operational groups in ATS to whom conflict detection is a big thing. This is all the more remarkable, given the fact that HindSight is meant "to help operational air traffic controllers to share in the experiences of other controllers who have been involved in ATM-related safety occurrences" - in other words, meant for the one group in ATS to whom conflict detection is NOT a big thing.

I wonder how many ATM-related safety occurrences are out there in which the controller simply failed to detect a conflict. I think very few to zero - but the operative word in the previous sentence is "simply". If a controller is not successful in resolving a conflict in a timely manner, I submit that the reason is rarely a failure of said controller to detect said conflict in the first place. It is more likely that after detecting the conflict the controller got side-tracked by other tasks that required more time to complete than initially estimated by the controller, leaving insufficient time to resolve the identified conflict.

Such other tasks could involve (in random order, and not meant as an exhaustive list): coordination with other sectors or centres, handing off traffic to other controllers, communicating with traffic, retrieving and processing weather information, updating flight progress strips or radar labels, responding to requests from pilots, and last but not least resolving conflicts between other aircraft pairs. Note that those are all considered "routine tasks" in most ATC workplaces; I deliberately left out things like dealing with equipment failures, or responding to aircraft emergencies, which of course also could happen at any time but hopefully less frequently than the other items.

When putting generic labels on the items mentioned above, we're basically talking controller workload, task distribution, and possibly also workplace design, equipment, and (safety-related) working conditions. Now print those phrases on the cover of a publication, and see how many operational controllers will pick it up to read it! All of a sudden we've touched upon issues that are very near and dear to the hearts of most controllers, for these are things controllers have to manage on a day to day basis in order to conduct their work successfully.

The disadvantage I have when writing the text for this column is that I don't know yet what will be the exact con-

tent of the magazine. Therefore I can only hope that the editorial team will succeed in once more putting together a number of articles that are relevant to operational air traffic controllers (i.e. the HindSight target audience), and that their choice of topic for this issue (i.e. conflict detection) is in fact a misnomer for what the articles really are about. Just as the professional cyclists in the Tour de France would be interested to read about (let's say) the contribution of equipment failures to bike crashes, or the effects of prolonged mountain stages over a two-week period without rest days, or successful team strategies during a multi-day cycling event, air traffic controllers will be interested in reading about things that relate to their daily work.

There is no way for an air traffic controller to directly enhance his/her conflict detection abilities. ("In the next half hour I'm going to be extra alert and detect more conflicts!") However, if there are ways to make it easier for controllers to under all circumstances effectively plan and/or manage their workload, or if there are significant improvements underway in equipment and workplace design, we sure would like to hear about it. After all, those things may greatly help us to be able to focus our attention on resolving the many conflicts that we so effortlessly detect.

Bert Ruitenberg

Well, what do you think? Have we touched the right spot for you? Let us know what you think about HindSight, conflict detection or any other safety issue. [Editor]

THE HUMAN FACTOR: CONFLICT DETECTION AND HUMAN-MACHINE COORDINATION

by Professor Sidney Dekker, Ph.D.

Sidney Dekker is Professor of Human Factors & Aviation Safety at Lund University in Sweden. He gained his PhD in Cognitive Systems Engineering at The Ohio State University in the US. His books include "The Field Guide to Human Error Investigations" and "Ten Questions about Human Error".

In our search for ways to improve controller conflict detection, we have often turned to technology. From short-term conflict alerts with relatively simple logic, we have moved to vastly more complex computational algorithms in the application of, for example, medium-term conflict detection tools. These tools introduce new capabilities, but also new complexities. The basic issue with conflict detection tools is a classic one in human factors, and is captured in signal detection theory (SDT). SDT uses two possible states of the world: either a conflict is coming up or it isn't. The conflict detector (either a human or a machine) then makes judgments about the world, based on the data it has available. This may include data from past experience, algorithmic calculations, radar picture, and so forth. But the judgment may be right or wrong. If there is indeed going to be a conflict and the detector says that there is, then SDT calls that a "hit"; if the detector says there is not, then that's called a "miss". If there is not going to be a conflict and the detector says there is, SDT calls that a "false alarm" and a "correct rejection" if the detector also says there is going to be no conflict.

|	Conflict Detector is right, there is going to be a conflict	Conflict Detector is wrong, there is not going to be a conflict
Controller says: "Yes, the Conflict Detector is right"	**HIT**	**FALSE ALARM**
Controller says: "No, the Conflict Detector is wrong"	**MISS**	**CORRECT REJECTION**

So far, so good. Now the power of SDT is that it handles the inherent trade-off in detection tasks so elegantly. It does so by introducing two separate features of the conflict detector (again, either human or machine). Together, these features determine how many of each of those four you are going to get. They are response criterion and sensitivity.

Let's take the response criterion first. This is the threshold that the detector sets, above which he, she or it will say "yes, this is going to be a conflict". You can see it as a matter of data. Some detectors need a lot of data to say "yes, trouble ahead". Others need very little data. SDT says that the latter have a conservative response criterion (they'll have a bunch of false alarms but very few misses). The former have a more risky response criterion (they'll have few false alarms, but they'll miss things too). SDT correctly says that as a detector, you can't win. Wherever you set your response criterion, it's going to cost you somehow (either you miss things, or you'll generate many false alarms). There is of course a good compromise somewhere. This, in SDT language, is about payoffs and probabilities. If the probability that the detector has it right in particular traffic situa-

tions is low (which may be known from previous experience), then the response criterion must be set conservatively. This ensures that nothing will be missed. If the payoff for a hit is very high, the response criterion will be set conservatively too. But if the cost for a false alarm is very high at the same time too, then this puts pressure on the response criterion to be set more risky.

What about sensitivity then? Sensitivity refers to the resolution of the detector. Some are very blunt: they are not very sensitive to subtle, small variations in the data they use for seeing whether it all reaches over the response threshold. Sensitivity is changed by other things than probabilities and payoffs. For a machine detector, sensitivity is baked deeply in the algorithms it uses, or in the kind and amount of data it relies on (which, many engineers will acknowledge, can or should always be more for conflict detection tools than is currently the case). For a human detector, sensitivity can vary with for example daytime: a fatigued detector is not a very sensitive detector anymore (and may therefore want to adjust his or her response criterion accordingly!)
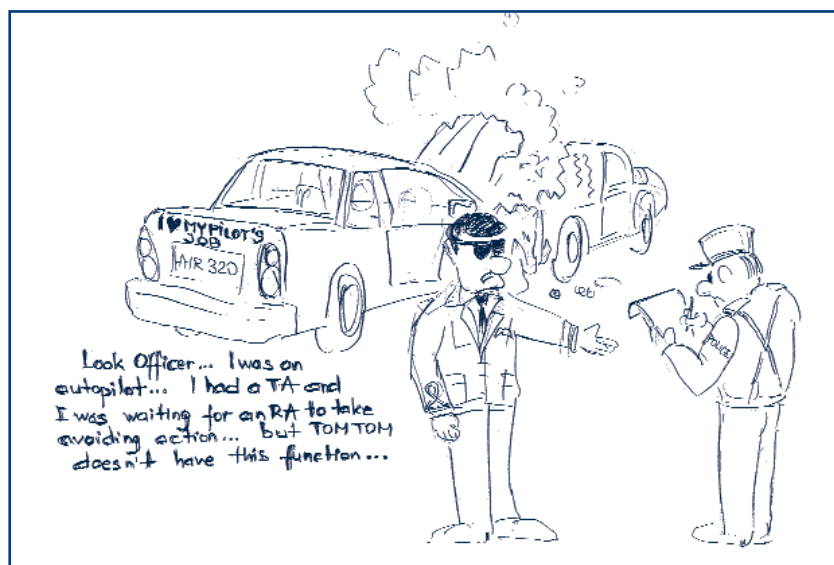
The picture with SDT becomes really
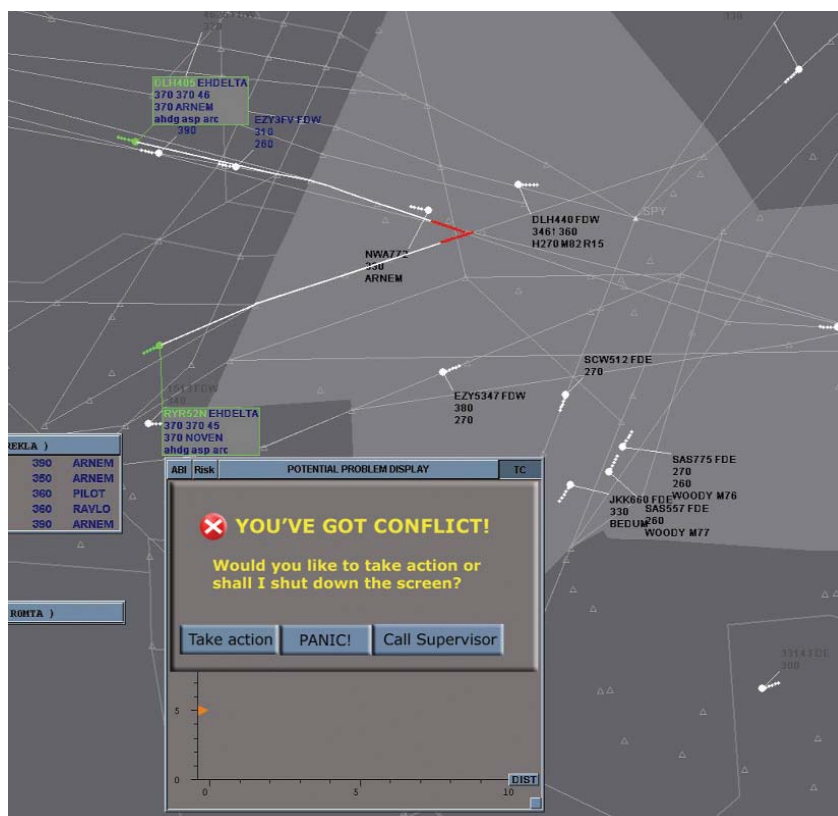
interesting when we set several detectors in series, as with medium term conflict detection (MTCD) systems and a human controller. Then the two features of each will start interacting in interesting ways. Low sensitivity in MTCD, for example, will have to be compensated by a more risky response criterion in the latter (otherwise the joint human-machine system will generate a lot of false alarms). Indeed, in situations where a controller intervenes on the basis of an MTCD alert, then this may generate additional conflict alerts (false alarms, given the context) since the system now no longer can really anticipate the human controller's next steps. This is low sensitivity generated as an unintended by-product from the joint interaction between human and machine-something that is very difficult to engineer around.

Generally though, it is said that MTCD has very high "accuracy"-the joint product of its own sensitivity and response criterion-creating up to 99.9% hits. But that is still one miss per 1000. So controllers are instructed or advised "not to rely on the MTCD". This is problematic for those centres that are stripless, as an MTCD is basically a precondition for making a stripless environment work. How exactly to interpret the injunction not to rely on a tool that you need to do your stripless job, and a tool that you probably come to rely on to some extent anyway, is anybody's guess of course. And the controller's burden to figure out.

But there is another side effect. Larry Hirschorn calls it a fundamental law of systems: each system will naturally be used at its capacity. As soon as some-

Look Officer... I was on autopilot... I had a TA and I was waiting for an RA to take avoiding action... but TOMTOM doesn't have this function...

body has found a new source of slack, the system will gradually use up that slack to produce more. MTCD is a source of new slack. And now it may become a factor in asking the system to produce more. Here's how: if MTCD is so "accurate", then it can also be used as an argument for increasing sector capacity. And it probably has been used for exactly that argument already. After all, with MTCD, the controller doesn't need to primarily detect all oncoming conflicts him- or herself, because of the sophistication of the electronic cocoon now woven around him or her. So then we have a situation where the controller gets more airplanes, because MTCD will help in detecting conflicts in time. Which means the controller will need to rely on MTCD. But the controller cannot rely on MTCD because it's not 100% accurate. That's what the instruction says. This is a fundamental double bind.

Where does that leave us? Perhaps we should consider, just as a little thought experiment, calling MTCD something else. It is not entirely accurate, so con-

trollers "can't rely on it". But then they are sort of expected to rely on it otherwise a stripless system or capacity increase won't work. Also, detecting conflicts for the controller is not necessarily what it is about: recall the complexity that ensues once the controller starts making an intermediate intervention on the basis of one MTCD alert, only to get a bunch of false MTCD alerts in return for his proactive efforts. Perhaps MTCD should be called a form of "attention-getter". It suggests to the controller: "Hey, look here, I believe this is something you'll find interesting, something that you may want to start thinking about". That's the kind of interaction we'd expect with our planning controller, for example. A dialogue. So why not with the machine attention-getter? There is plenty of distance to go to a more humane human-machine future, even in conflict detection.

ACKNOWLEDGMENT

121.5
SAFETY ALERTS

SAFETY REMINDER MESSAGE SUMMARY

WRONG REACTION TO "ADJUST VERTICAL SPEED" RA

Origin: European ANSPs
Issued: 02/06/2006

THE PROBLEM

- There have been repeated instances of pilots incorrectly executing "Adjust Vertical Speed" RAs;

- In some cases, such incorrect reactions have led to the deterioration of spacing between the aircraft.

ABOUT "ADJUST VERTICAL SPEED" RAs

- TCAS II is designed to generate an "Adjust Vertical Speed" RA instead of a stronger "Climb" or "Descend" RA, whenever possible;

- The objective is to solve a predicted risk of collision by a reduction of the current vertical speed, either in climb or in descent, while maximising compatibility with the ATC clearance. The reduction is associated with four different values: 0, 500, 1000 or 2000 fpm;

- RAs could occur when aircraft are in close proximity and the vertical speed of closure exceeds 1500 ft/min;

- This type of RA is mainly issued when an aircraft is climbing or descending to level-off 1000 ft from another aircraft. It reinforces the controller's clearance and helps to ensure successful level-off at the cleared flight level;

- "Adjust Vertical Speed" RAs are the most frequent RAs triggered by TCAS II.

POTENTIAL SOLUTIONS

- It is essential that all RAs are followed accurately.

- Aircraft operators - remind flight crews that:

  - It is necessary to watch the RA display carefully when manoeuvring, bearing in mind that an "Adjust Vertical Speed" RA always requires a reduction of vertical speed;

  - All RAs must be followed accurately, even if there is a discrepancy between the RA and the ATC clearance or instruction.

- ACAS II Bulletin No. 3 provides more information about the correct response to "Adjust Vertical Speed" RAs.

Anyone, wishing to receive hard or soft copies of any or all ACAS II Bulletins and to be put on a mailing list for future bulletins should e-mail their request to the ASU on: acas@eurocontrol.int

SAFETY REMINDER MESSAGE SUMMARY

FURTHER UPDATE ON RECTIFICATION PROGRAMME FOR ROCKWELL COLLINS TPR-901 TRANSPONDER ISSUE (ERRONEOUS '0607' SQUAWK)

Origin: European ANSP and EUROCONTROL - Mode S & ACAS Programme
Issued: 21/06/2006

THE PROBLEM

- A recent incident has highlighted the need for air traffic controllers to remain vigilant to the possible consequences of aircraft transmitting an erroneous Mode A code ('0607'), despite the threat of such occurrences continuing to decrease as more aircraft are modified.

- A conflict between two aircraft was aggravated because one of the aircraft involved transmitted an erroneous Mode A code '0607', with no Mode C information, which caused the ATC Short Term Conflict Alert (STCA) system to become inhibited. The lack of mode C information does not appear to be related to the '0607' problem and is currently under investigation. The conflict was resolved by TCAS.

- This Safety Warning Message updates and reinforces Safety Warning Message "Update on rectification programme for Rockwell Collins TPR-901 transponder issue (erroneous '0607' squawk)" dated 08/03/2006.

TRANSPONDER MODIFICATION PROGRAMME

- The transponder rectification programme managed by Rockwell Collins remains firmly on schedule. On 6th June 2006, it was reported that 41.4% of all transponders involved (1192 of 2876 units) had been modified, and that the rectification programme completion target date remained 21st November 2006.

- The progress of the field modification programme continues to be closely monitored by EASA and the Eurocontrol Mode S & ACAS Programme.

RECOMMENDATIONS FOR AIR TRAFFIC CONTROLLERS

The recommendations for air traffic controllers published in the previous Safety Warning Message on this subject (dated 08/03/2006) remain valid and are reproduced below. It is emphasised, however, that this list of actions is by no means exhaustive and that individual actions may not be appropriate to every ATC environment.

In the event of an aircraft being affected by the erroneous '0607' code issue, controllers are recommended to consider the following:

- thoroughly and systematically check all flight progress displays/strips for possible conflicts prior to issuing instructions;

- if possible, annotate the affected aircraft's flight progress display/strip in some fashion for the duration of time that it is being controlled, to act as an aide memoir and help the conflict checking process;

- assess the potential effect on controller workload and conflict detection in deciding when to split ATC sectors;

- advise subsequent controllers of any persistent observations of the erroneous '0607' code issue involving specific aircraft;

- file an appropriate report should any unusual performance occur.

SAFETY WARNING MESSAGE SUMMARY

ATC LOSS OF TRANSPONDER SIGNAL

*Origin: European ANSP, airline and aircraft manufacturer*
Issued: 29/08/2006

THE PROBLEM

● After experiencing a TCAS fault, with associated drill "TCAS MODE......STBY", the crew of an aircraft set the mode selector switch to STBY on the ATC/TCAS panel. As, on this panel, the STBY position sets both TCAS and ATC transponder to standby, this caused a temporary loss of secondary radar information and obstructed the automatic update of the flight data. On this ATC/TCAS panel, the TCAS mode only is set to standby when the mode selector is on the XPNDR position

● During this time the tower controller tried to contact the ACC/APP centre. Although several attempts were made, the calls were not answered. Unknown to the ACC/APP controller the aircraft was climbing in conflict with another departing aircraft. As the aircraft was not transponding, no TCAS or STCA alerts triggered and the minimum separation reduced to 3.7nm and 0ft.

THE TCAS PANEL

The airline concerned in this event is fitted with the following TCAS panel:
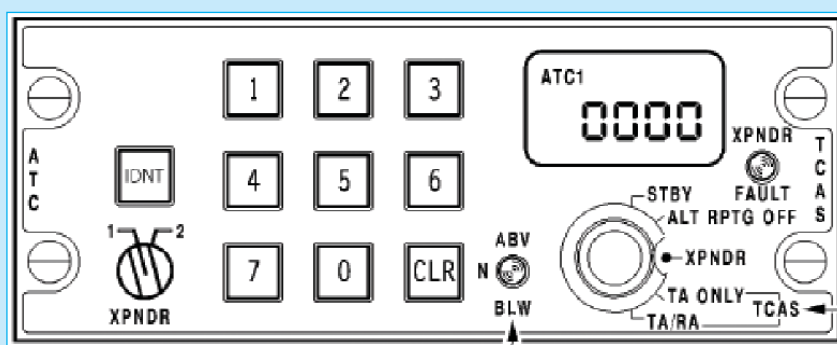
MODE SELECTOR:		
STBY	Sets both the ATC transponder and TCAS on standby.	
XPNDR	- The TCAS is on standby	
	- Aircraft on the ground:	The selected ATC transponder only operates in the selective aircraft interrogation mode of Mode S
	- Aircraft in flight:	The selected ATC transponder operates

ACTION BY AIRCRAFT OPERATOR:

● A crew notice was issued to all fleet pilots pointing out the anomaly and reiterating the correct procedure.

● The incident was featured in the airline Safety Journal for the purposes of lesson learning.

● The airline safety services and fleet technical pilots are reviewing methods to permanently reflect this information in operating manuals.

● The airline has contacted the aircraft manufacturer to determine a way forward.

ACTION BY THE AIRCAFT MANUFACTURER

● The aircraft manufacturer is still investigating this subject. Several technical solutions are under study but their feasibility has still to be validated by the design office.

ACTION BY THE AIR NAVIGATION SERVICE PROVIDER

● Jointly with the airline, the ANSP presented this incident to 100 safety managers at the Flight Safety Committee.

● Priority telephone lines are being installed between the tower and ACC/APP centre.

● The incident was featured in the safety publications.

SAFETY REMINDER MESSAGE SUMMARY

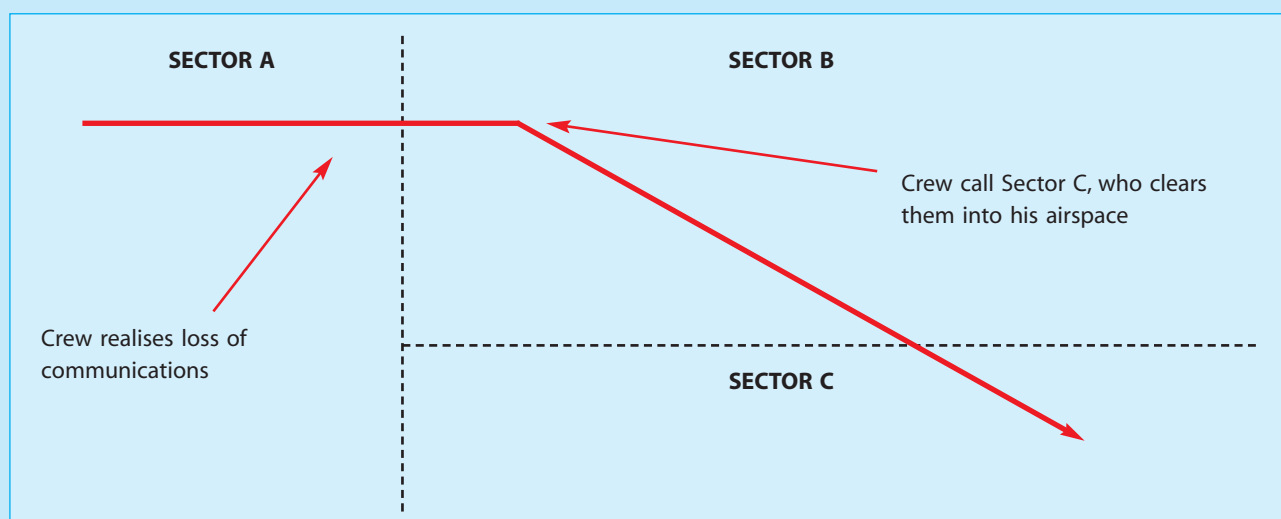## UNABLE TO ESTABLISH RADIO CONTACT

Origin: European ANSP
Issued: 02/10/2006

THE PROBLEM

- Inbound aircraft is instructed by sector A to contact the next sector B.

- Pilot is unable to establish contact with sector B and realises the problem.

- Pilot looks up a frequency for the area he/she is in (on his/her charts), and happens to select the frequency of sector C, adjacent to sector B. Sector C is expecting the aircraft to come to them from sector B after the latter has descended the aircraft to the coordinated level.

- Pilot fails to explain the situation (i.e. lost correct frequency) and doesn't report actual cleared level etc. Sector C assumes the flight was transferred to him by sector B and issues a descent clearance into his airspace.

- Aircraft descends through the traffic of sector B, without any separation assurance from that traffic. Sector B is left trying to second guess what the flight is doing.

- Contributing factors:

  - incomplete initial calls from the aircraft (e.g. only stating the callsign) & not explaining they were unable to establish contact with Sector B;

  - failure of Sector C to recognise the unusually early transfer;

  - failure of Sector B to realise that aircraft is lost and has no time to clear aircraft in its vicinity.

REFERENCES

- Radio communication failure procedures are provided in ICAO Annex 10, Volume II, 5.2.2.7.

- European Action Plan for Air Ground Communications Safety is available on http://www.eurocontrol.int/safety/public/subsite_homepage/homepage.html

SECTOR A   SECTOR B

Crew call Sector C, who clears them into his airspace

Crew realises loss of communications

SECTOR C

CONFLICT DETECTION ERROR – SEEN BUT NOT PERCEIVED!

By Markus Wassmer

Markus Wassmer is a controller in Langen ACC, Germany. He works half of his time in the Safety Monitoring and Improvement Division of the DFS Corporate Safety & Security Management Directorate.

Constant situational awareness is crucial to air traffic controllers in order to handle traffic without any conflicts. An error occurring in the traffic situation can easily have a dangerous outcome. Radar is undoubtedly the key technical tool to providing a complete picture of the traffic situation. The primary task of the radar or executive controller is to continuously monitor traffic and thus maintain complete situational awareness using radar. It is no surprise then that the origin of infringements of separation minima can often be found here. This article provides an insight into conflict detection errors.

There are various reasons for overlooked or delayed conflict detection in air traffic control. Often controllers fail to detect potential conflicts during periods of low traffic volumes as they may be easily distracted in such a situation. Problems are known to occur when controllers have to handle a small workload - particularly after a traffic peak. But the other side of the coin is that stressful situations can, of course, trigger tunnel vision in controllers who then overlook traffic relevant to their sector. In the following example, an aircraft is cleared to descend through the altitude of an oncoming aircraft, even though the latter aircraft could be clearly identified on the radar screen. So, what went wrong?

In the ACC sector, two aircraft on the same routing were flying close together, but vertically separated, at altitudes FL240 (flight A) and FL220 (flight B). The standard procedure is to hand these flights over to the adjacent sector at FL150 and FL160. The overall traffic situation at that point was very demanding. The controller later described the traffic volume as high and complex. At the time of the conflict, nine aircraft were on the frequency, some of which were moving vertically in the sector. The sector capacity value in this hour was almost reached but not exceeded. A further control problem had to be solved in another area of the sector. The weather conditions were good and did not impair the flow of traffic. Generally speaking, high demands were placed on the controller's attention, but the workload was not too high.

A crossing aircraft (flight C) at FL170 was relevant to the descent of flights A and B. Furthermore, a departing aircraft from the nearby airport (flight D) climbing to FL210 also represented oncoming traffic for flights A and B. Flight D had originally been cleared to FL230 by the controller, i.e. the requested flight level for this flight according to the flight progress strip. However, the crew changed its request to FL210 while still climbing - a short time before the conflict occurred. Flight D reached and maintained this flight level at approximately 15 NM opposite flights A and B.

The controller was under pressure to have both flight A and flight B descend to the coordinated lower flight levels on time before handing them over to the next sector. This explains why flight B was instructed to descend from its current flight level FL220 to FL180. The controller took the crossing flight C at FL170 into consideration, but not the oncoming flight D at FL210, which at this stage was approximately 10 NM opposite.

The controller reported having a mental picture of the flight at FL230, i.e. the flight level that had been originally planned. This was probably because the pilot had originally been instructed to climb to FL230 and had confirmed this instruction. The controller had lost awareness of the change to FL210. It was no longer perceived by the controller, despite being clearly visible on the radar screen.

It is true that the daily work of controllers involves picturing a two-dimensional radar screen - with flight levels and speeds depicted as numbers on all radar labels - in three dimensions, but this nevertheless poses a special challenge for our spatial visualisation. Thus, this skill is an important criterion in the aptitude tests for air traffic controllers. However, controllers often overlook information on the radar screen, such as altitudes, speeds or even the complete label of a radar target.

Analysis of incidents like this is important to aid understanding of error, error trends, development of error avoidance techniques, and assessment of techniques, and assessment of these results. The Human Error in ATM (HERA) method* developed by EUROCONTROL is a standard method of categorising human error based on interviews with controllers. Use of the HERA taxonomy ensures that similar incidents are always categorised in the same way.

The case in question is in fact a typical example of many other cases. After interviewing controllers according to the HERA method, it is common to find that there was an error detail "perception and vigilance", an error mechanism "no detection of visual information" or an information processing "tunnelling of information". In our example, however, the changed flight level of flight D also played a part. According to HERA, this may be an error detail "working memory", an error mechanism "forget previous action" and an information processing "preoccupation".

Categorisation is important, but we cannot ignore the fact that human error is a normal characteristic that will surface time and time again. It would be foolish to believe that people could ever shake off this characteristic. So this is where the really difficult part of the investigation begins. According to Sydney Dekker, Professor of Human Factors and Flight Safety and Director of Research at the School of Aviation at Lund University in Sweden, this concession is the root of investigations into what went wrong: the starting point

and not the end.

The Causal Factor Analyses Group (CAFA), a common working group of the EUROCONTROL Safety Improvement Sub-Group (SISG) and the HERA Users Group, addressed the issue of conflict detection error. Yet no common denominators were discovered during the investigation into the conditions surrounding comparable cases. It appears safe to say that conflict detection error cannot be correlated to the experience or age of the controller. Nor is it related to the length of time spent by the controller at the working position, the length of absence from duty or the type of shift.
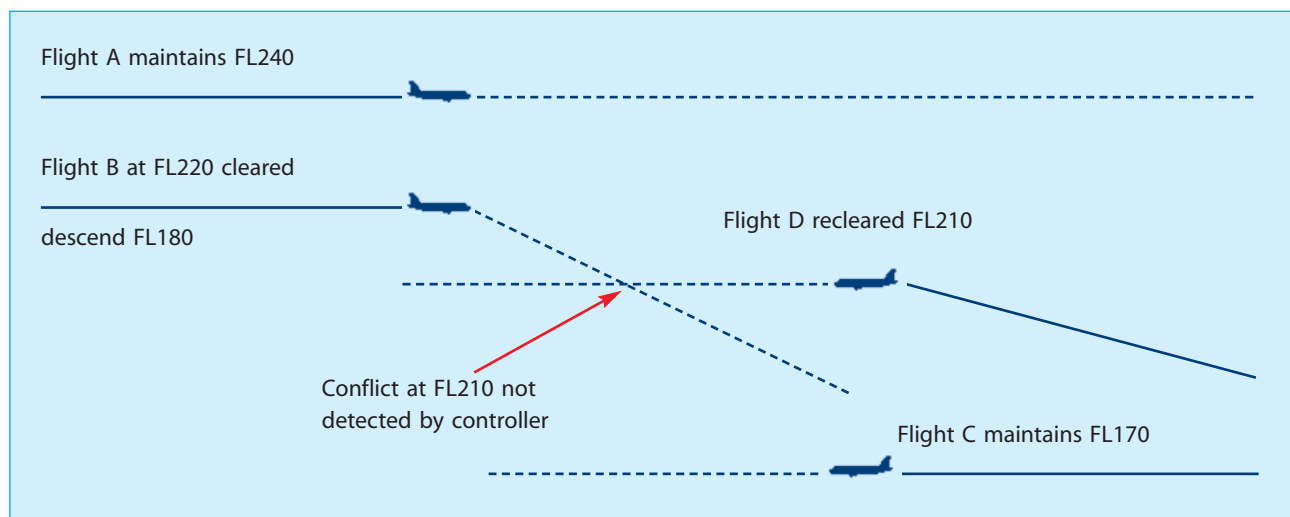
In our experience, conflict detection error occurs more frequently in ACC and UAC sectors than in APP or TWR. But, of course, conflict detection in TWR and at radar working positions cannot be directly compared. Based on past experience, it can be said that this human error is more likely to occur in situations where the controller is under- or over-challenged. The number of such errors could be reduced if the

controller handles 30%-70% of the maximum workload and works a restricted amount of time in front of the screen, depending on how stressful the traffic situation is. Preventing noise and other disturbances certainly also has a positive effect.

Enhancing our awareness of our own human weakness may also help us to identify potential for errors. Research in this field and the quest for solutions has only just begun. Although human factors findings are taken into account in technical systems, for example in terms of design and the human-machine interface, future air traffic control systems with their state-of-the-art functions should support us humans in detecting conflicts and preventing errors.

*For more information concerning the HERA method see the EUROCONTROL Human Factors web-site:
http://www.eurocontrol.int/humanfactors/public/standard_page/humanfactors.html

Flight A maintains FL240

Flight B at FL220 cleared

descend FL180

Flight D recleared FL210

Conflict at FL210 not
detected by controller

Flight C maintains FL170

ECONOMY VERSUS SAFETY – THE PROFESSIONAL'S DILEMMA

By Captain Tom Becker

Tom Becker is an active airline captain, flying mainly in European & African skies.

Working in aviation means teamwork. We, the pilots and you, the ATCOs are all part of this team, even though we are not physically in the same place. It is therefore important that we all have the same mental model of a situation all the time.

I would like to draw your attention to a particular flight hazard - one which you as an ATCO can help to prevent, thus making an important contribution to safety. I'm referring to **Un-stabilized Approaches**, which often lead to Approach and Landing Accidents (like CFIT or runway overruns or short-comes).

I want to look at safety versus economic interests - or human & aircraft performance restrictions versus flow management; this usually concerns speed restrictions on the approach. Specifically, the often-heard clearance during the approach, "maintain 170/180kt to the outer marker," or "maintain high speed during the approach".

I guess you know that Approach and Landing Accidents (ALAs) are still one of the top killers in aviation. The Flight Safety Foundation has worked hard in this field for many years with the very positive result of creating safety gates to prevent ALAs. The one which has the greatest influence on our flight decks is the Stabilized Approach Concept*.

Put simply, this means that every flight MUST be stabilized on approach not later than 1000' AGL. It is not meant as a goal - it is a hard limit!

With a jet like the common B737 it requires you to start further configuring the aircraft from the intermediate flap setting no later than 2000' AGL, which means around 7NM on finals - and, depending on actual weather and the environmental situation, further speed reduction may be necessary.

Now, here comes the practical side and your influence: You are well aware that the outer marker or equivalent fix is usually located around 5 NM from the threshold, which in a pilot's terms means around 1500' AGL. This means that if you ask us to "maintain 170/180 to the marker", we cannot do it without rushing our work, and thus producing unnecessary risks for our flight.

Additional risks? - You might ask, "why?" Remember that most accidents in aviation occur in normal operation, not in non-normal situations such as an aircraft system failure; and it is always the human factor which has the greatest influence in an accident - either in causing or preventing it. Therefore it is recommended that we stick to the 1000' Gate in VMC conditions, too, even

though the FSF say that a 500' AGL gate is OK in VMC Conditions.

But of course you cannot see this human factor aspect inside the cockpit from your working place - nor can I see yours. So I'll try to help you understand our needs on the flight deck in the hope that as a result you will not issue such clearances - or only with reluctance - in the future.

Our Stabilized Approach Concept does not only mean that the aircraft must be stabilized on finals at the correct speed and configuration; just as importantly, the flight crew themselves must also be mentally stabilized.

In ideal conditions (standard ILS approach in daylight/CAVOK without adverse wind conditions, landing on a dry runway without any special considerations and an alert crew working well together) it is manageable to fly at 170/180kt to the marker and complete the remaining cockpit activities (switch and lever settings, speed reduction, RT and checks) during the ~30 seconds remaining before the 1000' gate.

In a B737 you must start lowering the gear at 2000' AGL (~7NM finals) and configure your flaps further to one step before final landing flaps so that you can maintain this high speed on approach with high power set. Although this is not good for noise abatement, nor for fuel consumption, this is the only safe way of achieving your set goal of maintaining high speed to the marker and being fully stabilized by 1000' AGL.

But as you know, everyday operations are not always conducted in ideal con-

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* Flight Safety Foundation Approach and Landing Accident Reduction Tool - see www.flightsafety.org/home.html

ditions. I'd like to explain to you the risks resulting from some commonly encountered cockpit conditions, which do not allow the procedure described above, but require a very much earlier stabilization on final approach.

1. FLYING A NON-PRECISION APPROACH

Unfortunately there are still non-precision approaches at some airfields, although this type of approach increases the risk of an accident by a factor of five.

Of course it is quite true that every pilot should be able to fly such an approach. But a non-precision approach cannot be treated in the same way as a standard ILS approach. It should be treated as an abnormal procedure which requires a lot more

situational awareness and working effort than a precision approach.

Once again it is the human factor that makes flying a non-precision approach critical.

On most airliners a pilot can use the autopilot to help him with such things as tracking. If you are lucky you can also use a lateral navigation mode, which enables the computer to fly the approach track without further attention from the flight crew. Otherwise you must constantly readjust the heading to keep on the final approach track. This is not a big thing in itself, but together with descending along the prescribed glide path it is much more stressful, especially if you do not start the approach in the final configuration and speed due to a requirement to maintain high speed as long as practicable.

In this case, you will have to counteract for ballooning during flap extension and vertical speed adjustment due to speed change. All this, together with bad weather and maybe manual flying, can turn an "easy" non-precision approach into a flight hazard. One unfortunate example in European airspace was the accident of a Crossair Jumbolino in ZRH in 2001.

Therefore, when using any kind of non-precision approach, please calculate your approach sequence so that every flight crew can start the approach in final configuration at the final approach speed.

Please do not ask us to "maintain high speed as long as practicable", either. There might be colleagues in the cockpit who want to help you with your flow management, but overestimate
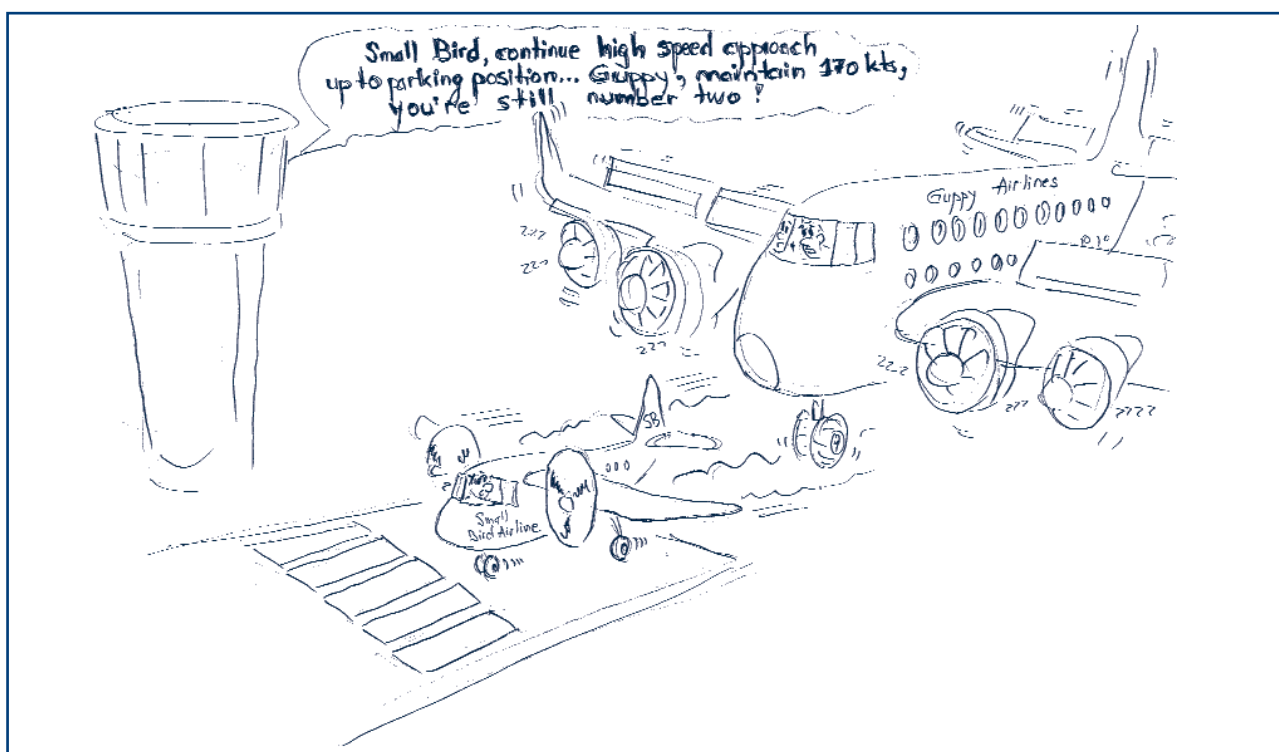
their own crew performance and thus increase the risk of an unstable approach for themselves, resulting in a higher risk of an approach and landing accident.

2. VMC VERSUS IMC AND DAYLIGHT VERSUS NIGHT

Basically, on an instrument approach there is not much difference between flying in VMC and IMC, in daylight or at night. But in IMC there are some more considerations of situational awareness - such as icing, or weather assessment in the go-around area - that the flight crew has to deal with. For a good assessment you need mental capacity and time. If you have to rush your landing items because you are flying 170/180 to the marker you might not have this mental capacity when you need it. Night time itself always brings the risk of fatigue, which can diminish your mental capacity dramatically too.

3. TAILWIND & CROSSWIND

Often the wind aloft on final approach is not the same as on the runway. Therefore as a pilot you have to deal with a changing wind situation on the final approach which can also lead to windshear conditions. If, for example you encounter a negative windshear, you will have to react quickly by adding more power to regain speed. But if your throttles are at idle due to the fact that you are reducing speed, e.g. when configuring after passing the outer marker, the engines need time to spool up - time you may not have when encountering windshear. As you also know, thunderstorms, even when not on the final approach path but in the vicinity, or orographic causes may

generate dangerous windshear potential. Early establishment in the final configuration and speed is the best countermeasure against these threats.

A tailwind component on finals may also make it very hard to lose speed, depending on your aircraft type and weight. It's as if somebody is pushing you from behind while you are trying to brake and bleed off speed. Although we have speed brakes installed, their effectiveness varies a lot between airplane types (e.g. on a B737 they are not nearly as effective as on an A310).

A tailwind on finals will also increase the required landing distance, especially on a wet runway. This might not be a problem on a long runway (e.g. >3000m) but on shorter runways it can be a big problem. This is because even if you touch down in the touchdown zone (TDZ) correctly, most of your braking will be on a slippery surface due to rubber debris from other aircraft in the TDZ, and most importantly, in the TDZ at the far end, which you will enter on a short runway.

In winter operations the runway can be extra slippery because of de-icing fluid, which is washed off our wings while departing at a speed of ~80 kt. So a tailwind on landing has to be avoided and a flight crew has to assess the situation and be able to discuss it in the crew in time during the final approach. You therefore once again need mental capacity and time, which you can only have if you are established early enough.

4. GUSTS

You will be aware that our Target

Approach Speed - the final approach speed - depends upon the wind you give us with the landing clearance. We take our so-called Vref (value depends on weight and selected flap setting) as the basis and we have to add an increment, depending on the wind. For example, a steady headwind component (HWC) of 16 kt requires us to add half, i.e. 8 kt. If the wind information you provide is, e.g. HWC 16kt gusts 28, we have to take half of the steady wind (8kt) and add all the gusts (28-16=12 kt), which means altogether, 20kt added. On a B737-800 with a typical landing weight of ~63 tonnes, this means a speed of 163kt. Seems to be easy to calculate, but when flying in gusty weather conditions, manually and while doing checklist items, distracted by auto call-outs it can be nearly impossible. Tunnel vision and loss of situational awareness is often observed in our cockpits.

5. COCKPIT ATMOSPHERE AND FATIGUE

The working atmosphere in the cockpit is a factor that you as an ATCO really cannot assess. Although the voice you hear sounds positive, alert and competent it might not reflect the actual feeling on the flight deck. Unfortunately, problems of hierarchy and a poor working atmosphere - or even one that is too good - are still observed on our flight decks. This alone, or coupled with factors like illness or fatigue, increases the risk of errors which will not be detected and caught. Analysis of Approach and Landing Accidents showed that in many cases, necessary callouts for deviations and the necessary call for a go-around when becoming unstabilized were omitted due to

bad CRM-behaviour and absence of teamwork on the flight deck.

Fatigue or illness itself reduces human performance immensely. In particular, it has been found that fatigue can reduce situational awareness. As it makes sense economically to keep our aircraft flying round the clock, we on the flight deck have to cope with the effects of fatigue. Although "napping" is usually possible on the flight deck during the cruise, it cannot compensate for a duty time of 12 hours or more, or a very early start in the night when you have to carry out an approach to a congested airport in unfavourable weather conditions. Therefore fatigue itself requires everyone to work as close to the safest standard as possible, requiring an early stabilization on approach, too.

Lastly, I have two options when you issue me with a clearance requesting high speed on the approach. Either:

1. I acknowledge your request by saying, "WILCO", and comply with it, or,

2. I say, "Sorry, unable due to flight safety," and start to stabilize my approach.

As a preventer of accidents and incidents, what would be your choice based on the information above?

Daily operation and our subjective feelings concerning the demands of our management may generate an atmosphere of time pressure for both of us. But as you might know, in the end it is always you, or me, or my colleagues in the cockpit who are the last line of defence to prevent a situation from becoming an incident or even an accident - not your CEO or mine. Our management will always say that flight safety is the paramount goal and not on-time performance or perfect flow management. Let's work this out together and try to avoid high speed approach clearances whenever we can.

Thank you for your help and for reading this article.

### RECOMMENDED ELEMENTS OF A STABILIZED APPROACH

All flights must be stabilized by 1000 feet above airport elevation in IMC and 500 feet above airport elevation in VMC. An approach is stabilized when all of the following criteria are met:

1. The aircraft is on the correct flight path;
2. Only small changes in heading/pitch are necessary to maintain the correct flight path;
3. The airspeed is not more than VREF + 20 kts indicated speed and not less than VREF;
4. The aircraft is in the correct landing configuration;
5. Sink rate is no greater than 1000 feet/minute; if an approach requires a sink rate greater than 1000 feet/minute a special briefing should be conducted;
6. Power setting is appropriate for the aircraft configuration and is not below the minimum power for the approach as defined by the operating manual;
7. All briefings and checklists have been conducted;
8. Specific types of approach are stabilized if they also fulfil the following: ILS approaches must be flown within one dot of the glideslope and localizer; a Category II or III approach must be flown within the expanded localizer band; during a circling, approach wings should be level on final when the aircraft reaches 300 feet above airport elevation; and,
9. Unique approach conditions or abnormal conditions requiring a deviation from the above elements of a stabilized approach require a special briefing.

An approach that becomes unstabilized below 1000 feet above airport elevation in IMC or 500 feet above airport elevation in VMC requires an immediate go-around.

Source: Flight Safety Foundation Approach and Landing Accident Reduction (ALAR) Task Force
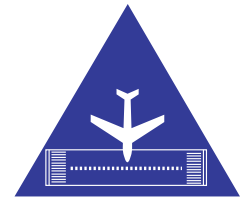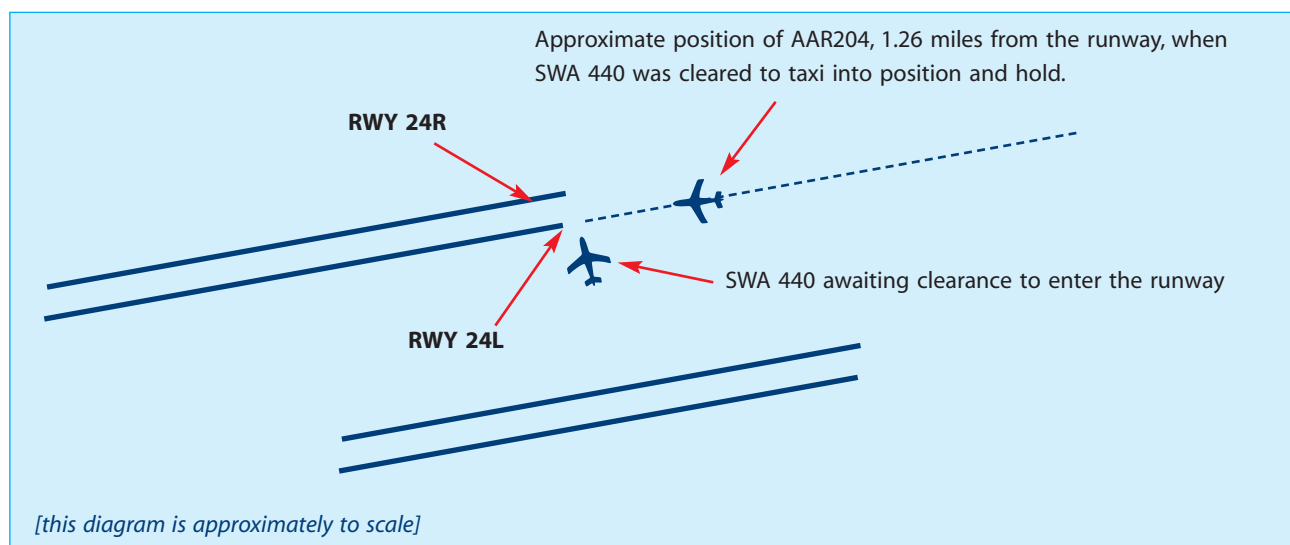
NEAR-COLLISION AT LOS ANGELES

Asiana Airlines AAR204, a Boeing 747-400 that had been cleared to land on runway 24L [at Los Angeles International Airport (LAX)], initiated a go-around and overflew Southwest Airlines flight SWA440, a Boeing 737 which had been cleared into position and hold for takeoff on runway 24L. Radar reconstruction of the event found that AAR204 passed over SWA440 at 200 feet during the go-around. At the time of the incident, a controller change for the LC2 position had just occurred and the relief controller was responsible for the air traffic control handling of both AAR204 and SWA440.

At 2151:21, the LC2 controller who was being relieved cleared flight 204 to land runway 24L. At this point, the Boeing 747 was 9.3 miles from the runway. About 2 minutes later, while AAR204 proceeded inbound on the approach, the LC2 controller provided a relief briefing to the LC2 relief controller and advised him that AAR204 was landing on runway 24L, which the relief controller acknowledged. After

assuming responsibility for the position, the first transmission from the LC2 relief controller was to SWA440, instructing the flight crew to taxi into position and hold on runway 24L. AAR204 was 1.81 miles from the runway at 700 feet. According to the SWA440 captain's statement, he saw the Asiana Boeing 747 on final approach but believed that the aircraft was landing on runway 24R. Twelve seconds later, the relief controller cleared SWA440 for takeoff. Radar data indicated AAR204 was 1.26 miles from the runway and about 35 seconds from reaching the landing threshold. Data retrieved from the SWA440's flight data recorder indicated the airplane was on taxiway V approaching runway 24L when given the takeoff clearance. This meant that the flight crew had less than 35 seconds to taxi on to runway 24L, begin a departure roll, and travel 6,000 feet before AAR204 crossed the landing threshold, which would be impossible. According to the Asiana captain's statement, he observed the Southwest Boeing 737 approaching runway 24L but believed the airplane

would hold short of the runway. Once he realised the aircraft was entering the runway, he initiated a go-around and estimated it was about the time his airplane was passing through 400 feet approaching the runway.

The relief controller said that contrary to the recorded relief briefing where he clearly acknowledged that AAR204 was cleared for the left runway, he fully believed AAR204 was landing runway 24R, and was therefore unaware of the conflict. He first became aware of the problem when the Airport Movement Area Safety System (AMASS) generated an alarm. At this point, AAR440 was only about 12 seconds from colliding with SWA440. Without the prompt action of the Asiana flight crew a collision would in all likelihood have occurred. When the relief controller recognized the problem, he cancelled SWA440's takeoff clearance and AAR204's landing clearance. However, AAR204 had already overflown SWA440 on the go-around, clearing the aircraft by about 200 feet. Although the relief controller believed AAR204 was

Approximate position of AAR204, 1.26 miles from the runway, when SWA 440 was cleared to taxi into position and hold.

RWY 24R

SWA 440 awaiting clearance to enter the runway

RWY 24L

[this diagram is approximately to scale]

landing runway 24R, this did not alleviate his responsibility to properly monitor the operation and ensure separation was maintained.

Recorded voice communications of the position relief briefing indicated the LC2 controller informed the relief controller that the inboard runway (RWY 24L) was in use for landings, and that AAR204 was cleared to land on runway 24L. There was no indication from the relief controller that he did not understand or needed clarification from the relieving controller. The LC2 controller addressed all major areas on the LAX position relief checklist, and conveyed information accurately during the position relief briefing. About 30 seconds after the LC2 controller completed the briefing, he remembered additional information about helicopter operations and began relating that to the relief controller; however, this conversation was interrupted by another radio transmission, which effectively distracted both the LC2 controller and relief controller and probably exacerbated the difficulty the relief controller had in converting the briefing information in his short term memory to working memory. Immediately following the relief briefing, the LC2 controller left the position.

Based on what is known about the volatility of information held in short term memory, and the speed of decay in short term memory without rehearsal of the information, it is not surprising that the relief controller failed to recall every detail of the LC2 controller's position relief briefing with complete accuracy. The relief controller was briefed on the location and clearances for seven aircraft (seven pieces of information is about the limit that can be effectively retained in short term memory), but was not given sufficient opportunity to rehearse this information in working memory until 13 seconds after the briefing was completed. The format and timing of the position relief briefing and its interruption by routine radio transmissions contributed to the relief controller's memory error.

LAX tower controllers interviewed during the investigation stated that, because of the location of the tower, it was difficult to determine visually whether a single approaching aircraft was lined up for runway 24R or runway 24L. Controllers stated that destination runways were most difficult to determine visually for large aircraft, such as the Boeing 747. The LC2 relief controller believed this was the reason he did not recognize the conflict between AAR204 and SWA440. Although this may be true, it does not alleviate the controller of his responsibility to monitor the operation. In addition, the relief controller was aware the inboard runways were in use for landings and should have been alert to the possibility of aircraft arriving on runway 24L.

To assist the controllers with visual observations, the LAX tower is equipped with Digital Bright Radar Indicator Terminal Equipment (DBRITE) displays. The relief controller stated that he saw AAR204's radar target on the DBRITE display during the position relief briefing, but that he did not specifically recall seeing AAR204's data block. A review of the radar replay indicated AAR204's data block displayed two sets of alternating aircraft information: runway assignment and aircraft type were presented for 5 seconds; followed by a 15-second presentation of altitude and ground speed data. The relief controller stated that he glanced at his DBRITE display before the runway incursion. However, he clearly did not perceive the critical information that AAR204 was assigned to land on runway 24L, and he therefore did not take action to eliminate the conflict. Time-sharing of runway assignment information on the aircraft data tag increased the likelihood that critical information would not be perceived when parallel approaches were being conducted on the north side of the LAX tower.

LAX is equipped with Airport Movement Area Safety System (AMASS), which is a computer software enhancement to the airport surface detection equipment. The LAX AMASS at the LC2 position generated an aural and visual alert only 12 seconds before a collision would have occurred, warning the controller of the impeding conflict; however, the flight crew of AAR204 had observed the Southwest Boeing 737 taxing towards the runway and, believing the aircraft was not going to stop, initiated a go-around before the AMASS alert activated. A collision was avoided, not by AMASS, but by the actions of the flight crew of AAR204.

At the time of the incursion, five certified professional controllers and one operations supervisor were working in the tower cab. According to facility personnel, there would normally be 10 people available to work on this shift but injuries and illness had reduced the available shift staff to five. It is common for ATC to combine positions to accom-

modate facility and/or operational needs. Controllers routinely work combined positions and are specifically trained to do so. However, in this situation, the absence of a local assist controller eliminated an additional safety net established to assist local controllers. The staffing decisions made by the Federal Aviation Administration supervisor on duty at the time of the incursion decreased the likelihood that the relief controller's error would be detected and corrected prior to the runway incursion.

In its evaluation of fatigue, the investigation determined that the relief controller had only 8 hours off between the end of his August 18 evening shift at 2330, and the beginning of his morning shift at 0730 on the day of the incident. As a result, the relief controller reported sleeping just "5 or 6 hours" the night before the incursion, and described his shift leading up to the incursion as a "hard day." This acute sleep loss resulted in a slight decrease in cognitive performance on tasks involving working memory and reaction time.

The National Transportation Safety Board determines the probable cause(s) of this incident as follows:

a loss of separation between Southwest flight 440 and Asiana flight 204 due to the LC2 relief controller's failure to appropriately monitor the operation and recognize a developing traffic conflict. Contributing factors included the FAA's position-relief briefing procedures, the formatting of the DBRITE radar displays in the LAX tower, controller fatigue, and the tower supervisor's staffing decisions on the day of the incident.

The full narrative of the NTSB report may be viewed at www.ntsb.gov/ntsb/brief2.asp?ev_id=20040830X01323&ntsbno=LAX04IA302&akey=1
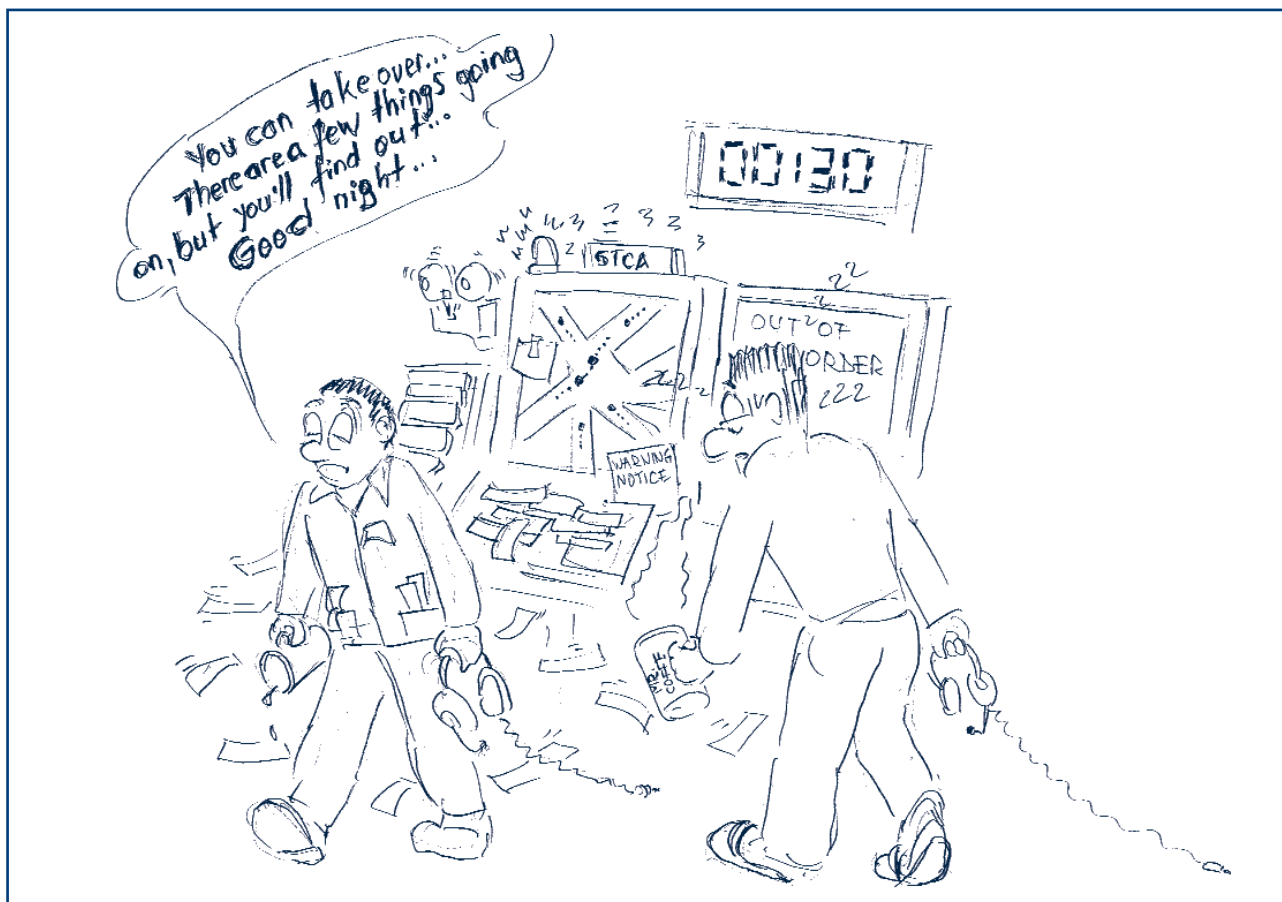
LESSONS LEARNED

The following recommendations are taken from Safety Reminder Message - HAND-OVER/ TAKE-OVER OF OPERATIONAL POSITIONS distributed by EUROCONTROL on 15/10/2004 which may be viewed at :
www.eurocontrol.int/safety/public/standard_page/safety_alert_board.html

Before hand-over:

- A hand-over produces a workload of its own. Careful consideration should be given to the timing;

- If it is likely that the sector will be split shortly after the hand-over - consider splitting it before the hand-over;

- Simultaneous take-over of all the sector positions (for example both radar and planner) should be avoided;

- Do not short cut the existing good practice during low vigilance periods;

- The handing-over controller should tidy up the working position prior to the hand-over;

- A hand-over should be commenced only after all the initiated actions for resolving the potential conflicts or recovering from actual conflicts are accomplished

During hand-over:

- Avoid distracting controllers during hand-over;

- Use checklists with the sequence of actions to be performed by both handing-over and taking-over controllers;

- The taking-over controller should ensure that he/she has been able to assimilate all information relevant to a safe hand-over and should accept responsibility only after he/she is completely satisfied that he/she has a total awareness of the situation;

- Use mnemonic reminders within the checklist like "check REST before going to rest". (See table below.)

After a hand-over:

- It is specifically important that the handing-over controller should remain available for a few minutes following the hand-over, particularly in dynamic traffic situations, to provide clarification/assistance on any points which may subsequently arise;

- Other controllers on the sector should impart additional information only after a hand-over has been completed.

R	Restrictions	Examples: flow restrictions, TSA, danger, prohibited and other special status airspace.
E	Equipment	Examples: status, maintenance, ground-ground communications, air-ground communications, navigation, surveillance, radar filters, radar source, type of surveillance, source integration if multiple, strip printers, workstations, information systems.
S	Situation	Examples: weather (fog, snow, hail, visibility, low/high pressure, CB, turbulence, CAT, winds etc.), staffing, configurations (sectors, runways, taxiways, adjacent sectors etc.), strips, holding.
T	Traffic	Examples: all under control, expected, military, VIP, aerial activity, non compliant with ATM regulations (RVSM, RNAV, 8.33, ACAS etc.), VFR flights, clearances and instructions given.

Please, note that there is an important logic behind the REST sequence, building consecutively the situational awareness for (1) environment framework (2) environment of operations (3) operations.

LOSS OF SEPARATION - A LESSON FOR THE INSTRUCTOR

An air traffic control officer (ATCO) was on duty at the combined tower/approach control at a European airport. With him in the control room were two air traffic control students who were receiving on-the-job training. Neither of them was qualified to act as ATCO, in fact their procedural approach control training was not scheduled to commence for another two months. However, one of the students had handled radio communications at the same ATCO's workstation the night before and the other student was now invited to do the same. She took a seat at the ATCO's work station and he moved off some 2-3 metres away.

At that time, daylight conditions prevailed and the visibility was good. The traffic consisted of VFR flights in the terminal area. The student had practiced handling this kind of traffic in the simulator and she dealt with the radio communications, annotated the flight strips and took care of the Air Navigation Services system. She worked well.

The ATCO took care of the telephones. He could hear the radio communications from the air traffic control loudspeakers and gave ATC clearances which the student forwarded to the aircraft by radio. However, there was no monitoring and override system for supervision of radio communications as required by the national authority in training situations.

After a while the traffic changed to IFR flights; there were three departing and one arriving aircraft. The student realised that she was not qualified to handle IFR traffic and asked for help from the ATCO, who let her remain at the workstation while he dictated the clearances to be forwarded to the aircraft. Due to the ATCO's location and distance he could not follow the student's annotations on strips or see the radar monitor display. The ATCO dictated the clearances based on the radio traffic from the loudspeakers and on his own memory.

The first aircraft to depart was a light aircraft. The ATCO dictated the route clearance, which the student at the workstation forwarded to the aircraft. Next a commercial turboprop, Turbo 109, requested start-up clearance. The aircraft was taxiing when the student passed the ATCO's route clearance - to point X-RAY at FL80. The crew read back the clearance correctly. Then a regional jet, Regional 443, received start-up clearance and the student forwarded the departure clearance and dealt competently with a query from the first officer.

The first inbound aircraft was another regional jet, Regional 505, approaching the airfield via point X-RAY. The student forwarded "Regional 505 cleared to Point X-RAY, expect approach runway 08, no delay, continue descent to 3200feet." The first officer read back the clearance correctly. The student then reported: "New QNH 1011," which was acknowledged by the aircraft.

Regional 505 descended towards the airfield with a clearance to 3200 ft. Turbo 109 climbed in the opposite direction cleared to FL 80. The crew of 505 noticed conflicting traffic on their TCAS and requested: "Tower, 505, we have an aircraft in front, on the TCAS, 1400 below, climbing, where is it going?" The ATCO replied: "Regional 44 ... correction Regional 505, did you ask about TCAS or what?" (At this point the ATCO moved to the work station and took over control). 505 replied: "Yes, it is about 10 miles in front of us, opposite, less than a thousand feet and climbing". Then a few seconds later: "Now maintaining." The ATCO replied: "Yes, wait a minute" then: "Maintain that level 90." 505 replied: "Climbing back to 90, 505, we have 86 now." The distance between the two aircraft decreased to about six nautical miles during this conversation. The minimum vertical distance between the aircraft was about 500 ft (150 m).

Communication between ATC and the two regional jets was carried out in the national language, which the crew of Turbo 109 did not understand. Therefore, they did not understand the clearance given to Regional 505 either, or their report concerning TCAS. According to the commander they too observed the opposite aircraft on their TCAS display but did not receive any TA and maintained the cleared level of FL 80.

Of course this couldn't happen to you ... and it shouldn't happen to anyone - but it did. No harm was done: there was no danger of collision because of the vigilance of the pilots. The incident was investigated by the national authority and you can bet there were some important changes made in that control room. Changes concerning:

☑ Ensuring that duties are carried out and supervised in accordance with given instructions, with special attention being paid to operational safety.

☑ The type and location of equipment within the control room to assist effective monitoring of training.

☑ The preparation of proper on-the-job training programmes and instructions which detail the responsibilities of the instructor and students.

☑ The appointment of on-the-job training instructors in accordance with national regulations.

Are all your ticks in the right boxes?

LESSONS LEARNED

The following recommendations are taken from Safety Reminder Message - SAFETY OCCURRENCES DURING ON-THE-JOB TRAINING (OJT), distributed by EUROCONTROL on 20/9/2005 which may be viewed at www.eurocontrol.int/safety/public/standard_page/safety_alert_board.html

● The OJT instructor is responsible for the safety of the ATC service being provided under supervision. Therefore consider:

- identifying needs for and implementing improvements in the selection and training of the OJT instructor;

- clearly defining and documenting the roles and responsibilities of the OJT instructor and implementing them in the OJT instructor training programme;

- limiting the time on the OJT position;

- providing refresher training on coaching techniques and error recovery to OJT instructors on a regular basis;

- introducing a regular meeting forum for the OJT instructors for exchanging lessons learned and good practices and for supporting drafting the respective Unit/ANSP Training Plan;

- making arrangements for sharing situational awareness and the plan of work between the OJT instructor and the trainee;

- detailing when and how to take over control from the trainee, including the take-over of communication by using the appropriate switch/pedal to activate the transmitter;

- detailing the procedure for the hand-over/take-over of the position, including introducing appropriate checklists;

- ensuring the OJT instructor is briefed on the level of proficiency of the student/trainee;

- developing a competence scheme for OJT instructors;

● Ensure that the ANSP has a procedure to provide assurance that students and trainees are appropriately trained and licensed.

● Consider limiting the number of permitted OJT instructors per trainee, ideally one to one.

● Consider restricting simultaneous OJT on more than one position of a sector or more than one adjacent sectors.

● Consider incremental increase of complexity in the training programme - defining training phases and communicating the objectives and progress of the phase, including strong and weak points.

● Consider introducing the practice of briefings and de-briefings between the OJT instructor and the trainee.

● Review the training programmes to ensure that they reflect the knowledge and skills required for:

- collision avoidance;

- emergency situations.

● Ensure smooth transition from simulator to OJT, including:

- sufficient simulator time;

- training in emergency and unusual situations;

- identical system support;

- simulation environment as close as possible to the operational environment;

- consider the possibility for OJT instructor and student to be able to use simulation facilities during OJT so that certain experiences occurring with live traffic can be repeated in a simulated environment in order to maximise the lessons learned.
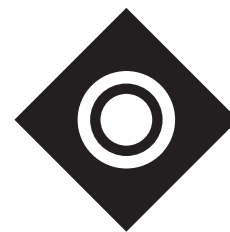
OVERFLIGHT OF DENSELY POPULATED AREAS BY AIRCRAFT IN EMERGENCY

The overflight of densely populated areas by aircraft in an emergency raises a number of questions concerning routeing, destination and the possible presence of dangerous cargo on board. The incident described below illustrates some of these questions, the answers to which will depend on local circumstances. This account is abridged from the official report by the UK Air Accident Investigation Board (AAIB)*.

In April 2004 a B747-100 cargo aircraft departed Ramstein Airport in Germany for a flight to USA. For the climb and the transit across northern Europe the weather was good with clear skies and no forecast precipitation. On reaching the cruising level of FL360, a cruise speed of 0.84 Mach was selected and the crew prepared to obtain their Oceanic clearance when they noticed that the No. 1 engine EPR (Engine Pressure Ratio) started to reduce and initially stagnate in the mid-range before reducing further.

The crew confirmed that the engine had failed and the engine shut-down drill was performed. Air traffic control at the London Area Control Centre (LACC) was informed of the engine failure and a descent to FL310 was requested and approved. When level at FL310 the crew attempted to re-start the No 1 engine, but this was not successful. They then contacted their Maintenance Control and were instructed to return to Ramstein where maintenance support was available.

The co-pilot advised the LACC of the intended change in routing and a 180º left turn was approved with a descent to FL210. During the descent the commander became aware that the thrust levers were positioned well forward of the normal position for such a descent, yet the EPR indications were at idle. When the aircraft was levelled at FL210, the air speed began to decrease significantly. In consultation with Maintenance Control the crew agreed that if normal thrust was not available, an immediate diversion to London Heathrow would be the safest option.

Control of the aircraft was initially being carried out by the LACC controller. When the controller was made aware of the problems with the remaining three engines and the fact that the pilot was declaring an emergency, she contacted the London Terminal Control Centre (LTCC) Radar Coordinator and informed him of the situation. The emergency transponder code of 7700 was allocated to the aircraft and a radar controller was assigned to control the aircraft using a discreet frequency. Control was then passed to the LTCC.

The assigned controller took up a radar console adjacent to the TMA controller who was managing all the other aircraft in or transiting that area of the London TMA below FL200. This permitted close dialogue between the two controllers when trying to sequence the air traffic.

The Group Supervisor decided that a London Heathrow approach controller would be needed to handle the final vectoring of the aircraft for the landing runway, which was runway 27R. The allocated approach controller made his way to where the TMA controller sat and occupied the adjacent console. Shortly afterwards the approach controller was joined by the Terminal Control Watch Manager.

Having created a controlling team co-located at adjacent terminals, ATC's intention was to use 35 track miles from when the aircraft was heading 315º to radar vector it from the left base position onto the final approach. At that stage the controllers believed that the aircraft was capable of reduced thrust and not suffering a total loss of thrust on the three remaining engines. Only when the co-pilot transmitted a warning "We're just not sure we're gonna get enough power to land," did the full extent of the problem become known. The controller immediately offered to vector the aircraft overhead the airfield to let down but this was declined.

At that point the aircraft appeared to stop its rate of descent and even climb slightly before continuing the descent. Given the height of the aircraft and its close proximity to Heathrow, the radar controller instructed that a 270º turn to the right should be executed to lose the excess height and speed. The flight crew accepted this instruction and the manoeuvre was flown, rolling out on an intercept heading of 305º for the extended centreline of runway 27R. This manoeuvre took the aircraft over the centre of London.

* See Report EW/C2004/04/04 in UK AAIB Bulletin 1/2006 at www.aaib.gov.uk/home/index.cfm
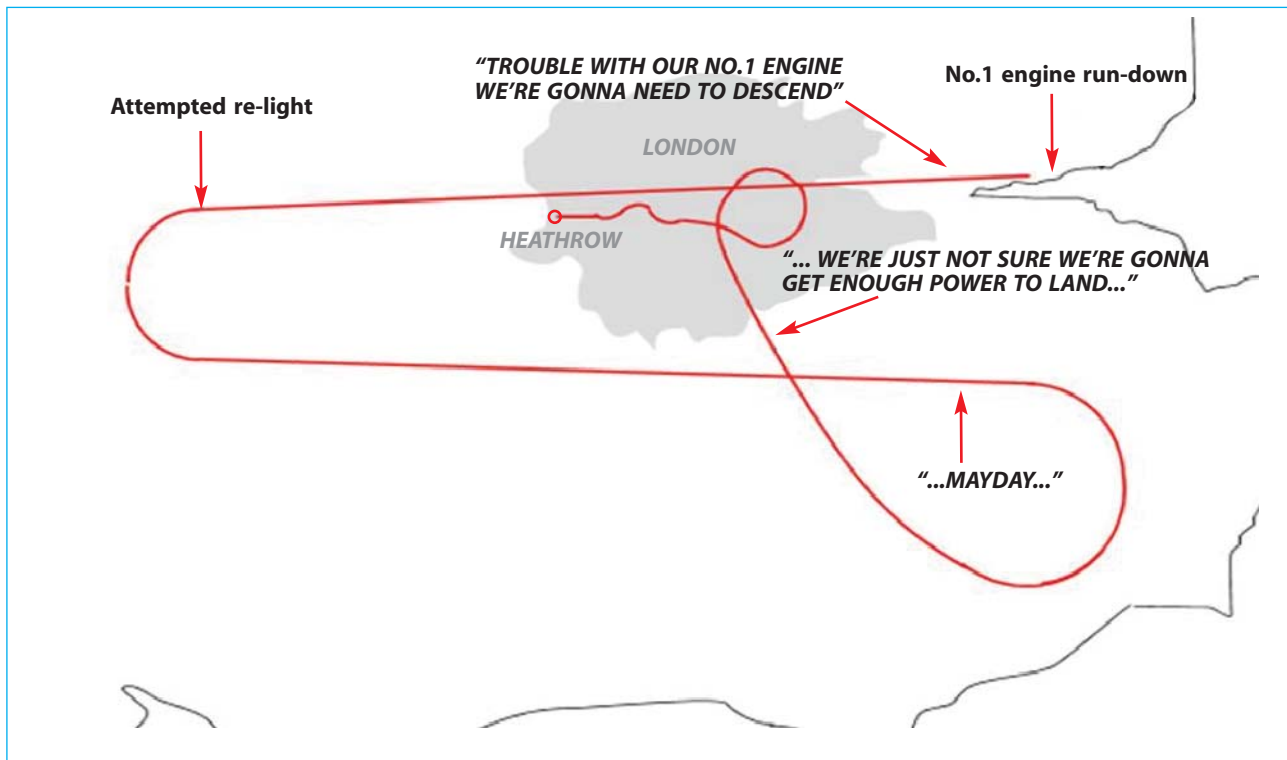
The Heathrow Approach controller took over control of the aircraft using the same discreet frequency to avoid the flight crew having to make a frequency change. He wanted the aircraft to slow down in order to improve the accuracy of his control but also to reduce the radius of the turns being made which were large, due to the aircraft's high speed. He discussed the track miles required by the flight crew to lose their height and his offer of 18 nm was agreed.

The approach controller was still concerned at the height and speed of the aircraft in relation to the reducing track miles to run and so he verified with the co-pilot that they were making their approach to runway 27R as it appeared on the radar display that they were aligning with 27L. The crew confirmed that they were visual with runway 27R and were going to make 'S' turns to lose the height. The controller monitored the progress of the flight, confirming several times during the final approach that the pilot was able to lose the height, which still appeared too great for the distance to run.

The controller obtained a landing clearance from the tower and passed it to the crew. He also knew that the last opportunity for an orbit was at about six miles from touchdown and after that, with no thrust, the aircraft would be committed. As the aircraft rolled out of the left turn onto the final approach track at 2 nm, the controller could see that the aircraft's height and speed were reasonable and he attempted to re-assure the crew by confirming this to them and re-confirming their clearance to land.

The aircraft touched down within the normal touchdown zone and was brought to a halt using normal aircraft systems. After a discussion between the aircraft commander and the airport Rescue and Fire Fighting Service, the aircraft was taxied under its own power to a parking stand.

During the handling of the emergency, there was some speculation within ATC concerning the nature of the cargo onboard the aircraft. The airline was conducting flights in support of the US

military and it was not known if there were dangerous goods onboard.

The incident was investigated by the AAIB. The investigation team recognised both the professionalism demonstrated by the NATS personnel and the skill of the aircraft crew, all of which contributed to a safe landing under difficult circumstances.

No reasons were found which could account for either the apparent run-down of No. 1 engine or the crew's subsequent perception that the remaining three engines were not delivering selected thrust. It was clear from the evidence given by the crew and the aircraft performance that following the run-down of the left outboard engine, the three remaining engines were not producing the thrust expected. The aircraft diverted to the only airport that the flight crew considered suitable and in the process, flew over some of the most congested parts of London in a gliding configuration from which a safe landing was not reasonably assured.

The commander believed that he was only able to position the aircraft visually and the safe outcome would not have been possible in IMC. There was no guidance available to the commander on the glide performance of the aircraft or glide approach technique and he was fortunate to have an unobscured view of the airport. Had the weather conditions been IMC, forcing the crew to carry out an instrument approach, the aircraft might have landed well short of the runway.

In making recommendations, the Board observed that: "It must be considered where the proper balance of safety rests when considering the plight of persons onboard an aircraft in difficulties in relation to persons on the ground in densely populated and congested areas such as those of central and greater London. The balance between delaying an aircraft's landing by routeing it around a congested area, versus the aircraft's condition deteriorating and possibly leading to an accident outside the congested area, should be considered. Moreover, circumstances under which the condition of the aircraft, through damage or technical failure, may pose an unacceptable danger to persons on the ground requiring non-standard routeing should be defined."

The Board noted that guidance is issued in UK for ATCOs handling aircraft emergencies, including manoeuvring over a densely populated area such as central London, and diversion from the flight planned route whilst carrying dangerous goods. However, it recommended that this should be reviewed to consider whether sufficient guidance is provided on the avoidance of built-up areas when vectoring aircraft in emergency.

The Board also remarked that the flight crew decided to divert to Heathrow because they had seen the airport. They were not familiar with the range of airport options available to them nor was it obvious to them that their desired destination involved overflying metropolitan London in a configuration that did not assure a safe landing. One reason for their lack of awareness was that they were not carrying the requisite charts for likely en-route diversions.

Finally, the Board noted that information on what dangerous goods are carried normally resides on board the aircraft and at its airfield of departure. The information is not readily available to Air Traffic Control at the time they might need it and having to ask the crew for the information when they are quite naturally pre-occupied by dealing with an emergency is inappropriate. Following an earlier accident investigation*, UK requirements were amended to include the following:

a. a copy of the Notification to Captain (NOTOC - detailing dangerous goods on board) or the information on it must be readily available at the airfield of departure and the next scheduled arrival point;

b. if the size of a NOTOC is such that transmission of information to ATC would be impractical, provision is made for the pilot to pass a telephone number to ATC for the use of the Airfield Authorities to obtain a faxed copy.

So what are we to learn from this incident? Certainly, the emergency was well handled by the ATC team, who did all that could have been expected of them in the circumstances. The outcome was a safe landing with no damage to the aircraft but that was not the end of the story. The recommendations

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See UK AAIB Aircraft Accident Report 3/2003

of the Board were followed, leading to a more robust system for dealing with any similar situation in the future.

Now is a good time to review your local plans and discuss them with your colleagues. How would you respond to such an emergency? Are there any weaknesses in your plans that need to be addressed?

- Flight Safety Foundation Approach and Landing Accident Reduction Tool - see www.flightsafety.org/home.html

- See Report EW/C2004/04/04 in UK AAIB Bulletin 1/2006 at www.aaib.gov.uk/home/index.cfm
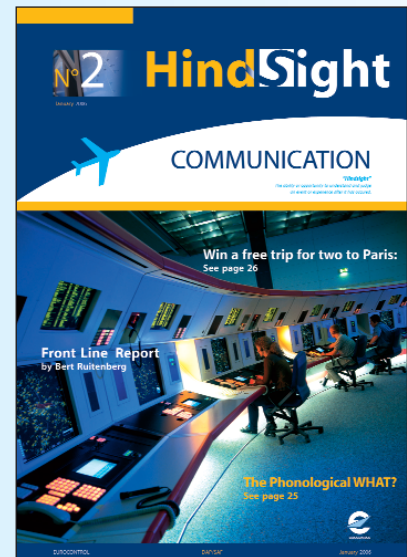
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