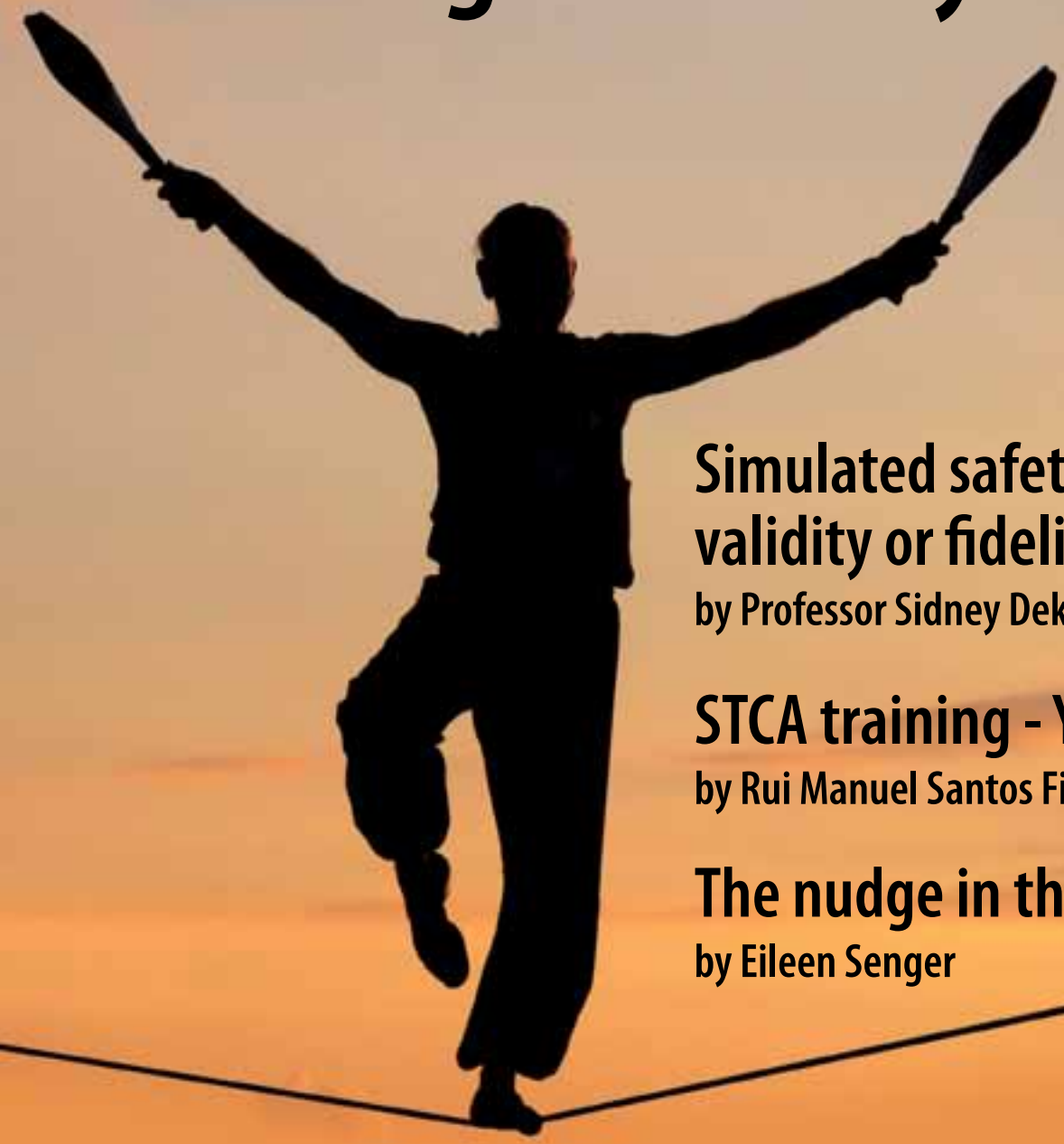
HindSight 14
The ability or opportunity to understand and judge an event or experience after it has occured
EUROCONTROL

Training for Safety



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by Professor Sidney Dekker

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Winter 2011/2012

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How can
operational
examples
be used
in training?

Training is necessary but we need to learn

Tzvetomir Blajev
Editor in Chief of Hindsight
Fellow of the Flight Safety Foundation

We have a proverb in my home country that can be approximately translated in English as "one learns while one lives". I have always thought that in aviation it is actually the other way round…

How do we learn in aviation from our experience and from the experience of others? And, do we really learn the lessons?

Let me highlight a unique event.

> If accidents happen and we, collectively, know why they happen, then we need to find mechanisms to make the collective awareness available and accessible to individuals.

On 17 January 2008, a Boeing 777 crash-landed short of a runway at London Heathrow after a loss of engine power on short final. This reduction of thrust was the result of ice causing a restriction in the fuel feed system that subsequently led to a loss of airspeed and the aircraft touching down 330 m short of the paved surface of Runway 27L at London Heathrow. The investigation identified that this restriction occurred on Fuel Oil Heat Exchanger. Ice had formed within the fuel system, from water that occurred naturally in the fuel, whilst the aircraft operated with low fuel flows over a long period and the localised fuel temperatures were in an area described as the 'sticky range'. The Fuel Oil Heat Exchanger, although compliant with the applicable certification requirements, was shown to be susceptible to restriction when presented with soft ice in a high concentration, with a fuel temperature that is below -10°C and a fuel flow above flight idle.

What makes this event unique, in my opinion, is the following "probable causal factor" included in the Final Report of the Investigation carried out by the UK Air Accident Investigation Branch and published on 9 February 2010:

"Certification requirements, with which the aircraft and engine fuel systems had to comply, did not take account of this phenomenon as the risk was unrecognised at that time."

In other words, the aviation industry had not fully understood the properties of an aircraft fuel system under conditions of prolonged low fuel flow in a particular fuel temperature area. We were not aware before the accident of such a potential scenario - the event was the first to be learned from. Even supposing that an ideal mechanism exists in aviation to immediately spread the everyday lessons learnt, we could not have known about this because it had not happened to anyone before.

How many accidents happen to us for which we, collectively, do not know the reasons and the available mitigations beforehand?

I am always surprised by the excellent aviation accident reviews of Jim Burin, Director Technical Programs of the Flight Safety Foundation (FSF). Jim presents a summary of accidents from the previous year during the FSF annual seminars, examining the "big killer" types and scenarios, their causal factors, distributions by flight phase and other interesting aspects. What surprises me is one fact, often emphasised by Jim, that each year we have the same old accident types, the same scenarios keep repeating themselves, with the same, or at least very similar, combination of factors for which we, as an aviation industry, have for a long time had reliable prevention strategies. By reliable strategy here I do not mean telling people that they "just to try harder" or "next time keep better their situational awareness". No, what I mean are things like the Enhanced Ground Proximity Warning System, which has proved to be a very reliable Controlled Flight Into Terrain mitigation. One of the only exceptions for the last decade, one of the few cases where we, collectively, did not know enough to be able to pre-

vent the accident was the above mentioned accident at London.

So, why do we not learn the lessons?

There are, I think, two major explanations. The first is that the knowledge, no matter how smart we are individually, does not belong to a single person. As Friedrich Hayek puts it in "The Use of Knowledge in Society":

"*…the knowledge of the circumstances of which we must make use never exists in concentrated or integrated form but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess.*

Or, to put it briefly, it is a problem of the utilization of knowledge which is not given to anyone in its totality."

If accidents happen and we, collectively, know why they happen, then we need to find mechanisms to make the collective awareness available and accessible to individuals.

The second explanation for why we repeat our mistakes is that it is not enough just to know. What is needed is the transfer of knowledge into daily practice, to shape the behaviour of individuals and organisations, to implement what has been learnt.

Where is the theme of training in all this? Well, I believe that training is needed to address both major reasons for accident repetition. Training helps to consolidate knowledge and to establish reliable professional behaviour. What is even more important is that training is just a part of another process, part of the bigger picture of learning. Having effective team briefings, sharing common explanations for risks, social networking and even "camp fire storytelling" are all parts of a healthy learning culture.

I remember my first years as a controller, when sometimes a more experienced colleague of mine would ask me to sit to one side and would tell me, in a kindly way, "a similar story that took place years ago" or "how things can be done even better". This informal and intuitive coaching helped us a lot and was, I now realise, a big part of our learning.

Recurrence of similar accidents tells us that there is a lot more learning that we need to do – collectively to consolidate the knowledge, and individually to apply it in our daily work.

Enjoy reading HindSight!

Front Line Reports

ALL CHANGE FOR THE FRONT LINE REPORT!

As the observant amongst you who can recollect the last edition of HindSight may remember, we needed to find a new Front Line Reporter. Our varied collection of assessors concluded democratically that two candidates met the criteria and both have been offered the role. This means that in some editions we may have contributions from both of them and in others from just one of them. They are Carlos Artero and Maciej Szczukowski.

They are both active Controllers - Carlos Artero in Barcelona Spain and Maciej Szczukowski in Warsaw, Poland.

Whilst warmly welcoming both Carlos and Maciej as HindSight 'Frontliners', I would also like to sincerely thank all the other 'entrants' in our competition. In particular, the piece by the (close) runner up, Eileen Senger, was considered so good that it has been included in the 'From the Briefing Room' section of this issue and she has been invited to become a regular contributor to HindSight. I hope she will accept.

The Editor

Training in safety

Training is safety

By Carlos Artero

As an Air Traffic Controller, I have been trained in many matters many times. However, I dare say that this preparation has not always been as useful as intended, especially for critical situations. In my personal experience, training for some aspects could have been better.

As Air Traffic Controllers we are naturally very concerned about safety, which is actually our main goal, but we are not alone. Everyone from aircraft manufacturers to aircraft mechanics, from pilots to cabin crew, from airport operators to regulators, also works with safety as a priority.

Once a plane is airborne, only pilots, cabin crew and air traffic controllers are involved and, since the plane is already flying, any abnormal or emergency situation may need to be resolved in minutes, thus causing probably the most stressful situations in this business.

Pilots are of course the ones flying the plane, so they must be prepared to act quickly and safely in response to any difficult situation that may occur. Even though their training is ultimately focused on flying safely, this is complemented by a lot of operational learning on subjects like aircraft performance and meteorology. They must know how to fly in different conditions and how to do so safely. Emergencies are just part of their training, but it's so important that they regularly receive emergency training on full flight simulators. Even if they study what they should, everyone would agree that pilots need to experience critical situations in a simulator so they can practice the necessary procedures and have their response observed and assessed.

Now let´s look at the Air Traffic Controller's situation. We have seen that pilots are concerned not only about safety but also about the wider context of flying. But Air Traffic Controllers do not have as much operational context to cope with, as they just monitor the planes on the screen or from the VCR and fill in the strips. Our main concern is safety. Separation, miles, turbulence... And only then, after safety, comes order, speed of the traffic and efficiency.

With that in mind, we now discover that in many European countries there is still no training using simulators. We see that, for example, Air Traffic Controllers receive theoretical training in emergency and critical situations every year. And what happens next is that one day an emergency occurs and we all look for the book to check the steps we are expected to follow. But we have never actually done it before or, wait, yes, we probably did, when we were in the Air Traffic Control School many years ago. Even if the theoretical course is brilliant, it does not show you how you will react under a very

Carlos Artero

is an Air Traffic Controller in AENA, Spanish Air Navigation Service Provider since 2005. He works in Barcelona and he has experience with Tower and Area Control.

stressful situation. Even if the theoretical course contains very clear steps, when a real emergency happens, the course will reveal its limitations, since you never really use the steps, just study them.

After finishing Air Traffic Control School, where I had been prepared to face emergency situations in tower, route and approach control, my first destination was the Control Tower of an airport situated in North Spain. Nights were busy as most of the aircraft were cargo carriers.

OK, now I really appreciate the importance of being calm and focused and why we have to practice the emergency procedures... but **NOW** can you tell me **WHERE THE BRAKE IS?!**

I was under instruction, it was midnight and a colleague was controlling while I assisted him. Late passenger traffic was inbound to the airport and a departing cargo plane was taxiing to the holding point of the runway in use. When the approaching aircraft was cleared to land, he did not reply. We tried again with no success. Then he called us asking for the clearance, but he couldn't hear us. We had a problem with the radio, an extremely unlikely problem, since all the systems were duplicated. But it happened. The incoming traffic went around whilst the departing traffic stopped at the holding point. We turned the holding point stop bar lights on. We had a 'Dittel' portable radio which we turned on. It didn't work. Someone had disconnected it from the power and nobody had connected it again, so the battery had run down. We connected it to the power supply and advised the technical department of the failure while the arriving airplane turned left and joined the circuit to try to land again. We found the signals pistol. The first problem was the meaning of the lights. We had studied this many times, yes, but at that particular moment we were nervous and not really sure about using it. We were almost sure that the continuous green signal meant both clear to land and clear to take off. Therefore, we had a problem because if we pointed the green light to an aircraft on short final, the traffic waiting to depart might think that he could take off and the arriving one think that he could land, so the situation would become very risky. The second problem was how to turn the green light on. We had done it before, but never in a stressful situation. And it was surprising that it took quite a while to get that green light, since we had to press two buttons at the same time.

The traffic in the circuit had flown abeam the tower whilst we continued to try and establish the exact meaning of the green light signal. We knew, since we had had the appropriate training, that the explanation was somewhere in the control room very clear and close to us, but at that moment we couldn't remember where it was. As usual, it was dark in the control room to allow us to clearly see the lights of approaching aircraft, and the darkness did not help us at all. The plane at the holding point started to become impatient

▸▸

Training in safety
Training is safety (cont'd)

when he called and we did not reply. The other traffic wanted to land. At least both planes were on the same frequency, so they could hear each other and were aware of their respective positions. We didn't find the meaning of the pistol signals in the control room, so we started to search for it in the Regulation Book but it was impossible to find.

By now, the inbound traffic was turning onto a tight base leg. We had to take a decision, so we just aimed at the flying traffic and shot the continuous green light, avoiding aiming at the aircraft waiting in the holding point. The arriving aircraft turned onto final and landed. When he vacated the runway he reported: "vacating runway. We have landed according to the green light". We turned off the stop bar lights at the holding point and at that moment the main radio started to work again. We told the departing traffic to line up and he heard us. He told us that he had stopped at the holding point as cleared, he didn't cross the stop bar, he knew a plane was inbound and he saw us with the pistol. He just took off and soon afterwards everything was fine.

What is shocking is that a pilot must train on simulators regularly but that Air Traffic Controllers in some European countries still don't

After the rush we saw that the light signal meanings were pasted on the pistol. It seems incredible that we hadn't noticed it, even taking account of the fact that it was dark. Once it was all over, we also found the meaning of the light signals in the Regulation Book in about ten seconds. The 'Dittel' was now charged enough to work. A technician came into the control room and told us it was the first time that a radio failure had happened since he had started to work at the airport twenty years ago. Nobody had noticed that the 'Dittel' was discharged since we rarely used it.

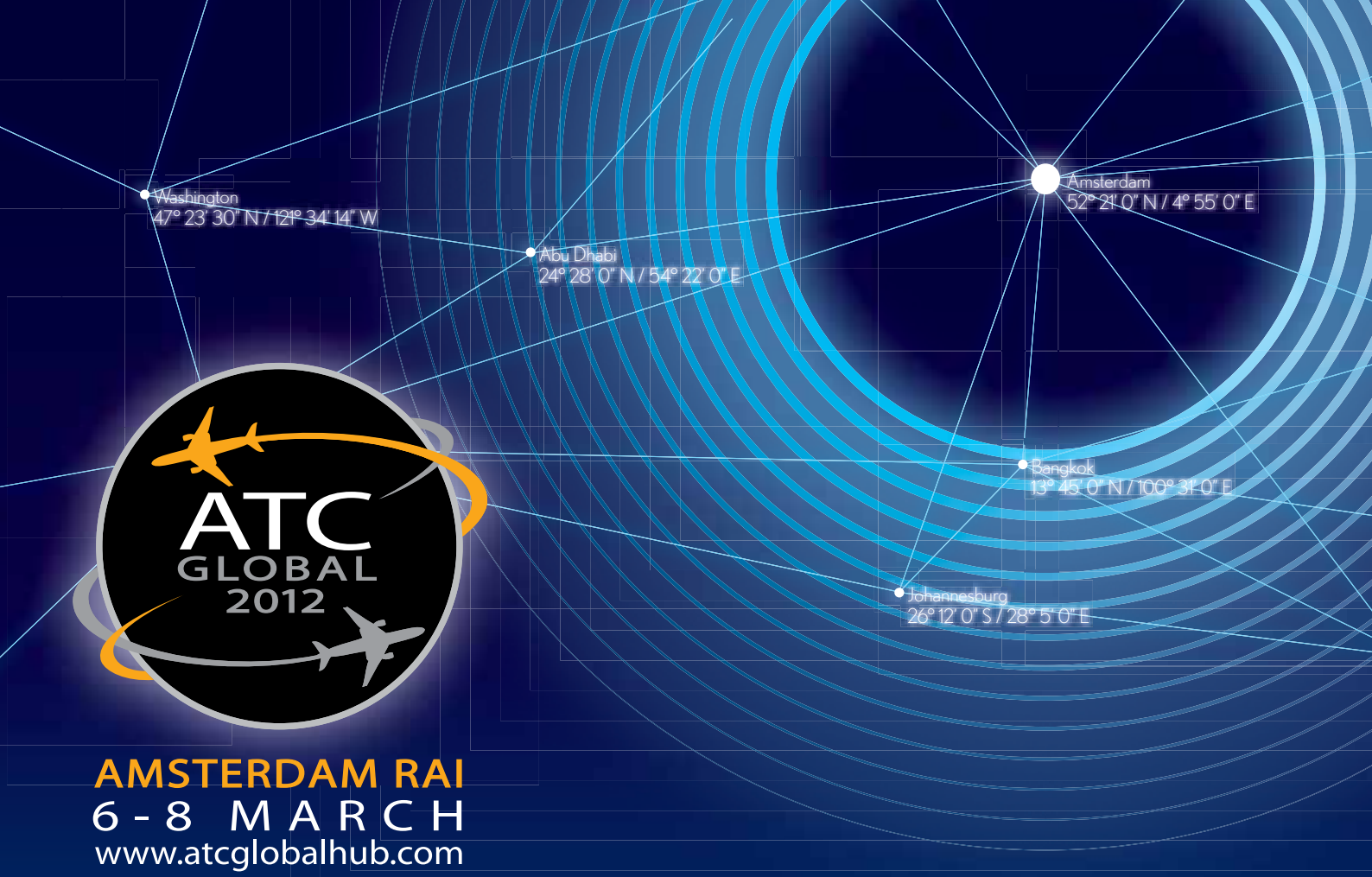
Even though we had turned on the red stop bar at the holding point, advised the technicians as soon as we found the problem and properly used the signals pistol, we found that under the stressful conditions we worked very slowly and much less efficiently than normally when we were relaxed.

Even though we were familiar with all the theoretical practice, we were not prepared for the human factors, by which I mean managing the situation when we were stressed and had to take decisions quickly. Next time, those involved would be better able to deal with such a situation having seen how they had reacted and what their weaknesses were in tense conditions.

I can drive every day and I can study how to race with the best teacher, but no one would let me participate in a car race unless I have practiced how to compete, know how the car works, know how to drive at high speed and know how I would react.

What is shocking is that a pilot must train on simulators regularly but that Air Traffic Controllers in some European countries still don't, despite the fact that our profession is focused on safety and that our usually stress-free job may become very stressful during an aircraft emergency.

Would you fly in a plane flown by pilots whose last Simulator Emergency Training was ten years ago? Maybe not. Maybe Air Traffic Controllers, Regulators and Air Navigation Service Providers should consider giving all controllers regular simulator training, in order to let us learn how to handle an adverse situation before experiencing a real one.



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Training for safety

By Maciej Szczukowski

My older ATC colleagues often recall the times in the 80's and 90's when they used to organise holidays together with pilots from our national airline. Then, sitting by the fire with a bottle of some tasty beverage, they used to talk together about aviation and their work. The longer they talked the more specific cases they used to talk about. One could hear questions beginning with "I always wanted to ask you if …" or "Tell me, how is it that you …".

After such contact, all of them were enriched with new, practical knowledge. And that knowledge, at least for a time, allowed them to cooperate more effectively and work more efficiently. But only until new procedures arrived. Luckily the next holiday was only a year away.

Today, I sense that pilots and controllers are far more apart. More and more, I can see how different our points of view are and how disparate are our goals. Economic pressures and safety regulations do not always mix well and the effect is clearly visible (or rather audible) when you listen to everyday radio communication or to telephone conversations between controllers and pilots, after their flights or shifts. Airlines want pilots to fly safely and to schedule. ANSPs want controllers to enable them to do it safely. Sometimes one needs or wants to push the tempo. Other times someone needs to slow down or even stop for a moment (unless it's the pilot!). There is usually no time and space to describe the reason to the other interested party. Questions arise. Conflicts and claims are on their way to ruining the atmosphere.

Maciej Szczukowski

has been an Air Traffic Controller, for over 10 years, at Warsaw Okecie Airport, Warsaw, Poland. He also holds a PPL.

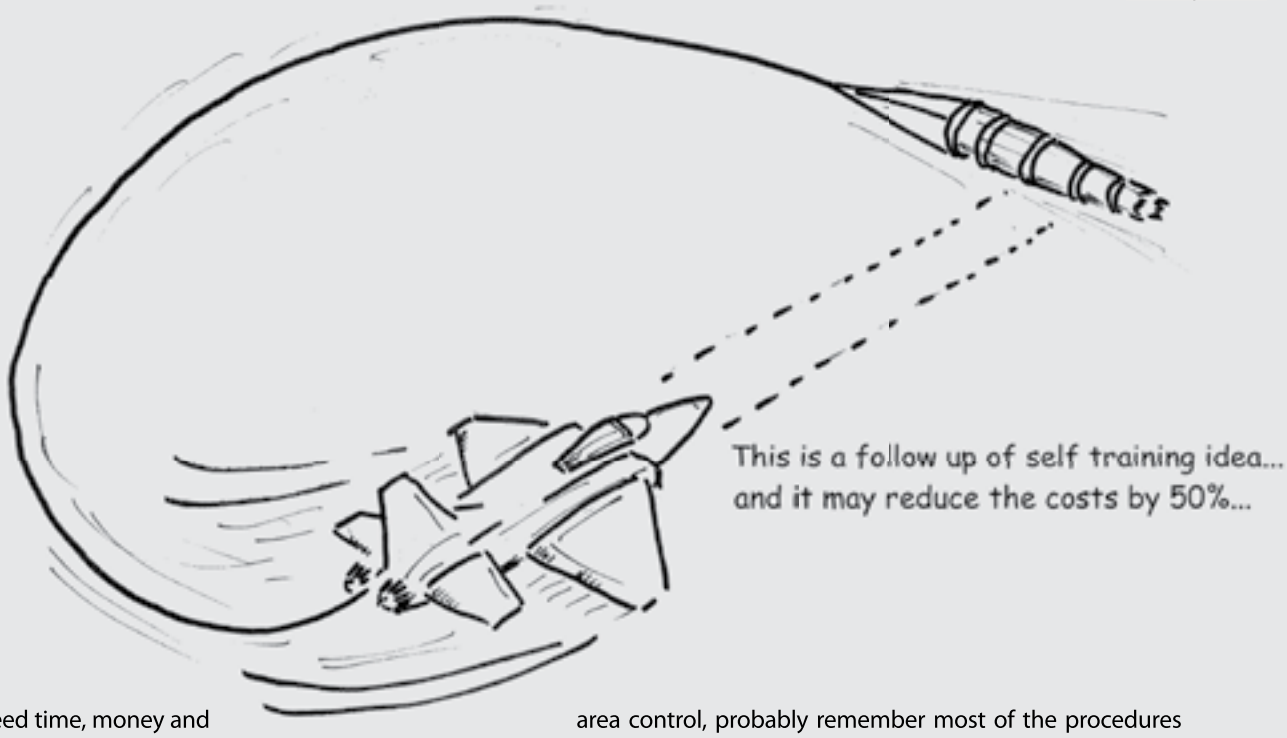
Probably most of us are accustomed to periodic classroom sessions. Our memories go back to the times of our first, basic course, though now we sit at the desk only to refresh what we believe we already know. We are used to the fact that for a day or more we will look at the white board and will once again be taken through an interminable number of PowerPoint slides and probably some short educational movie clips. Still, most controllers will only learn that when there is a bird strike or engine fire they need to call here and there, inform this guy and that guy, provide this and that. And probably only a very few of us will ever really learn about the other side of the story. About real life on the flight deck or in the cockpit.

I am absolutely not here to judge but when I listen to the R/T recording of the now famous Hudson River ditching, I find the controller a "victim" of this type of training. I know he did very well and offered probably everything he could but I feel like he had no idea of what was really going on in the flight deck. Maybe it was only a shortage of available information.

> If we need the training programmes to be better, more attractive and more professional, we need time, money and close cooperation with all other parties involved.

The other very well known case, the Manchester bird strike, with almost 3 million views on YouTube, gives the impression that both the flight crew and the air traffic controllers were actually in the same place during the whole situation, sitting side by side. All information was given at the right moment, in a calm and steady voice and with nothing unnecessary and nothing missing. I don't know what the difference is between the training programmes for New York and Manchester controllers, but both situations show how very important it is to prepare and educate both pilots and controllers about the needs and limitations of other parties involved.

The problem which arises everywhere and every time any change is needed is… money. If we need the training programmes to be better, more attractive and more profes-



sional, we need time, money and close cooperation with all other parties involved. Along with the increasing level of traffic and regular procedure changes, we need to go through all the programmes periodically and change or improve them as necessary. That again means time and money. Many people need to be involved in such processes. People who are known for their expertise, experience and knowledge – 'active specialists'. The very people who are probably most important to the success of their company. So surely the company would not want them to be taken out from their normal duties to allow them to work on some "unprofitable" education programmes or refresher courses. And nobody should expect those people to work in their own time.

So maybe we should leave all the presentations, handouts and books and concentrate only on case studies? I would say no. I also go through refresher sessions in my work and one of the case studies used for the last few years is one I was involved in. I generally have no problem with that but when I see the reactions, or when we discuss the case after seeing its recording, I always have the impression that it is not the 'plot' and the 'ending' which is really important but the cast of 'actors'. We know each other, we know our good and bad sides, talents and limitations and we often have the tendency to ask the question "could that happen to me?" Or "did it happen because that particular person was on duty at that time?" It is at such times that I regret having no opportunity to watch the same situation from the pilots' perspective. I know what happened in the tower at that moment. I was there. But I have no idea what happened in the flight deck. If I was able to find out, my own awareness would surely gain a lot.

I am sure we all agree that we are learning all the time. Therefore it is also worth thinking about how much of the available learning process those ANSPs who do not allow personnel interchangeability lose. A person with years of experience solely in aerodrome control will, after transfer to approach or area control, probably remember most of the procedures and conditions of tower controllers' operational work for a few months or even a year. With no opportunity to be able to see (and 'feel') both sides of the story, local priorities and not the bigger picture gradually come to 'centre stage'.

Is cross training a solution here? Yes, why not. And there are people who warmly welcome me when I decide to spend an hour looking at one of the ACC sector screens. But is it something that people are encouraged to do? I also understand those who decide to spend an hour off relaxing rather than taking part in the ATC process somewhere else, even if only as a spectator.

Well then, maybe simulators will do? But how complex should an ATC simulator be to be able to "replay" human reactions and behaviours as they are in real life? Or how many people would have to operate it to "act" as all the parties involved? Once again, economy, money, time, people. So there will always be limits to the use of simulation. A point beyond which the simulator itself cannot go any further even though we all know that there may be a lot still to be done in situations of genuine distress.

So how about 'coordinated simulations'? Aircraft and ATC simulators connected with the exercise being done in parallel by pilots and controllers? But are the needs common? Are the training programmes alike? What about planning, certification, regulations, instructor availability? Economy rings the alarm bell again, doesn't it?

I would love to be the one to have all the answers to all the questions. Especially for the problems and challenges that come with aviation, but it seems that training is another issue which will not develop for the better until some of the priorities change. So for now, trying to take everything I can from the training I am provided with, along with my own 'cross training' or self-study, I will stick to what my colleagues used some 20 years ago. I will ask, talk and listen to those on the other side of the microphone whenever I can.

Simulated safety training - validity or fidelity?

By Professor Sidney Dekker

It is a common belief that human factors issues, rather than technical ones, are behind the majority of our incidents and accidents.

In aviation, we have responded to this by devising a variety of non-technical skills training. We call it CRM (crew resource management), for example or TRM (team resource management) or soft-skill training or human factors training. We want our people to get better at speaking up, at coordinating, at communicating, at managing. After all, this is where – we fear – things unravel, where things go wrong, where errors go undetected and grow into larger problems that may become unrecoverable.

When managers from other industries get taught these kinds of skills (how to communicate, coach, build a team, coordinate, persuade, and so forth), they typically go to a place that is not their workplace. As a minimum they will go to some hotel conference room and sit there around a table with blackberries and iPhones switched off, away from the desk, away from the usual hubbub and technical details of their daily lives. The idea is that this is necessary because they will not be able to reflect meaningfully if they are constantly in the same environment that generates the problems they need to learn to deal with. Other management groups go outside the hotel conference room, disappear into the bush and hang upside down from ropes to cross a raging river with a wholesome-looking paramilitary screaming at them in some lame version of boot-camp. Or some such thing. All in the name of team-building, communication training, or people-skill improvement.

Professor Sidney Dekker

is Professor and Director of the Key Centre for Ethics, Law, Justice and Governance at Griffith University, Brisbane, Australia.

Author of best-selling books on human factors and safety, he has had experience as an airline pilot on the Boeing 737.

Guess where we go in aviation? Well, there is one place where my communication and coordination skills get "tested" (even formally so, nowadays). It is not in the bush, nor in a hotel conference room. It is in a simulated cockpit. It is, in other words, in the exact environment that gives rise to the very problems I need to learn to deal with. The simulator is an attempt at an exact copy of the normal working environment. Rather than getting me away from it, the simulator plonks me right into the middle of that environment – with all the confusion and noise of knobs, buttons, tasks, screens, checklists, technical language and skill demands, manuals, books and even radio calls.

The contrast is instructive. Together with my colleagues Nicklas Dahlstrom, Roel van Winsen and Jim Nyce, we raised the question whether such fidelity automatically means validity. Let me explain that. Fidelity refers to how much the simulated environment looks like the real one. High-fidelity simulators are the level-4 airline cockpit simulators we have for flight training. They move, shake, smoke, rattle and roll, and even have displays of satellite pictures of the areas surrounding your airport outside their "windows", so you feel right at home. This is called photorealism. The simulated environment is made to look like the real thing. Aviation has great confidence that high-fidelity simulation can stand in for the real task environment. So much so that we are comfortable giving people zero-flight time type ratings (though on the back of a series of recent accidents, a debate is raging about whether pilots may actually be forgetting how to fly…).

The focus on making the training environment as photorealistic as possible has a few important consequences. One is that, very easily, the focus of safety training glides back to technical skills. To flying the aircraft, programming the Flight Management Computer, answering the radio call, finding the right display page, turning to the correct non-normal checklist in the manual. The recurrent training exercises that I (and all airline pilots) have to do are breathless exercises in technical credentialism: show that you can handle the airplane when it all but breaks apart in your hands. The sessions are so full of technical problems and issues that they are like a sausage: stuffed full of all kinds of ingredients without much regard to placement or authenticity. The debriefings afterwards, naturally, can hardly do justice to the social and coordinative nature of the work that had to be done in the cockpit to survive the various technical failures and problems. "You might have spoken up a bit more here or there," might be the encouragement afterward, for example. But it was pretty superfluous. In hindsight, it was never hard to come to such a generic conclusion yourself.

Then there is another hugely important consequence, and limit, really. In a simulator, we can only train that which we can program. And we can only program that which we have the fantasy to foresee. This is problematic, because not all problems are foreseeable. In fact, some people will, at some point or other, be left to 'fend for themselves' at the edges of our otherwise extremely safe industry. It is at these edges that skills need translating to counter threats nobody had ever foreseen. The flight of United Airlines 232 in 1989 is an extreme example. The triple-engine DC-10 lost total hydraulic power and became seemingly uncontrollable as a result of a mid-flight tail engine rupture, with debris ripping through all hydraulic lines that ran through the tail plane. The crew figured out how to use differential power on the two remaining engines and steered the craft towards an extremely difficult high-speed landing at Sioux City, Iowa. The majority of passengers and crew survived the landing. In simulator re-enactments of this scenario, none of 42 crews managed to get the aircraft down on the runway. Both the crew and the investigation concluded that the relatively successful outcome of this impossible situation could largely be attributed to the training of general competencies in the carrier's crew resource management training program.

This is where validity comes in. Having a high-fidelity simulation does not necessarily mean that the training that is received is valid, that it carries over to those situations in which it is actually called for. Validity, as defined here, refers to the overlap between training and target situation in terms of cognitive and coordinative skills. The focus on fidelity in the simulator industry may have muted the possible development of simulation styles that allow a more subtle analysis of cognitive and group interaction skills. This is particularly true for the training of soft skills. It is exactly in unusual, unanticipated and escalating situations where such skills are most needed. These are dynamic situations that involve underspecified problems, time pressure and complex group interaction requirements to draw on different kinds of expertise. These are situations that cannot be resolved through pre-programmed routines or pre-specified procedural guidance. It may not matter how quickly you find the right page in the manual, in other words.

Back in the mid-1990's, when ideas about "free flight" were very popular, my colleagues and I created a relatively cheap table-top simulation where time pressure was one of the only high-fidelity factors. With this, we wanted to see how effectively controllers could develop and apply team competencies and soft skills (such as sorting through and processing information, coordinating with others, prioritising, getting expertise where and when required, deferring to or challenging authority, and so forth) to solve combinations of problems without having positive control over all aircraft in their sector. The use of such low-fidelity simulation did not of course provoke any wow-factor (as in: "wow! What a beautiful simulator!"), but we wanted individuals and teams to be adaptive and capable of creative, appropriate improvisation.

This time, no matter what happens, I don't want to hear anyone say "Nice try"!

We found that these really are skills that can be practiced and learned effectively in lower-fidelity simulations, at least as a complement to the procedural skills gained from high-fidelity simulation. It is in fact really interesting to see how these lower-fidelity simulations can lead participants to re-think their normal roles, routines, procedures and behaviour – precisely because they are not locked into the technical hubbub of their normal working environments. This, in turn, can help them develop more adaptive and flexible competencies, and help them develop confidence at using them. It makes good economic sense too.

EDITORIAL COMMENT

Fortunately, not all flight crew simulator sessions are "like a sausage" and not all debriefings afterwards are "pretty superfluous" even though this is quite common.

Full flight simulator validity is not always about specific occurrences allowing you to experience them before they happen for real but about the use of representative scenarios to train and assess the 'generic' response to the unexpected. Proper post – exercise discussion of the human factors aspects of these responses then needs, but often doesn't get, adequate post-simulator session time and also benefits from access to video recordings of what went on to 'jog the memory'. This observation can be applied equally to the use of ATC simulators for training and assessment.

So the economic choice might actually lie between the suggested addition of low-fidelity exercises and a greater focus on getting the full potential value out of high cost, high fidelity training.

Providing effective training for the unexpected

By Captain Ed Pooley

Of course, training for safety is very important. And I would suggest that such training for controllers and pilots has a common objective for a common operating environment.

There has been much evidence of, and discussion about, whether pilot training and competency assessment as presently configured necessarily does the job of delivering pilots who can always deal with the unexpected in the best way. Of course, whether pilots are successful in such circumstances will depend on many things. The key question for now is whether the training (and assessment) system that we rely on produces pilots who are likely to be able to deal with sudden problems effectively. This is a realistic question because we know the majority of fatal air accidents are the direct consequence of 'failures in human performance'.

For the purpose of subsequently stimulating some thought on the potential read-across from the pilot training world to the controller training world, I am going to make some observations about the system of training which most pilots of multi crew jet and turboprop aircraft experience. I will not ignore the process of initial aircraft type validation but I will focus more on the recurrent training / re-qualification process.

I will not make any reference to the selection process which recruitment is based on. Although this has a significant effect on both initial training success rates and (perhaps less obviously) indirectly on the subsequent recurrent training performance of those who are recruited and successfully complete their initial training, it is absolutely a subject which I believe needs space of its own.

I will take it as a given that the development and retention of practical competency is founded on considerable classroom and / or CBT theory - and perhaps also by some supporting self study for those who recognise that there is always something to be added to their store of knowledge and understanding as specialist professionals.

I want to focus first on what happens in training once the candidate can handle normality well. How do you set about training - or re-training - for the unexpected? After all, this is the most common (but nevertheless still rather infrequent) challenge to pilots in today's world of automated reliability. Of course, the training programme always includes some of the 'most likely' occurrences. These will often involve selective system failures and reversion to flight control with less of the protections against deviation than prevail when the aircraft is 100% serviceable. They will also involve resolution of conflicts with other aircraft, dealing and responding to difficult weather conditions and the possibility of incapacitation or irrational behaviour of the

other pilot. Flight Operations Regulators typically stipulate a cycle of subjects to be covered at least once over a 3 year cycle - recognising that there is far too much subject matter to mandate it at every re-qualification.

This is all useful activity as far as it goes, but the focus is based quite narrowly on specific circumstances which in many cases will never be encountered. It has been suggested that the average interval between failures of the latest big fan jet engines is of the order of 100,000 flying hours, a figure which is some way off the flying hours accumulated during the career of even the longest-serving long haul pilot!

Are you sure this is the best way to acquire new OJT training skills?

It has been suggested that the average interval between failures of the latest big fan jet engines is of the order of 100,000 flying hours, a figure which is some way off the flying hours accumulated during the career of even the longest-serving long haul pilot!

On the other hand, there are so many detailed abnormalities which might (but will probably not) be encountered, it could be that a significant proportion of recurrent training would be better released from the cycle of predictable compliance-driven exercises and re-focussed on the development and use of a large bank of abnormal scenarios. Their function would not be to train the response to their specific detail but to focus on the effectiveness of the response to the unexpected. The scenarios would be designed to present a similar level of challenge and would be entirely 'unseen' beforehand with the debrief solely based on the effectiveness of the response.

Of course this is merely a (significant) development of the LOFT[1] concept which is already commonplace and it would still be necessary to incorporate 'core business' such as TCAS RA and TAWS responses. But this modification to focus on initial responses to whatever occurs would be a good solution to accident reduction when so many of today's accident chains start suddenly and unexpectedly and where this 'startle factor' often leads to inappropriate initial responses which create secondary circumstances from which recovery may be much more difficult than the appropriate response to the first situation would have been. The evidence produced so far in respect of the 2009 loss of the Airbus A330 over the Atlantic[2] is but one notable example of this.

This proposition does not directly address the significant distinction

1- Line Oriented Flight Training
2- See http://www.skybrary.aero/index.php/A332,_en-route,_Atlantic_Ocean,_2009_(LOC_HF_AW_WX)
3- See http://www.skybrary.aero/index.php/B772,_London_Heathrow_UK,_2008_(AW_LOC)
4- See http://www.skybrary.aero/index.php/B738,_Mangalore_India,_2010_(RE_HF_FIRE)

Providing effective training for the unexpected (cont'd)

in respect of whether the sudden-onset abnormality came directly 'out of the blue' like the Boeing 777 fuel icing event at Heathrow in 2008[3] or was the eventual result of an excess of 'can-do' as in last year's Mangalore landing overrun[4], but it would be a step in the right direction.

Next, I want to look briefly at the relationship between training and formal competency assessment. For pilots, the latter is typically focused on a tick-box process that mainly uses flight with inoperative engines as the way to 'load up' the pilots to prove that they can still safely control the aeroplane under pressure. This is an easy-to-standardise, but rather old fashioned tool in the context of Performance 'A' aeroplanes and the high engine reliability noted earlier. The testing is predictable and entirely lacking in any direct connection to the 'line oriented flight training' and coverage of periodic mandatory systems subjects which forms, for the re-qualification case, the refresher training element. To emphasise this disconnect, the testing element is generally completed prior to the training element!

So my second proposition is that, rather than just repeatedly relying on one predictable version of a high workload situation, pilot competency assessment might more usefully follow the refresher training provided rather than precede it. It might also mirror declared training objectives more closely. This would place new demands on the competency assessment process which would need to adapt to a system where judging pass/fail would be a lot more demanding. Especially since it should use unpredictable 'test' scenarios selected from the large bank developed for training purposes under proposition one above (excluding of course the scenarios just previously used for training purposes!)

So now I invite you to consider the possible relevance of these issues which many believe currently exist in pilot training regimes to the rather similar process of training ACC or Terminal Radar Controllers who must work busy sectors and have shifts punctuated by essential periodic rest breaks. For the purposes of this comparison, perhaps it could be assumed that, as for pilots of multi crew commercial aircraft, basic controller competency achieved by simulator training is then validated by on-the-job training - analogous to the line training of pilots

Thought about it briefly? Good! To conclude, I have a question for the controller community on behalf of the pilot community. Arising from the apparent read-across of OJT for controllers to Line/Route Training for pilots - and of course the acquisition of the necessary tick in the box at the end of it - is an interesting disparity between the delivery of one-to-one validation training in the two cases. In the world of pilots, Training Captains are a carefully selected small subset of all Captains who themselves have had, when First Officers, to be assessed suitable to command. The progression is not at all automatic or expected, it's based on the assumption that the minority who are really suited to the role and will enjoy it are appointed. Certainly, I can say that I really enjoyed my time as a Check/Training Captain and I know that this was the case for almost all of us. We received more salary than Line Captains, but we contributed proportionally more to the maintenance of overall safety standards than they did as individuals. For controllers on the other hand, it seems to us pilots that most controllers can 'look forward' to joining the OJTI List unless there is a good reason why they shouldn't. Which is the exact opposite of the pilot case. I don't know about the salary differential involved, but it might be a case of spreading the training budget across too many people who do not all have the task focus that makes task delivery effective in the pilot world. Certainly there are incident reports out there in the public domain which have shown, apart from task slippage, that some OJTIs actually positively dislike the duty. Surely, ATC could learn a rather obvious lesson from Flight Crew Training - that motivation is as important for the Trainer as for the Trainee…. and that not every controller makes a good trainer, however good they are at their job.

Captain Ed Pooley is an experienced airline pilot who for many years also held the post of Head of Safety for a large short haul airline operation. He now works as an independent air safety adviser for a range of clients and is currently acting as Validation Manager for SKYbrary.

SAFETY ALERTS

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EUROCONTROL

Let me introduce a new feature which we hope will in future make a regular appearance in Hindsight! We know there are a lot of people out there who are rightly proud of helping to create innovations in working practices which might be interesting to others. Our first interviewee is one such person.

But there are many other people out there with experience of interesting ways of working which they may or may not have invented. And many more who have found out things that work really well. It is particularly such frontline people that we'd like to find for future editions, but we'll also be keen on interviewing anybody else with an interesting perspective that may help link 'service delivery' with 'safety'.

All you have to do is offer yourself for interview to the Editor and if you're chosen, we'll do the rest. And if you're shy, don't be put off by interviews that appear alongside a photograph - we won't insist on one!

Four-to-one

An interview with Training Manager Nina Lindén, Stockholm-Arlanda Tower

"I am not saying we are excellent in teaching, but in fact we are"; *Nina Lindén laughs, one of those bubbling generous laughs a nice down to earth person can deliver. Following eleven years as a tower controller, she took up the challenge of Training Manager for Stockholm-Arlanda Tower in 2004.*

HOW HAS TRAINING CHANGED OVER THE YEARS?

"A lot, today we always treat the student as a colleague from day one", she explains. "In addition the introduction of an on-site 270 degree tower simulator has of course improved transition training. Today, normally the first three weeks is classroom training mixed with simulator exercises, e.g. basic traffic combined with using the electronic strips; it gives the students a good introduction to the real work".

WHEN THE STUDENTS ARRIVE, WHAT ARE YOUR ROUTINES?

"Before the transition training, we prepare the arrival of the students carefully. Four instructors per student are selected; three air traffic controllers plus one assistant controller. These instructors are carefully chosen from controllers and assistant controllers applying for and passing the instructors´ training programme.

Following the arrival of the student, we arrange an introduction/familiarisation day. In a relaxed way the instructors present themselves, it is important for everybody to get to know each other well. Of course we also talk through the training schedule, presenting the "game plan". We have developed a document that clearly describes what is expected from the students, it is a detailed description of the stepwise approach we use. The document includes everything from analysis and planning to coordination, behaviour and attitude. It is done in a relaxed way though; it is extremely important that the students feel welcome and part of the working environment".

FOUR INSTRUCTORS PER STUDENT, DOES THAT REALLY WORK?

"Using four instructors works extremely well", explains Nina. "We always stress that all operational personnel should work in a similar way, adhering to the procedures and showing respect to each other; above all, we stress that everybody is responsible for safety. By using several instructors the student can clearly see that this is not just empty words. In addition, it is better to not be dependent on one instructor, by using several we secure an uninterrupted training period".

HOW DO YOU FOLLOW THE PROGRESS OF THE LEARNING CURVE?

"Following each planned development period (step), we start with an instructors´ meeting. Prior to this meeting the instructors individually, plus the student, deliver a summary of the progress so far. We use questions such as: What is excellent? What needs to be improved? Both the instructors and the student use the same feedback document. Also personal opinions are allowed, the more we speak plain language the better. We can compare the instructors´ opinions with that of the student, and ask are they seeing the same picture? Discussing all these aspects with four instructors gives a higher quality. We actually only see advantages by using multiple instructors", explains Nina.

"Finally a decision is made whether the student is ready to move on to the next training level or not.

Minutes from this meeting are mandatory. The minutes include observations from the on-the-job training reports; examples of specific training points (good or not so good) are added if needed. We then produce a draft action plan where all the observations are included".

AND THEN?

"As soon as possible we meet the student; without feedback it is difficult to improve. We describe the instructors´ observations, not individually but as a group observation. We ask the student to produce his/her action plan based on our observations, to see how we can improve together. Finally we agree to one action plan to follow in the next phase of the training".

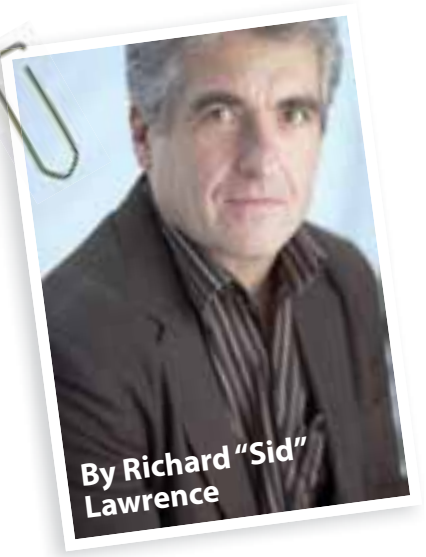
DO YOU EVER HAVE PROBLEMS?

"Sometimes a student has extremely good results; sometimes it may take longer to achieve acceptable skills. Some students only need around 80 days of operational training, whereas others need 140 days. The standard is 100 days; 80 in the ATCO working positions, 15 as an assistant controller (e.g. clearance delivery) and 5 for others (e.g. supervisor). The most difficult situation is when the student and the instructors have differing views of the progress. If problems occur, we always offer the students time with an independent behavioural psychologist to talk things through; we have found that such sessions help to improve the learning curve dramatically even if it may not be accepted immediately. At the end of the day, though, the students are ready to accept the help.

> "It is better to not be dependent on one instructor, by using several we secure an uninterrupted training period."

WHAT ARE THE SUCCESS FACTORS?

Nina stresses that it is extremely important to be clear and straightforward in communication (like all Swedes; author's comment). "This is valid for communication with the students as well as internally between the instructors. Support the student, make her/him feel comfortable and welcome, but make it very clear what is expected. Without clear goals it is difficult to achieve good results. So far we have been quite successful. Using four instructors is here to stay"!



REQUEST FOR SUPPORT MESSAGE

Handover/Takeover of operational ATC working

"During the past few months the EUROCONTROL Safety Alert service has been approached by a number of stakeholders requesting the promulgation of a safety alert covering a variety of topics. In the pages that follow, I aim to take you through a selection of the alerts that I hope will spark your interest.

As in the previous edition, my intention is to try and bring new information to the table. So, instead of a faithful reproduction of each alert, this section will also feature more in the way of feedback, responses, comment and analysis.

If you would like to know more about the EUROCONTROL Safety Alert service, register as a subscriber, submit a suggestion or have a subject that you wish to consider for a safety alert then please contact me at ***richard.lawrence@eurocontrol.int.***

The first Safety Alert to be reviewed is a Request for Support Message, Handover/Takeover of Operational ATC Working Positions ..."

Synopsis

Released on 26 May 2011

In 2004, a EUROCONTROL Safety Reminder Message (SRM) was released which provided advice concerning the handover/takeover process of operational ATC working positions. Since then, although progress has been made in many ANSPs, there are still problems in others that need to be addressed.

Indeed, more recently, a European ANSP detected incidents associated with a lack of transfer/assimilation of appropriate information during the handover process, leading to poor situational awareness of controllers taking over operational working positions.

Analysis

As the previous SRM on this topic said, *"It has been acknowledged that the vast majority of handovers take place without any problems, and only a very small proportion are flawed. Therefore, the level of normal human reliability has been already reached and potential mitigations should be targeted at the other system elements procedures (checklists) and/or equipment".*

Information requested

The purpose of the message was to collect details of the practical measures taken by controllers during the handover/takeover process to reduce the known risks in this area. Therefore, copies of any associated checklists, SOPs, techniques and good/best practices were requested.

Further reading

- **EUROCONTROL Safety Reminder Message - Handover/takeover of Operational Positions - 15 October 2004.**
- **'Selected Safety Issues for Staffing ATC Operations" http://www.eurocontrol.int/esp/public/site_preferences/display_library_list_public.html#7**

Alternatively, register your interest through the EUROCONTROL Website - Safety Alerts Board ***http://www.eurocontrol.int/safety/public/standard_page/safety_alert_board.html*** *or go to SKYbrary:* ***http://www.skybrary.aero/index.php/Portal:EUROCONTROL_Safety_Alerts*** *to access the Alerts featured here and all previous Alerts.*

positions

Summary of Responses (Identified)

Responses were received mainly on behalf of ANSPs, but the perspective of individual controllers was also represented.

The information received and consolidated below complements that which can be seen at the Safety Reminder Message, 'Handover/Takeover of Operational ATC Positions" dated 15 October 2004, on SKYbrary. Moreover, the feedback was sent to the requesting ANSP for consideration.

It is evident from the responses that a variety of means are used to assist controllers with the handover of operational working positions. The principal findings are:

- Most ANSPs have some form of checklist to assist in the handover/takeover process; the content is roughly the same but (unsurprisingly) there are differences between checklists used in ACCs, APP and TWR.
- Popular mnemonics for checklists include: 'REST', 'WEST', 'PRAWNS'. These are described in more detail later.
- At ACCs, checklists tend to be based on a 'corporate level' format/content and are often mandated for use, whilst in the aerodrome environment the design (format/content) and the use of checklists is often left to the discretion of local management.
- Checklists need to be short, easy to use and relevant. If they are too long and contain too much (irrelevant) detail, controllers are dissuaded from using them.
- Checklists are not exhaustive. It is the responsibility of both parties to ensure that all relevant aspects of the handover have been covered although in general it is accepted that overall responsibility for the successful completion of the handover/takeover sequence lies with the controller handing over.

Common Themes

Other themes, common to the handover/takeover procedures of all ANSPs, irrespective of the working environment, include:

Before Handover:

- The importance of pre-briefing, i.e. before the start of the operational shift/watch - see Request for Support Message, "Briefing and Provision of Operational Aeronautical Information to Air Traffic Controllers" dated 20 August 2010 as highlighted in HindSight 12.
- A handover produces workload of its own. The role of the Supervisor can be important in particular regarding current and expected traffic situation and possible sector splits. Careful consideration should be given to the timing of the handover, and if it seems likely that it will be necessary to split a sector within 10 minutes then the split should occur before the handover.
- Simultaneous double handovers of Executive/Radar and Planner/Coordinator controllers on the same sector/working position should be avoided where possible.

During Handover:

- Avoid distracting controllers involved in a handover. For example, OJT briefings should be held away from the handover in progress and Coordinator/Planner inputs should be saved until after the handover whenever possible.
- Follow the operational handover checklist (e.g. REST, WEST, PRAWNS).
- The outgoing controller must ensure that all relevant information has been passed on. The incoming controller must assimilate, and where necessary clarify, all information relevant to a safe handover and should accept responsibility only after he/she is completely satisfied that he/she has a total awareness and control of the situation.

REQUEST FOR SUPPORT MESSAGE (CONT'D)

Post Handover:

Some ANSPs also insist on an ATCO overlap period whereby the controller handing over is required to remain at the control position for a specified period until it is clear that the controller taking over has full command of the situation.

Until the handover is complete, other controllers on the sector should not give additional information unless operationally necessary.

The preceding elements can be captured in a general handover process checklist used by a number of ANSPs.

Handing Over	Taking Over
Prepare for the handover	
	Plug in to signal start of handover
Tidy up strip display	Evaluate the situation while outgoing controller performs 'house keeping'
Follow checklist such as WEST, REST, PRAWNS (see below)	
	Ask questions where necessary
Hand over control	Take over control but only when satisfied that a comprehensive handover has been given
Plug out; stay and monitor	

As part of a wider initiative to improve ATCO visual scanning processes, one ANSP unit has provided the following general handover guidance to its operational controllers:

Controller 5-Point Handover Check:

1. Are you fully rested/mentally ready to take the handover?
2. Approach the handover with the correct mental attitude... concentrate!
3. Take a while to watch what is happening before starting the handover, particularly where the traffic situation is complex.
4. Do not attempt to take over when a critical task needs completing (e.g. traffic on short final with one on runway still not cleared for take-off).
5. Outgoing controller to monitor situation after handover for a short while to ensure that the incoming controller has assimilated all the essential information.

Finally, several ANSPs also stated that it was important that controllers do not attempt to short-cut the existing good practices during low vigilance periods.

Handover Checklists

ACCs

Two common checklists used by ANSPs in ACCs are:
WEST and REST:
WEST (incorporating the most common elements from several examples (not exhaustive)

W	WEATHER	Turbulence, Winds, CB's, Icing, Pressure (Hi/Lo)
E	EQUIPMENT	Radio, Radar, Telephone, Spt Information, Navaids
S	SITUATION	Sector configuration, Individual Agreements, Military areas/activity, Holding, Special flights, CFMU/Flow regulations, etc
T	TRAFFIC	Traffic on frequency, Pending traffic and future tasks, Potential traffic conflictions and planned solutions

REST 1

R	RUNWAY IN USE	Runway in use, Weather
E	EQUIPMENT	Radio, Radar, Telephone, Spt Information, Navaids,
S	SITUATION	Sector configuration, Military areas/activity, Holding, Aerodrome Situation,
T	TRAFFIC	Traffic on frequency, other important traffic and future tasks

REST 2

R	RESTRICTIONS	Flow, TSAs, Danger, Prohibited and other special status airspace
E	EQUIPMENT	Radio, Radar, Telephone, Spt Information, Navaids, Maintenance
S	SITUATION	Weather, Staffing, Configurations, Strips, Holding
T	TRAFFIC	Traffic on frequency, pending traffic, military, VIP, un usual aerial activity, non-compliance with ATM regulations (RVSM, RNAV, 8.33, ACAS etc). VFR Flight, Clearances

Note. There is an important logic behind the REST sequence, building consecutively the situational awareness for:

1. *Environment framework.*
2. *Environment of operations.*
3. *Operations.*

Terminal (Approach and Tower)

A common mnemonic for checklists in the terminal environment is 'PRAWNS'

TMA/APPROACH

P	PRESSURE: High - Low - MSL
R	ROLES: Own and adjacent sectors
A	AIRPORTS: Runway(s) in use
W	WEATHER: Visibility, avoidance, winds
N	NON-STANDARD/PRIORITY INFO: Navaids, danger areas, non-standard frequencies
S	STRIPS TO DISPLAY

In one ANSP, PRAWNS has been adapted for TOWER as follows, although it is recognised that it does not always lend itself to all operations:

P	PRESSURE: Highlight
R	RUNWAY in use
A	AGL; lighting state AIDS: ILS, DME, NDBs, IRVR, ATM, SMR, DRDF, Wind Dials status AIRSPACE: CAS(T) etc
W	WEATHER: Highlight warnings, anything relevant W.I.P: Cranes, grass-cutting, surface repairs etc
N	NON-STANDARD: Procedures, flights, closures or restrictions
S	SITUATION: Full explanation of the traffic situation

Another ANSP uses 'SUSI'.

Sector	Runway configuration, runway change, spacing, restrictions, overflights, direct routeings, active aerodromes, actual conflicts and planned solutions
Unusual (operative)	Parachuting, military, Y/Z flights, VFR, priority flights etc
Situation (environment)	Equipment status, navaids etc
Information (general)	Weather, pilot reports, miscellaneous

Depending on the circumstances an additional 'S' can be added to make 'SUSIS':

S...plit	Transfer of control, frequency(ies) diversion

One ANSP provides a common handover crib sheet which details the runway in use at the unit, the runway in use at a close adjacent unit, the minimum stack level for aircraft transferred from the TMA sector and several other specific items. The sheet also includes a section for free text messages relating to non-standard items:

QFU XX (own unit)	
RUNWAY 14/32	
STATUS	
QFU YY (adjoining unit RWY)	
UNSERVICEABILITIES & OTHER INFORMATION	
Free text	
MIN STACK	
STD LANES	
SAFEGUARDS	
XXXX PARA ZONE	
LVPs	

Another unit from the same ANSP has developed an "Attention Directed Handover System" where the handover procedure is guided by physically numbering the salient points of the handover information and directing the attention of the incoming ATCO to each item in turn.

	Visual Control Room		Approach Control Room
1.	Information Board.	1.	Information Board.
2.	ILS Status.	2.	Weather.
3.	Weather.	3.	ILS Status.
4.	Surface Movement Radar.	4.	NavAids – Status and serviceability.
5.	NavAids - Status and serviceability.	5.	Traffic Situation.
6.	Airfield Ground Lighting Panel Status.		
7.	Traffic situation.		

The "Attention Directed Handover System" is deliberately different between the VCR and ACR:

- Firstly the position of the information in each of the two positions differs; therefore, to encourage expediency in the handover it is more suitable that the various parts of the handover are addressed in a different order.
- Secondly, the different order promotes awareness in the controller that the handover is taking place in a different operational environment which has proved valuable when dual-valid controllers are moving between operational positions without breaks.
- One of the advantages of this system is that as the outgoing ATCO is briefing the incoming ATCO, their attention is physically directed to each part of the process and it is therefore methodical and structured.

Conclusion

Handover/takeover is a known potential weak point in ATC operations. In reality not much has changed since the first SRM on this issue was published back in 2004 and the comments made then are still valid today. The information gathered as part of this RFS merely reinforces the situation. To reduce the known risks requires a mixture of professional standards backed up by systemic processes, procedures and methods (e.g. checklists) to be in place and utilised for each and every operational handover/takeover.

SAFETY REMINDER MESSAGE

Pilot actions on weather deviation

Synopsis

Issued on 12 July 2011

EUROCONTROL has received reports where flight safety was compromised because some pilots in adverse weather avoidance scenarios do not ask for prior ATC clearance/inform ATC when they are clear of the weather and are returning to their previously cleared route.

ICAO Provisions

Doc 4444 PANS-ATM - 8.6.9 Information Regarding Adverse Weather:

- 8.6.9.1 "Information that an aircraft appears likely to penetrate an area of adverse weather should be issued in sufficient time to permit the pilot to decide on an appropriate course of action, including that of requesting advice on how best to circumnavigate the adverse weather area, if so desired.

  Note - Depending on the capabilities of the ATS surveillance system, areas of adverse weather may not be presented on the situation display. An aircraft's weather radar will normally provide better detection and definition of adverse weather than radar sensors in use by ATS."

- 8.6.9.2 "In vectoring an aircraft for circumnavigating any area of adverse weather, the controller should ascertain that the aircraft can be returned to its intended or assigned flight path within the coverage of the ATS surveillance system and, if this does not appear possible, inform the pilot of the circumstances.

Note - Attention must be given to the fact that under certain circumstances the most active area of adverse weather may not be displayed."

Special procedures apply to weather deviations in Oceanic airspace and these are contained in PANS-ATM, 15.2, § 15.2.3.

completion of an adverse - ATC clearance

Analysis

- Avoiding adverse weather conditions places increasing demands/workload on pilots and controllers, in particular in congested airspace. Consequently, they should work together utilising the best information available to ensure the safe passage of aircraft around areas of adverse weather.
- In Oceanic airspace, depending on the circumstances, it may be permissible for pilots to return to the previously assigned route without prior notification to ATC.
- In non-Oceanic airspace, whilst pilots are usually very diligent in informing ATC or obtaining ATC clearance to avoid adverse weather, uncoordinated turns by them to return to their assigned route once clear of the adverse weather may affect the controller's planning, further disrupt the flow of air traffic and induce conflicts with other aircraft.

Pilot and controller considerations

- In case of adverse weather avoidance, controllers should, whenever appropriate, and as part of the clearance limit, include a request to the pilots to report when clear of weather and able to resume the flight plan route.
- Pilots should, in situations as described above, once they have manoeuvred around the area of adverse weather, request ATC clearance/confirm with the controller before turning back to their previously assigned route.

Your attention is required

Aircraft Operators and Air Navigation Service Providers were invited to note the subject, follow the guidance as appropriate and share any relevant operational experience concerning the issue.

Comment

Modern day radars and surveillance systems are not very good at displaying areas of poor weather to controllers and in a lot of cases do not show it at all. Aircraft weather radars are therefore key safety features, but to get the best out of them from an ATC perspective it is essential that any actions taken by pilots to deviate an aircraft from its assigned course are properly coordinated with the controller on the ground.

Of course we all recognise that the pilot in command (PIC) has the ultimate responsibility for the safety of the aircraft, crew and passengers. Deviations around areas of adverse weather are a necessary part of day to day operations and are best done in coordination with ATC, although it is accepted that in some situations there may not be time for pilots to inform ATC before avoiding the poor weather. Similarly, it is safer, for all concerned, if pilots follow the same procedure once they are clear of the weather and wish to revert to their original track.

Further information

- SKYbrary - ATC Operations in Weather Avoidance Scenarios: http://www.skybrary.aero/index.php/ATC_Operations_in_Weather_Avoidance_Scenarios
- ICAO Doc 4444, PANS-ATM

SAFETY WARNING MESSAGE

Aircraft Mode S transponders - Incorrect and missing data - EASA safety information bulletins

Released on 11 August 2011 in response to a request from the EUROCONTROL Airborne Monitoring Project (AMP)

Synopsis

Accurate and reliable surveillance information and aircraft flight data, transmitted by Mode S transponders when an aircraft is in flight and on the ground, is crucial for the safe and expeditious operation of today's air traffic management environment.

Incorrect or missing data, whether caused by transponders or transponder systems' non-compliance with required Service Bulletins (SB), installation deficiencies, poor and/or incorrect maintenance practices, individual equipment malfunctions, or human input error may prevent aircraft from being presented on air traffic controller surveillance displays and Airborne Collision Avoidance Systems (ACAS II) equipment, and result in potentially hazardous situations arising.

The Airborne Monitoring Project (AMP) coordinated by EUROCONTROL had identified a number of safety issues and events related to the operation of Mode S transponders. Consequently, EASA had issued the following Safety Information Bulletins (SIBs):

- **EASA SIB 2011-13 (issued 04 July 2011) - Mode S Transponder – Loss of Detection (Complete or Intermittent) of Aircraft by Mode S Interrogators.**
- **EASA SIB 2011-14 (issued 04 July 2011) - Mode S Transponder – Incorrect Setting of ICAO 24-Bit Aircraft Address.**
- **EASA SIB 2011-15 (issued 04 July 2011) - Mode S Transponder: Ground Testing.**
- **EASA SIB 2011-20 (issued 15 July 2011) - Rockwell Collins TPR 901 Mode S Transponder - Incorrect 'Downlink Aircraft Identification' and Incorrect Operation with Airport Ground Tracking Systems.**

Purpose

The purpose of the Safety Warning Message was to further publicise these SIBs and highlight the associated operational safety-related issues.

Non-detection of aircraft by Air Traffic Control Radar Systems and ACAS II:

- An aircraft with a faulty Mode S transponder, which does not respond correctly to Mode S interrogations, can cause the aircraft not to be visible to air traffic controllers on their radar displays and seriously degrade or even disable ACAS II systems.
- An aircraft address acquired from other than the appropriate State of Registry or common mark registering authority, or an organisation approved by such authority, is not legitimate and can also cause the aircraft not to be visible to air traffic controllers on their radar displays and seriously degrade or even disable ACAS II systems.

Note: The provision of air traffic services using SSR Mode S relies wholly upon a unique ICAO 24-bit aircraft address for selective interrogation of individual aircraft and at any one time, the same address shall not be assigned to more than one aircraft. The unique 24-bit aircraft address is also an essential element of ACAS II.

Further reading

- The latest SIBs and ADs lists can be accessed at the EASA website (http://www.easa.europa.eu/).
- The SIBs referred to previously are at http://ad.easa.europa.eu/sib-docs/page-1 .
- SKYbrary: Mode S http://www.skybrary.aero/index.php/Mode_S

Increased controller and flight crew workload:

- Transponders or transponder systems that are non-compliant with the necessary SBs can downlink incorrect or corrupt data for aircraft identification purposes, which can cause an increase in workload for controllers and flight crew.

The AMP provide the following recommendations for aircraft operators:

- If you become aware of, or are notified by your national Aviation Authority (NAA), or an air navigation service provider (ANSP) of, a transponder deficiency affecting your aircraft, initiate unscheduled maintenance action to arrange for any deficiencies to be corrected, at the earliest opportunity.

- If you become aware, or are notified by your NAA, or an ANSP, that your aircraft has an incorrect ICAO 24-bit aircraft address, take action at the earliest opportunity to ensure that the address, as assigned to your aircraft by the State of Registry or common mark registering authority, is set correctly and tested for operation in the approved manner.

- Follow the guidance for testing of transponders found in the Appendices of the EASA SIBs 2011-13, 2011-14 and 2011-15.

- Check with your maintenance department or maintenance agent to confirm that the required Service Bulletins (SBs) relating to your transponder model have been complied with correctly and tested.

- Check with your maintenance department or maintenance agent that those EASA Airworthiness Directives (ADs) and SIBs that are applicable for the operation of your aircraft and transponders have been complied with.

Safety alert follow-up

Regular readers and Safety Alert subscribers will recall that in summer 2009 a Safety Warning Message was released highlighting the growing menace posed by the unlawful and inappropriate use of hand-held laser pointers against aircraft and, sometimes, ATC towers.

Since then, through EVAIR monitoring and other sources, it has become apparent just how widespread this hazard is across Europe and, indeed, the world. In concert with industry partners, ICAO, the EC and EASA, a multi-disciplinary Laser Interference in Aviation Seminar was held at EUROCONTROL on 10-11 October 2011. The aim was to bring together all the main actors to gain a better understanding of the threat and appreciation of the risk with a view to determining possible ways ahead, at national and international level. The event attracted over 140 people from across the aviation spectrum and also from law enforcement agencies and scientific academia.

The consensus from the seminar was that whilst national mitigation strategies and actions were having some effect on reducing the threat, these efforts were piecemeal and a wider concerted European approach to the problem would be advantageous. Consequently the main conclusions from the seminar were:

- timely and effective in-flight and post-flight procedures for dealing with interference are needed;
- training was necessary in these procedures for both pilots and air traffic controllers;
- the processes for alerting the authorities have to be defined and awareness campaigns run;
- guidance material for decision-making is also required;
- advances in nanotechnology filters might prove helpful in the future; and
- **the European Union should consider developing stringent regulation on the production, distribution, purchase, carriage and use of lasers.**

Case Study - Some mussica anyone?

By Bengt Collin, EUROCONTROL

In a bus

The bus was late. Not that it was important; a bus left every ten minutes. Perhaps this one is five minutes early, positive thinking he thought and drank some water from his bottle. The bus departed. He put the cap back on the bottle, returned it to his bag and started reading the morning paper.

"Wow, last Saturday was magic, just magic, you should have been there"; a girl in front of him talked on her cell phone. She did not need the phone, who ever she talked to could hear her anyway. Next to the woman was another identical girl. They were both wearing cabin crew uniforms, he could not identify from what airline. The bus was for the airport, it was not unusual to see people wearing uniforms. Normally passengers were sitting by themselves, sleeping or reading, sometimes just looking out at the landscape passing by. The bus left the city behind, they were surrounded by an intensely green forest, a few hills, a herd of cows grazing in an open field; I wonder what the cows think about us?

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"Have you ever flown on this aircraft type before?" The girl was now talking to her colleague sitting next to her, still using the same loud voice. He could not hear the answer, but he could follow the rest of the conversation, whether he liked it or not.

"Well I have never been inside one; they only trained me on that long aircraft with two engines at the back". "MD80" the other woman replied. "Yes that sounds familiar; anyhow today we will be on a 747; how many emergency exits has a 747? This is going to be exciting!" She almost did not have time to inhale. "And all the way to Greeeece". Her way of pronouncing the name of the country was interesting. She continued "I hope I have time to eat some local Mussica, or whatever it is called"; she giggled loudly; he closed his eyes and tried to sleep.

In an office

Arriving at the airport, he remembered his first meeting with the previous head of the training department. It was a long time ago, shortly after he had started his career as a controller. He had just turned twenty three; he thought the other man was very old, probably over thirty. The man was sitting silently in his office. The radio played classical music; it was an absurd scene because nothing happened. The man did not take any notice of him. After some time he started talking, still without looking at him; "when I started here, you could buy real yoghurt". It was the start of a long friendship. He used to help develop training exercises, everything from multiple choice papers, to search and rescue training in the forest next to the airport. He remembered that time with pleasure, things were much easier then. Now he was in charge of the training, life was complicated.

In the meeting room

He had called the meeting and invited three local instructors plus a representative from the ATC Academy. The results for the new trainees were alarmingly poor. This took resources away from recurrent training of centre controllers; for example, the simulator training for degraded modes had been postponed indefinitely.

The man from the Academy explained; "we have tried a new concept at the academy. The basic hypothesis involved was that 'natural talent' does not guarantee success. Studies involving elite sportsmen had shown that routinely it took at least 10,000hrs of practice (at a given skill), often over a 10 year period, for somebody to reach a level where they could be considered as 'elite'. The question was raised whether this could have a read across to air traffic controllers. This would avoid students being kicked out of the academy"; he twisted his pen continuously while talking, he gave an impression of nervousness.

What an idiot, he thought as he smiled at the Academy representative. This is a stupid idea. Intuition? What you need is talent! But he did not say that, instead he asked for advice on what to do.

"You should give them time and trust", the reply was interesting, time, how much time? "Forgive and forget

that is my advice. They will develop into bright young controllers; just let time do the job".

In the aircraft

Already when the pilots had accepted their jobs with the airline, they knew that things were not perfect, but they never dreamt it could be this bad. The owner was a true entrepreneur; some called him a cowboy, this was his third airline. The airline consisted of two hired MD80s soon to be returned, plus three newly-leased Boeing 747-200s, which had first flown in the late '70s. Little or no documentation on the maintenance of the aircraft existed. And whilst the pilots were experienced and well paid professionals, the cabin crew were young girls, with very limited training.

"Why is it so high?" The Captain did not sound worried at all, it was more of an expression of genuine interest. When you have 13,000 hours plus you never sound worried. The temperature on engines three and four was relatively high, not too high but high enough to ensure that the pilots stayed alert.

In the meeting room

"We have to do something", one of the instructors started the conversation two seconds after the door closed behind the Academy representative. "But what?" said the Training Manager. "We have budget restrictions, no overtime is allowed". "I do not care about budget restrictions; this is not going to work" the instructor replied. "Should we really continue training new students under these conditions, perhaps we should focus on our own recurrent training instead" the third instructor added. "But we will need the new controllers before the summer vacation period" the manager replied. "And now we are going to pay for our parking too" another instructor added. The conversation faded away.

In the centre

A tower controller visited the centre to talk to the supervisor. After entering, he walked slowly behind the row of approach controllers; "yep, now I have a full radar rating again", he said loudly enough for the controllers to hear. No one got upset, this was typical banter. In both approach sectors, student controllers were working. The trainee handling arriving traffic for the left hand runway had a relatively inexperienced instructor behind him, the other trainee a very experienced one. Or should have had, the instructor was temporarily outside the control room. Now and then he left; it was his way of teaching the trainee to handle the traffic himself. "The system is frozen", a controller from the left side of the room shouted, in fact they could see it by themselves, no labels were moving.

In the aircraft

They reduced thrust on engines three and four, it helped temporarily but soon the temperature on engine number three started to rise. "Shut down engine number three" the Captain told the First Officer, still in a very calm way; "I'll tell control that we want to return".

In the centre

The supervisor acted quickly; he pressed the button for the back-up system. All the standard systems were duplicated, plus they had an extra system with reduced presentation capability. This was the first time since they moved to the new centre three years ago that he had needed to start this final back-up system. "We have an emergency", an area controller shouted at him, "answer your internal phone, I am trying to call you". He picked up his phone; "a 747 is returning with one engine out, guess what airline". "OK, check souls on board and fuel endurance and switch him to approach", the supervisor replied.

Case Study
Some mussica anyone? (cont'd)

When the normal system stopped, the two student controllers were immediately overloaded. Even the less experienced of the two instructors was momentarily a bit lost, although he would never admit that afterwards. The 747 Captain called the trainee controller for the right runway whilst his Instructor was returning to the position, slowly walking across the floor completely unaware of what was going on. At the same time the other instructor took over control of the left runway from his student plus giving orders to the other student, "turn that aircraft NOW", he pointed at the returning 747. "T-line 123 turn right heading three three zero", the student for the right runway gave the instruction immediately, slowly resuming a normal awareness. He was not used to this back up system, the labels had returned but the scale, the colour was different. "Say again T-line 123". The instructor controlling the left runway observed that the T-line was not turning, instead giving an instruction to his own aircraft; "J-line 224 turn right immediately heading one six zero, opposite traffic twelve o'clock two miles same altitude. "TCAS climb J-line 224". The aircraft passed within half a mile horizontally whilst separated by only a few hundred feet vertically. The more experienced instructor was now back in position, he started working with fast short, focused, instructions. Finally everybody had the picture; the instructor turned and descended T-line for the ILS to the right runway. "Established runway 34 Right, T-line 123".

In the aircraft

He made a brief PA to the passengers to say that they had a minor technical problem and needed to return back to where they had taken off from. Always safety first, the phrase was perfect to use when something went wrong. The cabin was not chaotic but some minor incidents occurred when the passengers were told to remove the snacks and drinks the cabin crew had just sold them; "I want my gin and tonic", one passenger was almost crying. Finally everything calmed down. The aircraft landed and stopped on a taxiway, I hope I do not need to open the emergency exit; the cabin attendant thought to herself, the slide is locked into the lavatory.

In the de-briefing room

"I did not know what to do when the radar screen went blank. The seconds felt like minutes before it started working again"; one of the students explained. All the personnel involved were sitting in the de-briefing room after the shift ended. The walls of the room were white and the room had a bright wooden floor. In the corner was a small bronze statue of a large fish. "I thought you trained for such things at the Academy", one of the instructors asked. "No, we just do normal radar training, I do not even know if the system is capable of simulating these sorts of events", the other student replied. "The problem is that even if you train for it, such events are so rare that you forget what to do when it happens", the Training Manager added. "What could we have done differently?"

In the pizzeria

"No Greece today but still so exciting", the cabin attendant was in high spirits despite the abrupt end to their journey. "Come on, let's order a pizza with Italian Mossaka cheese".

Case Study Comment 1
by Dragan Milanovski

This is an interesting story about a loss of separation between aircraft where so many details seemed to contribute to the incident.

If ATC training is your daily business (instructors and training managers), you probably found it realistic. If you also found it extremely familiar, it is worth answering the training manager's question: "What could they (we) have done differently?"

This incident took place as the training manager was trying to find a solution for the alarmingly poor progress of trainees that was taking resources away from the refresher training. He was under pressure: they needed the new controllers by the summer vacation period, while facing budget restrictions – no overtime allowed and having to postpone indefinitely the degraded systems refresher training. What happened to the real yoghurt? Can we blame the ATC Academy for spoiling it by applying a new concept in training?

The study involving elite sportsmen with at least 10,000hrs practice over a 10 year period required to reach a level where they could be considered "elite" has been around the ATC training "world" for a few years. I have heard many different opinions (pros and cons) on whether the same theory can be adapted to ATC training or not. An interesting fact is that I (and many others I know) have played about 10,000 hrs of football in life, over a period of 30 years; I (and certainly many others) can hardly be considered football players, let alone "elite". However, I am not in a position to dispute the results of either the study or its application to ATC training.

The "supporters" would say that there are positive examples of ANSPs with very similar training philosophy and an extremely high success rate in training. Given the time and trust, everyone can develop into a bright and young controller. Although I am not sure about the "young". Such ANSPs are usually not under any sort of pressure (budgetary or manpower), or at least not under serious pressure, and they have great flexibility in assigning controllers to less or more complex ATC units. The few failures usually take place after several years in training when the student realises that ATC is not a job for him/her. Even then, there are many non-operational support posts where the student can fit in. So the training is not a total financial loss.

The "opposers" would say that ATC training is extremely expensive. The longer a student remains in training, the greater the financial loss in the event of failure. There are ANSPs where manpower planning is very strict, with constant budgetary restrictions and with no resources to spare. The choice and complexity of assignments is not always flexible enough. Within such ANSPs, the students' training is terminated very early (the moment any doubt is raised) in order to limit the potential financial losses, regardless of the fact that they are probably losing students (and money) who would make it in the end.

So, who is right?

The situation today, where most ANSPs are facing requirements to perform efficiently and improve over time, leads me to believe that a maximum training time has to be set. If not, it is just a matter of time until you end up in a situation similar to the one described in this case study, or you cannot perform as required. The ob-

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Case Study Comment 1 (cont'd)

jective of setting such a time is to find the right balance between the two options, appropriate for the ANSP. Students should be given all support, patience and trust for as long as there is a glimpse of a chance of success within the defined maximum training time. So, how do you find the right balance?

Unfortunately, there is no "one size fits all" answer and the discussion goes well beyond these comments.

The point I am trying to make is that it is not only the change of concept that created the situation from this case study. It is more the way it was implemented. One can rightly object to the ATC Academy deciding to try a new concept without taking the customers "on-board" (ATC Unit). Obviously they did not ask for an opinion, or bother to inform them. Hence, change risks were not assessed and mitigated. There is a clear lack of trust and cooperation between the ATC Academy and the ATC Unit in the story. The training manager did not think much of the ATC Academy representative, who was nervous at the meeting (he twisted his pen continuously) – maybe he was not sure about the new concept or most probably he understood the situation created by the way things were being handled.

I cannot say that a situation like this is unique to the story, on the contrary. The reality today is that there are training establishments who believe training students is their core business and they do not expect operational units to interfere with it. There are also operational units (or OJTIs) who are not completely aware of the training content provided (I thought you trained in such things at the Academy) nor appreciate the work done at the training establishments (forget everything you learned so far – I will teach you real ATC). Unfortunately, many students find this lack of cooperation and trust very difficult to deal with and their progress suffers.

Training establishments and operational training units have a common goal – licensed air traffic controllers within a reasonable training time. Therefore there has to be a common approach to training through cooperation and respect for each other, only then will the training be seamless for students and training success maximised.

Although I find the relationship between the ATC Academy and the ATC unit in the story very disturbing and probably the main reason for postponing the training for degraded modes, I do not think the incident could have been avoided if this was not the case. Postponing refresher training until further notice is definitely a mistake, but clearly, the more experienced instructor did not find it difficult to deal with the situation. The feeling that it was a minor contributor prevails.

Yes, the less experienced instructor was momentarily lost, but he did well to take over as soon as he realised the student (or himself) was overloaded. Some of you might find it completely inappropriate when he started giving orders to the other student, which is true if the other instructor was present at his working position. However in this case, I think it was necessary and it shows that the less experienced instructor had a lot more to worry about than just an emergency and degraded system.

The incident from this story could have probably been avoided if the more experienced instructor was sitting behind his trainee at the time of the emergency and the system degradation. It is not quite clear from the story whether the supervisor was aware of the situation or not. Obviously he/she has the ultimate responsibility for appropriately staffing all working positions at all times.

I must say that, unaware of possible consequences, I used to like working alone as a student (a rare opportunity given only by the most experienced instructors) – it was a real confidence booster. Later on, I was tempted as an OJTI, but never did it. Not because I did not trust the students, but because I was worried about missing a valuable training opportunity. I learned there are many other ways to boost students' confidence.

A RECOMMENDATION

The training manager / supervisor needs to take steps to ensure OJTIs are always present at the operational position while training is taking place. If a student needs to be trained he/she needs an instructor sitting behind (physically, but also mentally). I know this is easier said than done, especially with experienced instructors within certain environments where leaving a student on his/her own is part of the working culture, and, it might require more time to deal with.

If an OJTI thinks that their presence is not required while a student is handling the traffic, then they have a reason for celebration – that student is ready for check-out. Mussica...

Case Study Comment 2
by Alexander Krastev

The article describes an incident that could happen and may have happened anywhere. As is the case in many accident and incident scenarios a number of existing issues (latent threats) that cannot be easily designed out of the system manifest themselves at the same time and render the ATC barriers ineffective.

Why did it come to the point where TCAS had to save the day? The obvious, but by no means complete explanation is that the trainee controller could not maintain adequate situational awareness following the loss of radar information. Of course, the situation was seriously aggravated by the emergency state on board of the T123 flight that did not comply with the late clearance intended to prevent loss of separation with the conflicting traffic.

Is it possible to prevent such events in the future? I would rather give a positive answer to this question subject to the proper management of the 'latent threats' mentioned earlier, notably:

- simultaneous OJT at two neighbouring sectors;
- The OJTI's 'unsafe' practice (leaving the ops room to teach the trainee to handle the traffic himself);
- Considerable HMI difference between the main and back-up systems which impacts on controllers' ability to restore quickly situational awareness following failure of the main system;
- Insufficient training for degraded modes of operation and handling of unusual situations;
- The notorious shortage of ATC training resources, whether in the form of overbooked simulator facilities or an insufficient number of instructors always underpinned by ever increasing cost-efficiency requirements;
- Last but not least, the fact that the controller selection, education and training concept has changed a lot in the past 10 years. For example, many service providers have relaxed the educational requirements in order to ensure that the necessary uptake of ab-initio students is achieved.

> The possible measures need to be prioritised for implementation so that an acceptable level of safety is maintained all the time.

On the other (airborne) side - the airlines can also contribute to reducing the likelihood of such incidents by proper aircraft maintenance and continuing airworthiness procedures. Of course, adequate training of flight crews for emergency and unusual situations is a 'must', too.

In 'live ATC operations" it will take some time (probably a few years) to implement effective control of all of the above threats. Therefore the possible measures need to be prioritised for implementation so that an acceptable level of safety is maintained all the time. It is tempting to think that banning the instructors from leaving the operational position while training is on-going is the 'low hanging fruit' that will solve the problem.

A RECOMMENDATION

I would not bet my lunch on that, but make efforts to improve training for degraded modes of operation and the handling of unusual situations.

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Case Study Comment 3
by Captain Ed Pooley

Here we are looking variously at training standards and training performance as well as being forced to see the valid or invalid budgetary context within which the delivery of the training contribution to safety performance is attempted. And because we have hindsight, we can see whether the judgements on the use and quality of resources needed for acceptable safety performance were reasonable.

Although the main actual risk here is the TCAS-mitigated near miss between the returning 747 and the other traffic, the context for that was an aircraft which we can note was old and assume was not airworthy – hence the engine prelude to and fact of the engine shutdown and turn back. Not a terribly big deal for the Captain at least, since flight on three engines instead of four even at the likely aircraft departure weight makes very little practical difference. But it was obviously enough of a workload increase for the flight crew as a whole for their prompt acceptance of ATC clearances to suffer – and lead to the near miss.

The context for the un-airworthy aircraft is the fact that it was operated by a particular variant of the description 'entrepreneur'. Such ownership is usually inspired not by any desire to make money (if you want to lose money, set up an airline!) but by the 'glamour' of running an airline and the day to day challenge of survival. This is business on a knife edge and some of the names and faces, as in this case, keep on re-appearing. These people know that there is no possibility of any return on the investment made or on the risk taken. The former means minimising the investment and this in turn invites a characteristic series of business management decisions, some of which probably prevailed at the 747 operator in this case study. They are perhaps of only indirect relevance to ATC but as an aside on the premise of possible interest, they include (but are not limited to):

- Run the airline on an AOC provided by a State which doesn't interfere too much and is not greatly concerned with whether the airline has much affinity with its business domicile, provided the necessary regulatory fees are paid.
- Buy or lease old aircraft with low hull values to minimise insurance costs (despite their higher fuel consumption).
- Focus on ad hoc work because of the higher margins it yields relative to the unavoidably high cost of fuel
- Minimise the permanent employee headcount – wherever possible use part time or temporary personnel and maximise the use of contract or self-employed and/or part time or temporary personnel.
- Minimise the cost of aircraft maintenance; avoid long term contracts for it, save money by putting off 'fixes' to known problems and compliance with airworthiness directives until the last possible moment and avoid taking action on any non mandatory Service Bulletins; the next 'C' Check may cost more than the aircraft is worth so expect to cease using it at that point!
- Obtain cabin crew as cheaply as possible and give them the absolute minimum of safety training; most of them will almost certainly not be permanent or even full time employees and so investment in training them for either service or safety is self-evidently a complete waste of money.

Enough about the operation of 'fringe' airlines! There isn't much that ATC can do about them as airspace users except, perhaps, to watch the progress of their aircraft just a little more closely than aircraft of those airlines which

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form a more established part of the ANSP customer base.

Now to controller recruitment and training. Both the balance between the resources devoted to ab initio training versus those devoted to recurrent training and the role of OJTIs bear examination. It seems that the budgets for both types of training may have been set independently despite the fact that the single goal is a known quantity of operationally current controllers. If true, this would certainly represent very poor judgment by senior ANSP management. But rather more fundamental is the notion voiced by the ab initio trainer here that, given enough effort, almost anybody who makes it through this ANSP's selection process can and will eventually qualify as an operational controller – and will not then be 'incident prone'. Any reference to selection based on aptitude – or any thought that it might be relevant – is absent. And yet the use of psychometric profiling of both individuals and jobs is already moving beyond being just a critical element of selection for task-focused professionals towards its use throughout individual's careers to ensure that their attributes continue to match those required for evolving role requirements. Such processes ensure that, as the cliché goes, square pegs (not round ones) are put in square holes which produces happy competent controllers and almost certainly reduces overall training budgets, thus producing happy managers too!

On the operational front, we see an excessive requirement for OJT. We are told that both positions are being run by supervised trainees - and that even two quite small events – a non emergency turn back followed by a single missed clearance – led to a near miss and a need for a single qualified controller to temporarily take over supervision of both trainee-manned positions. It is fortunate that these sectors were quiet. Any attempt to rely on this type of solution extrapolated to, say, the Amsterdam, Paris or London TMAs, would not work and it should not be considered acceptable at the case study ANSP either.

Both the balance between the resources devoted to ab initio training versus those devoted to recurrent training and the role of OJTIs bear examination.

A RECOMMENDATION

I see an ANSP not entirely fit for purpose. It needs more effective selection processes for prospective new controllers. They should all check out with the required standard after a similar (and reasonable) amount of training and then go on to be comparably successful controllers able to respond similarly – and productively – to recurrent training throughout their careers. Once that's been fixed, some attention to the OJT system is clearly required. OJT whilst delivering ATS should be the exception not the normal condition, just as line/route training is an exception to normal operations for pilots flying aircraft. In other words, OJT should provide the icing on the cake baked in the simulator, not part of the cake too!

Gorillas in our midst

By Alberto Iovino

If you are ever planning on attending a Human Factor for ATM Safety Actors course, you should better not read the following lines: the murderer is going to be revealed, and most of your future fun would be spoiled...

On the other hand, you might eventually change your mind, and decide not to take the class any more, or life will maybe hinder you from doing it, or you may simply wish to read about them after the course and enjoy their content with the additional flavour of hindsight (not the magazine). So, unless you collect the full set of issues of Hindsight, meaning the magazine, the best solution is probably to tear this page out, put it in an envelope, seal it and write a to-be-read-after-HFfASA-course note on its back, afterwards stowing it in a safe place, but not so safe that you will not be able to retrieve it.

So, if you do ever attend a Human Factor for Safety Actors course, which I incidentally recommend, sooner or later you will be shown a video where a bunch of young mobsters engage in throwing a basketball to each other. Before playing it, the teacher will assign you what he, or she, will present as a very challenging task, i.e. counting the number of passes of the ball between folks wearing a shirt of the same colour, somehow suggesting all sorts of hidden and unexpected tricks and obstacles to what may appear a rather simple task. The video will run, you will watch very carefully and count, possibly developing a feeling of increasing self esteem, because it would turn out not to be such a big deal. At the end, you'll say your number, and most of the people will agree on the exact one, but very few, if anyone at all, will have noticed that, while the kids were doing their job, a guy (or a woman, very hard to determine) in a gorilla costume has entered the scene from the right, played the fool for a while in the middle of the joyful circle, and walked away to the other side.

The goal of the experiment is to show how human perception is driven by mechanisms, among which is the focusing of attention, which can make it so selective that people may fail to detect things otherwise perfectly evident and seemingly hard not to notice. This will probably remind surveillance ATCO readers of how, in the first phases of their radar training, they were so concentrated on picking precisely the right moment to assign a heading that they completely missed the unknown blip strolling across the display.

Alternative inferences are also possible. My favourite suspect is that gorillas are actually among us, exploiting some special power which makes them temporarily visible only to Discovery Channel cameras. Like it or not, this would at least account for all that hair in your shower drain. Anyway, this will not be the teacher's official standpoint and I am not in a position to argue. Instead, let's take this as an additional chance to consider a few thoughts on the subject of humans and safety, and relevant training.

A basic assumption is generally that humans make mistakes. As a matter of fact, the usage of the word mistake itself may be considered wrong, as specialists apply it to one specific category of errors, which also include slips and lapses, and that already gives you the idea of a complex, though indeed fascinating world. Never mind taxonomies, it is a recognised fact that doing something wrong is part of our very own nature; this we realised a long time ago, and any of us would readily admit this if asked for our opinion. Nevertheless, our errors in everyday life still tend to catch us by surprise and afterwards we ask ourselves how it could have happened.

An Italian journalist and writer once drew a clever picture of this . A spectator at Roland Garros in the 80's, he happens to watch a match between a local player and the German Boris Beck-

er. Becker, whom readers of my generation will certainly remember, ranks number one in the ATP, the best tennis player in the world, and he truly is at the top of his glittering career (not that it really matters, but I used to be a fan of Stefan Edberg). Still, when it comes to smashing a not particularly demanding lob, he "puts together his eighty kilos of power, the thousands of hours spent repeating that same gesture, his youth given away bouncing to a wall, the billions earned by doing it in front of people, the hundreds of matches won and lost, the thousand moments exactly like that already lived, always the same, and loads them all into his racket as he rotates it behind his back, raises it up over his head and perfectly hits that yellow ball". And buries it into the net. The message is clear and simple: "there is nothing to be done - if Becker fails on that stupid ball, why shouldn't you miss your life smashes?"

Accident statistics, and not only those in aviation, show a variable, but invariably significant percentage of human errors or, rather, human-factor related elements, as causal factors. Human involvement in any sort of activity is virtually inevitable, and even tasks fully performed by machines are still subject to some human contribution, even if it is only defining the processes they accomplish or designing them. So, once we have subscribed to the "errare humanum est" point of view, we are caught in the syllogism that humans do wrong, all things involve humans, therefore all things (may) go wrong.

Lots of common sense in that, though not far from the scientific approach, and at least one risk. In fact, what we now do is to go and look for the organisational factors that encourage a certain behaviour, for the latent failures that created preconditions for an error and for changes and actions that can help people to do the right thing. Many recommendations after occurrence investigation and analysis include the need for more or better training. The risk is complacency.

Such an alternative perspective on the matter is made available by Dr Tony Kern who, at an NTSB Aviation Safety Forum last summer, pointed out once more how we possibly went a bit too far in the "nothing to do" direction, proposing a catchy parallelism with our attitude towards cancer: though that disease may be seen as innate, we still actually keep on considering it a disease and we keep on fighting it and, while its full defeat remains a conceptual goal, we have at any rate achieved dramatic improvements over time. In Kern's words, errors do happen, but just saying that to err is human "gives up far too much ground"; after technology, systems, procedures and training, the final focus is on personal behaviour, where a lack of "professionalism" can bring the whole building down by what reports may refer to as inexplicable deviations from standard operating procedures.

There's neither the room nor the need to go deeper into this approach here, which one may legitimately accept as a useful counterbalance to a sort of involuntary, generalised fatalism, or instead as a reversion towards a blame culture; food for thought, a bit exotic perhaps. In truth, even beyond the author's intention, one can give various readings of the assumption that training someone to do something right does not imply simultaneously training them not to do it wrong.

In this issue of Hindsight, you will find out a lot about the importance of training, and share very valuable considerations and ideas about it, including the feeling of "better" training being even more important than "more" training. All in all, this is in the end consistent with the cancer-fighting philosophy, inasmuch as it is an expression of steady effort towards improved safety through error reduction, and insofar as it is accompanied by a constantly professional, individual approach on (and in some respects also off) duty.

Plus, of course, a regularly renewed cluster of fresh bananas.

Alberto Lo[illegible]no

is currently head of ATS Operational Procedures Unit within the Safety & Operational Quality Department of ENAV Italy. He was an airline employee for 8 yrs (PAN AM and Delta at Fiumicino – passenger service, ramp/operations; FAA licensed aircraft dispatcher) and worked for 13 years as ATCO.

The nudge in the back

By Eileen Senger

Do you still remember how it felt like when you were freshly checked out on a sector? When the theoretical exams were not too long gone and you knew every dot and every word of the rules and regulations, procedures and Letters of Agreement by heart? When nothing had changed yet?

With months and years passing by and documents being changed almost on a weekly basis this very theoretical knowledge fades, some, that you hardly use more than those that are kept up to date by every day use. But something very important happens instead: You build experience. And the more experience you build, the more you realise you are nothing without it. I wonder, how could I ever survive without it? Somehow I did, partly because of the experience being built whilst still in training, partly because of luck.

In a perfect world controllers would have both: enough experience to fall back onto in stress situations and the flawless theoretical knowledge that once made us pass our written and oral exams with pass marks well above 90%. Instead, if we are honest, most of us know that we have the theory we need for day to day business and, if we face a situation where we are not sure anymore about the theory, we at least know where to look it up. But isn't that just an excuse to calm our bad conscience?

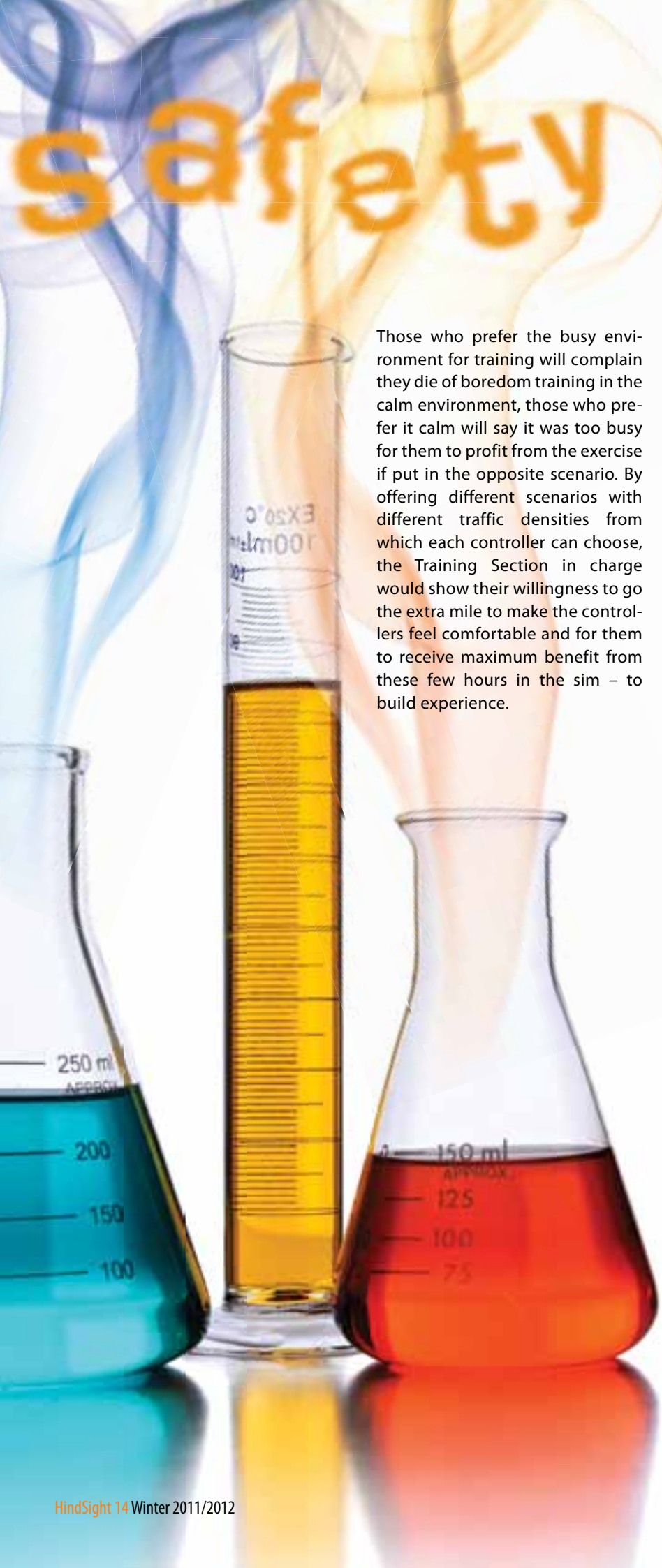
Eileen Senger

is an Air Traffic Controller at EUROCONTROL's Upper Area Control Centre in Maastricht. She works in the Hannover Sectors which cover north-western Germany and is an OGTI.

This is why refresher simulator and theory training is so important. There will always be those Superman types who claim they do not need it, that it is a waste of time and manpower. Maybe they really believe that, maybe it is a defence mechanism because they do not feel good about having to leave their comfort zone. But the vast majority is grateful for this opportunity to go into the simulator and train, to be able to make mistakes without endangering peoples' lives and to be able to ask questions about things they should know - but that have faded. Of course, all of us complain when the deadline for the theoretical knowledge test comes closer and we have to spend some of our precious time studying and recapping. But once it is over, the relief of having passed comes with the calming feeling of having again updated my theory database. I am grateful for this little nudge in the back every year!

When it comes to the practical simulator training different types of people prefer different types of training. There are those that prefer to train their unusual occurrences in a very busy, traffic-dense environment according to the philosophy that if I have to drown in traffic than I prefer to do it in the simulator. They claim their approach is supported by Murphy's Law ("What can go wrong will go wrong") as you can usually count on the fact that, when something unexpected happens, you are already busy enough handling the normal traffic. Then there are the more conservative types who prefer the opposite approach with very little traffic so that they can concentrate on every small aspect of the occurrence to be trained. To focus 100% on the holding pattern, fuel jettisoning or emergency descent rather than doing it with 15 other aircraft to be separated, climbed and descended.

> I feel lucky to work in an environment where it is demanded by the regulator that we train for safety again every year and where the employer supports and accommodates that



Those who prefer the busy environment for training will complain they die of boredom training in the calm environment, those who prefer it calm will say it was too busy for them to profit from the exercise if put in the opposite scenario. By offering different scenarios with different traffic densities from which each controller can choose, the Training Section in charge would show their willingness to go the extra mile to make the controllers feel comfortable and for them to receive maximum benefit from these few hours in the sim – to build experience.

In addition to the annual theory polish-up and practical simulator session, there is one more aspect contributing to building experience in unusual situations which I consider is important: and that is to share experience from situations where things went wrong, i.e. 'incidents'. Again, if such briefing sessions are offered on a voluntary basis, you will not reach all people and especially not the "Superman" type we met before and who again thinks it is all a waste of time because what could he learn from other peoples' mistakes? But if such a session is included in routine training days, then everyone will be covered. I have always found that a few incidents selected, shown, explained and discussed have been very helpful for my future work and whenever it helps me identify a potentially dangerous situation building up, I silently thank the incident briefing team. A simulator session alone cannot provide that same learning effect.

I feel lucky to work in an environment where it is demanded by the regulator that we train for safety again every year and where the employer supports and accommodates that. Yes, it does take time and it does draw manpower away from Operations but it is a very wise investment in safety. Because a solid theoretical knowledge plus experience plus – every now and then – a little luck, equals safety.

Of culture, catwalks and models in ATC initial training

By Max Bezzina

In this article I will look at learning the ATC culture during initial training and the corresponding role of the instructor.

BUT BEFORE I BEGIN, A SHORT PREFACE:

Of knowledge and culture:

We could say that to be successful in a particular field one would need a combination of ingredients, rather like a good balanced recipe. These ingredients are:

- knowledge of what needs to be done,
- knowledge and application of how to behave in the environment and
- good doses of luck, audacity and timing.

It would be very interesting to have a look at how luck, audacity and timing play their role in successful ATC, but that would need a separate article with a focus on ¨The other factors¨ (maybe in a future edition of Hindsight?). In this one I will focus on the first two points on the list which, for the sake of brevity, we could call:

- **Knowledge** what I referred to as 'knowledge of what needs to be done' and
- **Culture** (short for: ¨understanding and thriving in the culture¨) which I referred to as 'knowledge and application of how to behave….'

Whereas knowledge could be considered as a ´hard´ component - you know it and apply it or you don´t, culture is softer, and the subtleties of behaviour are harder to teach and/or learn.

Of learning:

In any learning activity there is both formal and informal learning. We could say that formal learning is what is contained in a training syllabus and therefore what will be formally taught in a training establishment. Informal learning, on the other hand, is what a person learns that will help them in the tasks they are to carry out, but which is not itself part of the syllabus.

To illustrate the four items above, if we consider a student learning how to drive, then:

- **Knowledge** is what the student knows in terms of traffic signs, right of way and of handling of the car.
- **Culture** is how to stay calm (or lose it), how to behave in traffic jams or in busy parking lots, when to use or not to use the horn, etc.
- **Formal learning** would be what the student learns from the books and during the practice hours with their instructor.
- **Informal learning** would be what they learn (or shouldn´t learn) by observing their father drive through the years.

ATC training

If we apply all the above to initial ATC training, we see that in terms of formal training, we have many hard objectives focusing on the knowledge component – e.g. all the basic subjects like Navigation, Meteorology, ATM, ... (with the exclusion of Human Factors) and all the procedures in the Rating part including most of the practice in the simulator. At the end of this, the student who passes will "know what needs to be done", will obtain a student licence and will be eligible to start unit training.

Formal learning in terms of culture is mainly covered in the Human Factors modules and in others dealing with the professional environment. These modules teach how to "behave in the environment" and include some application through role play and familiarisation visits.

This is already a very good start, but since the ATC culture is very rich, in my opinion one can do more – and in many schools actually more is done. In the definition of ATC culture, I would include amongst other aspects how to behave in an operations room, how to work in a team, safety culture[1], and the concept of service in terms of efficiency and order.

Teaching the culture improves safety awareness and safety. And who needs to transmit all these softer elements of behaviour and attitude? Well, the instructor.

In terms of a training organisation, it is never too early to introduce as much ATC culture to students as possible. It is true that initial training is detached from the operations room and that there are still training phases later on, such as the on the job training, when the student will have the opportunity to learn culture. However, from experience, on the one hand students are eager for information on how it will feel to work as a controller and are sponges for behaviours and attitudes (good and bad ones) in the ATC world and on the other hand having the students already assimilating part of the culture as early as possible is of great benefit for their understanding of what the ATC world is about.

Culture can be transmitted during training in a number of ways, a couple of which are:

- imitating the real environment whenever it benefits training and
- raising awareness amongst the instructional team, especially the simulator instructors, about their function as role models for the profession.

In the rest of this article I will develop on these two aspects which in the end are intrinsically linked with one another.

1- how a controller behaves professionally to ensure that while he or she is working, safety is facilitated at all times and that the system within which he or she works maintains an adequate level of safety or improves it

Imitating the environment

When imitating the life environment during training, it is important to keep the balance between two things:

- On the one hand that students are still learning and therefore that it is normal to make, and learn from, mistakes, and
- On the other hand that even though they are working in a simulated environment, there is a certain degree of seriousness and responsibility and that everyone needs to do their best to ensure safe services.

On other aspects, the same should apply: If it is forbidden to use mobile or smart phones in an operational room, the same should be applied in a simulator. If it is good practice to be at least five minutes early for a hand over in the operational world, then it is also positive to teach the student punctuality, the time a good handover needs, and the need to be there a little early so that their colleagues can have a full and well deserved break. Students should be taught not only the hard and fast procedures (knowledge) but also how to address and talk to colleagues, adjacent centres, pilots and others. They should not only be taught how to execute a procedure, but also that they are part of a safety chain and that there are defensive ways of controlling that will strengthen that chain. They should learn that procedures are there for a reason and that the justifications for bending or omitting them are very rare if not non-existent....Teaching the culture improves safety awareness and safety.

And who needs to transmit all these softer elements of behaviour and attitude? Well, the instructor.

The instructor as a role model

As mentioned in the example above, a lot of what a new driver has learned is what he or she has observed their parents, senior siblings, or significant others doing. It is like that in all aspects of life; our children do what we as parents, what society at large, what elder siblings, what TV and what cinema do. Our culture is taught informally through observation, trial and error. There are some who learn quickly, some who learn even more to the extent of manipulating others or of challenging the status quo, and others still who never learn and end up in trouble.

Now, ATC being quite a closed environment, all that parenting, sibling, cinema and TV, especially in the early (but often super intensive) days of initial training is condensed in the few instructors who have lived in and are part of the ATC culture that the students can interact with, observe and scrutinise.

Of culture, catwalks and models in ATC initial training (cont'd)

So it is very important that we instructors are aware of our role and that while walking on the catwalk we need to act as positively and as naturally as possible.

What follows are a number of areas where we instructors, apart from teaching hard and fast procedures, need to be aware of our role in passing on ATC culture in the knowledge that we are ourselves being observed for such behaviour.

Setting limits

It is very important that we instructors set limits to what is and is not allowed in a simulator, both in terms of controlling traffic and in attitude and behaviour off the mike. We also need to be aware that we are under observation as we interact with our colleagues, on how we treat diverging opinions with respect, on how we correct mistakes, on how we follow rules.....

In terms of safety, for example, it is of benefit, as I commented above, to allow the student to try out new things and to push his or her limits, however this should never be to the extent which gives the impression that everything could be tried out and that everything is allowed; after all ATC training is not a video game, even if it may look like one to someone who knows nothing about its culture and goals. I am a firm believer that safety as a paramount priority, and that in our job we cannot bring aircraft too close together, must be transmitted at all times to students.

Max Bezzina

is the Head of ATC training at SENASA in Spain. He also keeps a regular blog on ATM.

On the same theme but outside of the immediate operational environment, we as instructors are being observed for our attitude in the simulation room: arriving late, excessive talking or laughing during an exercise should be stopped both for students and for us. ATC culture does not allow that.

I am a firm believer that safety as a paramount priority, and that in our job we cannot bring aircraft too close together, must be transmitted at all times to students.

Teamwork

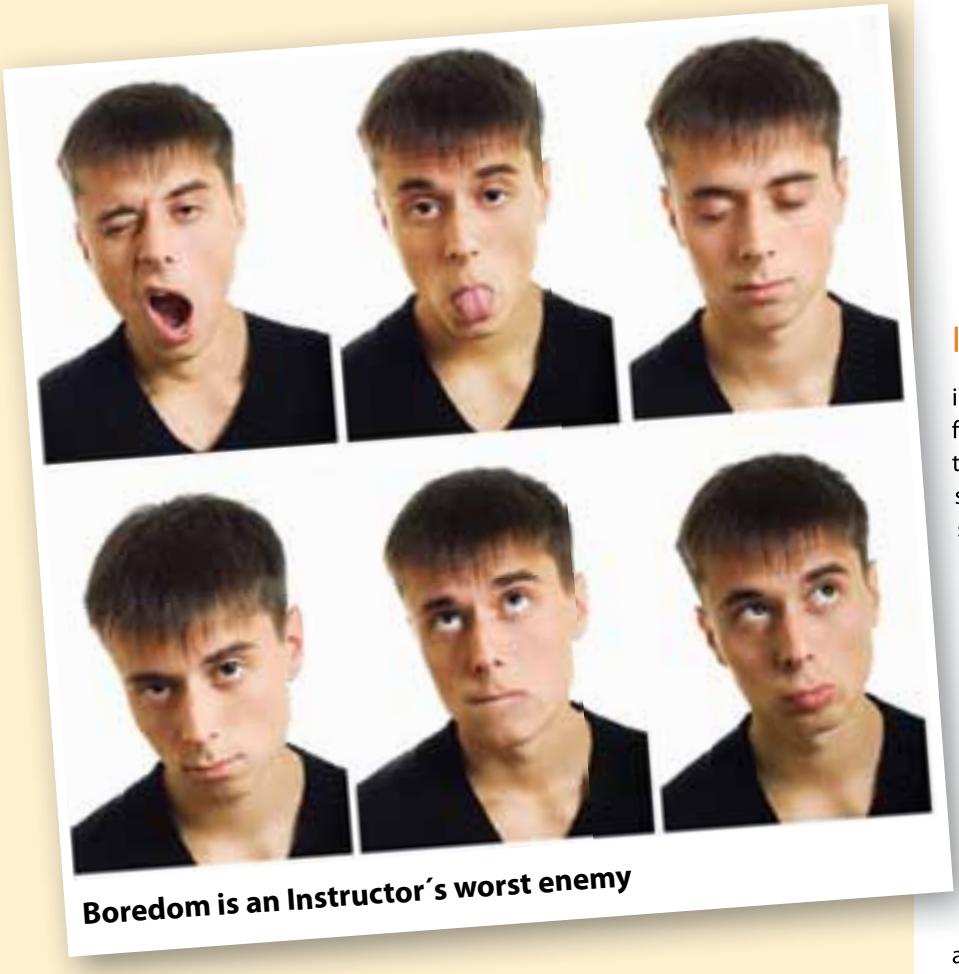
Teamwork is another area where the instructor is being observed. In training theory we insist a lot on the necessity of good teamwork, both between controllers in a unit and between all those involved in the chain. Not all students come to training with an innate disposition to working in a team and the idea that a team will help them and will improve safety. Some have individualistic traits that need to be curbed. In addition to teaching procedures, we should observe and correct the attitude of students to one another and to other people in the environment such as pilots or assistants. Also, charity begins at home and we are part of that chain and we also work within a team. We should not forget that how we relate professionally with others, such as pseudo pilots or administrative members of the team, is being observed by our future controllers, who are registering: ¨This is how a real controller behaves¨.

The ¨In the real world we do it differently¨ syndrome

Students look for guidance from instructors on how to apply the procedures they are being taught.

Some instructors feel the need to go further than simply teach procedures and it is of great benefit for a student to work with an instructor who explains the background as to why a procedure exists and to explain the links and rationale between procedures and how we use these with real traffic. I remember to this day an instructor on my initial ATC course who would take time to explain to my colleagues and I how he had used a certain procedure on a given day and why it was very convenient for him to know it. He was patient and a good story teller. He used to make us feel like we were already working with him in the ops room.

On the other hand, there are only a very few things which are worse than an instructor telling a student that ´in the real world´ things are done differently and that a procedure is only being used for ´school purposes´. The contextual difference between the application of a procedure in an academy and in operations is considerable, but instructors need to understand that a student who has only a few months' experience in an academy and has not yet worked in operations cannot fully understand this context. Running before learning to walk is as illogical as trying to teach complex operational contexts to students who do not have the experience yet to appreciate them.



Boredom is an Instructor´s worst enemy

Students are still learning things instructors (should) already know. Students are still pushing their traffic threshold; ours should have already been pushed up. Students are seeing an exercise for the first time: for us it is maybe the tenth or twentieth time we are seeing the same exercise. The student is performing; we are observing.

All the elements above mean that our mental activity rate is many times slower than that of the student. This is part of training and part of our job. We should never try to make things interesting for our benefit. We should not, for example, ask the students to try new things that they have not covered. We should not, as mentioned in the part just above, oblige the student to do something in a different way to that which they have been taught already if the main reason for doing this is not for their benefit but for us to moderate our boredom. We need to remember that students have a very limited set of tools in their bag and they are still learning how these tools fit together. Adding more new tools to it will not make them better or quicker, it will just overwhelm them. It will give them the impression that you are teaching them a completely different thing to that taught on the course and we risk creating an impression of conflict between our team of instructors. It reflects badly on us as a team and on our message of teamwork.

Nor should we fall into the trap of showing disinterest or fall asleep during an exercise (like one of my instructors used to do sixteen years ago when I was a student – I still remember it!). Before we reach that point, it is time to move on in our career and do something else!

In conclusion

in this article I have tried to highlight the fact that ATC culture is something that ATC training professionals should be aware of as something to actively teach because it helps students to make sense of the working world and of its modus operandi. Teaching culture is not achieved mostly through formal training, since knowledge about a culture only goes some way, so the main way is by being immersed in it. Culture is soft and informal. We instructors are the ones who are best placed, in the first days of a controller's career, to begin developing awareness of this culture. This needs to be done by being clear on the behaviour expected from the students and by being prepared to correct and comment upon this and by being aware that instructors are role models and that our behaviour in the simulation is being scrutinised by our future colleagues, who would like to look a bit like us!

Before I close I would like to make a point on one final cultural trait – Professionalism. ATC is a profession which we should be proud of. As instructors we are the initiators (I intentionally did not write bouncers!) into the profession for all the students who eventually will become our colleagues. We need to carry the banner of our profession high. We should never talk down our profession, and when we need to criticise things (since the right sort of criticism is healthy) we should do so constructively and in a way which can be understood by students with only a few months of experience. The analogy might be like talking about feelings to a six year old. We also need to implicitly pass on the message to our students that they have made the right choice, that they are in a great professional environment and that it is good to be in ATC. The best way we can communicate this is with the message which is written all over our body.

The Emperor's new clothes... or what exactly is TRM?

By Svetlana Bunjevac

So what exactly is TRM?

A Technical Reference Model

B Total Runway Modeller

C Team Resource Management

Yes it is (c).

Still, Team Resource Management as a term does not immediately communicate what it is. Is it Team Building? Resource Management?

The word "resource" has many meanings as it is, let alone when accompanied with another word of similar ambiguity. For example, when looked at from the ANSP's budgetary department point of view "resources" are usually thought of as funds per fiscal year, expenditure and the like. Moreover, human beings are also seen as a 'resource' and valued in terms of money. And here is the first hint – TRM considers people as a resource based on the value of their team work, on the benefits of working together, on what we gain by helping each other.

Svetlana Bunjevac

teaches in EUROCONTROL Institute in Luxembourg. She is former controller, OJTI and shift supervisor.

TRM has been around for many years and still there are many examples of misunderstandings. So to dispel any remaining confusion and for the purposes of this article it's my belief that TRM is about recognising the safety impact that the team performance of professionals has on OPS. More to the point, we analyse how individual and team actions, successes and errors make the human shield against incidents and accidents stronger or weaker. Thus, the goal of TRM is to prevent team related errors and manage the effect(s) of those errors that still occur.

It is the controller's equivalent of Crew Resource Management for pilots

Do you remember Hans-Christian Andersen's tale about the Emperor who was promised a new suit of clothes that are invisible to those who are stupid or incompetent? When the Emperor parades proudly in his "new clothes" nobody dares to tell him the truth that he is naked, for then it would be said that he was unfit for his position or that he was stupid. Only a child says, "but he isn't wearing anything at all!" The analogy with seeing your colleague naked and not giving some feedback may be exaggerated but here are the words of Captain Al Haynes, pilot of United Flight 232, which on 19 July 1989 suffered an uncontained engine failure which led to the loss of all three hydraulic systems, consequent loss of flight controls and a crash-landing at Sioux City, USA. Although still an accident, the event is considered to be an example of good crew resource management – communication, coordination and decision making. Captain Haynes commented:

"Up until 1980, we kind of worked on the concept that the captain was THE authority on the aircraft. What he said, goes. And we lost a few airplanes because of that. Sometimes the captain isn't as smart as we thought he was. And we would listen to him, and do what he said, and we wouldn't know what he's talking about. And we had 103 years of flying experience there in the cockpit, trying to get that airplane on the ground, not one minute of which we had actually practised any one of us. So why would I know more about getting that airplane on the ground under those conditions than the other three. So if I hadn't used [CRM], if we had not let everybody put their input in, it's a cinch we wouldn't have made it".

I'm just wearing what my boss told me to!

Do you have TRM in your organisation?

"Sure we do have it. I am absolutely sure because we have a TRM course during which we watch videos and play role games. Oh it was so much fun the last time - we were assembling a floor puzzle. A very simple puzzle of 20 pieces, each of us holding a piece or two, but we were all blindfolded. Man, it took us lots of talking to coordinate this simple task! I have a feeling that we are playing a similar game in aviation with the chaps from airlines and airports".

Well, if all you can say about TRM at your place is that there was a course, even if it was a funny one, then I have some news for you. There is a great chance you do not have TRM.

To work, TRM must be applied in the operations room, not just in the classroom. It is not about being convinced of the importance of good team communication and decision making and leaving it there. It is rather about, on a regular basis, giving each other feedback, learning from each other's experience and keeping the two elements a part of our daily life. It is about building sustainable, reliable and consistently safe behaviour.

So far we have looked at the meaning of TRM, at its basis and we have questioned what "having a TRM" means. What follows is reflection - do we need it, what exactly is done during a possible TRM session and why not use a lecturing format for TRM.

It is not all that natural to us – we do need time to reflect on our work and recognise the "good solutions" and the "not so good ones"

For example, a question here might be: *"Why do I need training to communicate better with my colleagues? We are all professionals."*

Well, in stressful situations, and we do have some in aviation, our brain still follows the very ancient strategy of "fight or flight". The brain tends to sharpen the sensors, stop complex thought and triggers an automatic, 'knee-jerk' response that can have very negative wider effects on complex systems and the teamwork which controls them. This ancient and automatic response is hard-wired into our brains and may have been very good for helping our ancestors to survive when unexpectedly crossing paths in the forest with proverbial sabre tooth tigers.

Today, especially in the aircraft flight deck or in the ATC centre, the sabre tooth tigers are extinct and besides keeping the traffic safe, we need to be able to effectively communicate and cooperate with our team mates when stress hormones flow into our bodies. This is not something we do naturally because the primordial instinct to "fight or flight" is still with us. So here we need reflection time, a dedicated and structured self-learning process to understand how to recognise in good time the signals of "fight or flight" in abnormal situations and to still be able to effectively communicate and make appropriate decisions. Even if it is only to ask for a brief break from duty in order to rebuild one's "mental picture".

What do you TRMers* do exactly?

What exactly happens in this "TRM World"? Well, we use a lot of "case studies" but the aim is not to find the guilty party. Also we watch films - but not to train as film critics. And we play games to have fun, of course, but not only that.

All the above will be our prompts to start discussions on topics that affect safety, such as situational awareness for example.

▸▸

***TRMer: person who embraces TRM in their work**

The Emperor's new clothes… or what exactly is TRM? (con'd)

A concrete example?
Within a team of ATCOs and/or assistants, hold a discussion on situational awareness or "having a mental picture". Here's a quick plan of how it might be done:

1. Play the funny video that many know as "USS Montana Battleship" (and have a good laugh).

2. Enable a short discussion on What just happened?!? Why did the Captain react the way he did? Was the real situation known to him?

3. Ask if something similar to what happened in this video happens in the OPS room? What exactly do I use to build my picture of what is going on around me? What helps me do that? (recognising what works well). What makes it difficult for me to build a realistic picture? (identifying error prone conditions).

4. And finally ask for (and log) lots of ideas and advice on what action exactly one can take to make sure one's situational awareness is maintained? Or rebuilt after it was initially lost? (developing a plan of actions for future use)

This was a very general example using a non-ATC video to discuss an ATC prerequisite of having and maintaining a "mental picture of the overall air traffic situation". Using documented cases or videos will focus the discussions even more and will enable very specific "advice" and possible solutions to be given by a panel of experts in their domain – in our case, air traffic control.

Why do you do it this way – using self-learning rather than classic lectures?

In my opinion, this is one of the keys to a good TRM training programme – it is not meant as a tool to allow experts to lecture experienced controllers on how to be safe as there are many training courses available to teach/lecture different aspects of ATC including safety methodologies and the like. A TRM training programme delivered in the form of discussion sessions can unlock the existing expertise, experience and skills that ATCOs have and enable all the operational questions, doubts and uncertainties to surface and receive appropriate attention before they become an irreversible situation. The starting point of TRM is that someone who does the job "day in, day out" gains first-hand knowledge of whether they are safe or not as well as a very good idea of why that is so. TRM, in a structured way, then makes use of this expertise and experience in order to prevent errors or manage the effect(s) of errors which do occur.

A good TRM training programme … is not meant as a tool to allow experts to lecture experienced controllers on how to be safe.

OK, we have looked at the meaning of TRM, at its basis, we have questioned what "having a TRM" means, reflected on why we need it, what exactly is done during a possible TRM session and why we don't use a lecturing format for TRM? To round things off, I think it is only fair to also give some points on TRM programme pitfalls:

- To prevent; verb (pre-vent) – to keep from happening. This can be a big problem at times, especially if one wants to measure effectiveness of preventive programmes. Have I not got the 'flu because I have been taking vitamin C for some time now, or is it because I was not exposed to the virus? … And TRM is the prevention programme.

- In aviation, once something like an incident or an accident happens, there is an established set of actions and procedures to be followed in order to understand what has happened and what caused it to happen. CISM support is made available to staff. Also, we keep all the findings carefully filed to be used to change/improve our environment. Now, if an incident does not happen, what are the procedures to understand why it did not happen? What worked well? This is exactly the problem of the visibility of TRM operational benefits because the ultimate OPS aspect of TRM is that error is prevented (or promptly controlled with no significant incident resulting) and so "nothing happened".

A little conclusion

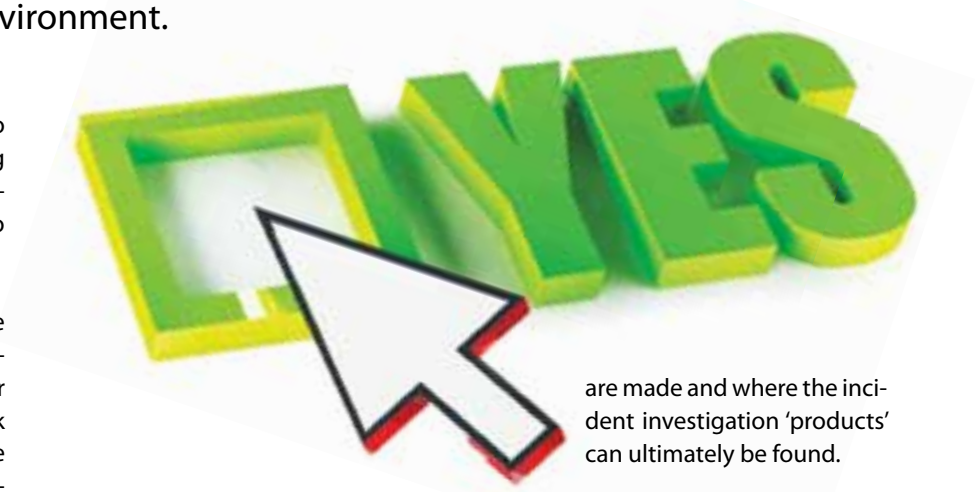
It is interesting that the need for, let's say, voice communication system weekly/monthly/yearly preventive maintenance programmes is hardly ever questioned. But there are not many preventive or maintenance programmes for operational human systems in ATM, let alone weekly or monthly ones.

Finally, I would like to propose that since the TRM is a safety programme, it can also be seen as the opportunity to allow experts to give constructive feedback on our 'new clothes', hence we do not end up walking naked around the town.

STCA training - yes, we can!

By Rui Manuel Santos Filipe

We all know the consequences of a loss of separation or risk of collision can be extremely severe – psychologically, emotionally, socially – for the controller(s) involved, even in a no-blame just culture environment.



We know that, but sometimes we do nothing or very little in our training to prevent it from happening. In Lisbon we were aware of the problem, so what did we do?

The need for a simulation replica of the operational system was initially identified in 2003, when the first refresher course for Lisbon controllers took place at the NAV training centre. The participants found the existing simulation platform inadequate for the refresher courses. The differences from the operational system in terms of both functionalities and user interface were very considerable, e.g. no availability of OLDI and STCA, flight strips with a different layout and sometimes not event-printed etc. The decision to develop a simulation platform capable of replicating the operational LISATM system was taken by NAV in 2004. The new simulation system would be used not only for ATS training at local units (like Lisbon ACC) but also for pre-implementation testing and staff training.

The new SIMATM simulation platform was installed in the Lisbon ACC training room during the 3rd quarter of 2009, aiming to provide the Lisbon controllers (both ACC and APP) with a simulator which could cover all the functionalities, tools and capabilities of the operational system, including the user interface.

Between October and December, the 2010 area surveillance control refresher course modules (sixteen of them) were conducted using the SIMATM, allowing us (finally!) to train controller response to STCAs, as recommended by NAV SEGNA back in 2004.

> After all, the product from investigation is not just the investigation report but the real improvement of safety.

The need for specific training in this area had been identified early on. We have learnt from the incidents. Our incident investigation process is very efficient and always directed at practical improvements. After all, the product from investigation is not just the investigation report but the real improvement of safety. Training, together with operations management and procedure and equipment design, constitute areas where improvements are made and where the incident investigation 'products' can ultimately be found.

The incident analyses which I refer to here are events involving STCA. We found that late issuing of conflict avoidance instructions, lack of use of precise and adequate avoiding instruction phraseology and insufficient corrective instructions for the flight profile resulted in otherwise avoidable loss of separation. Prompt and decisive action would have solved the

▸▸

Rui Manuel Santos Filipe

51 years old, flight data assistant since 1979 and air traffic controller since 1983. Between 1983 and 1991 ATCO in Santa Maria OACC (Azores), from 1991 to 1996 worked in the SATL Project for a new ATM system for Santa Maria OACC. From 1996 to the present ATCO in Lisbon ACC (ACS) and ATC instructor since 2001.
Joined the NAV CISM Team in 2003 as a Peer, and later also as the Team's National Coordinator.

STCA training – yes, we can! (cont'd)

problem with no infringement of the applicable separation minima.

It is important to note that although the purpose of avoiding action is to prevent collision, the use of it should not be restricted to the cases where the required separation has already been lost. Indeed, proper avoiding action can be efficient in the cases where an instant action is required in order to preserve separation and to prevent the situation from further deteriorating and becoming less controllable for ATC.

The team made it very clear that any potential conflict situation should be treated separately. The Avoiding Action phraseology should always be applied - not only when a potential risk of collision is detected, but also in every situation where a potential loss of separation exists.

It is difficult to precisely describe to controllers exactly what sort of action should be taken for any particular collision risk because the combinations of encounter geometry are too great.

Nevertheless, we believe that what we learn from incident investigations can be incorporated into some sort of generic learning scenarios.

We took up the challenge and the team resorted to trigonometry. This resulted in findings in terms of adequate amount of vectoring, which were demonstrated through simulated scenarios (opposite direction, crossing traffic and same direction). For example, two aircraft are vectored or only one, comparing the time remaining to actual loss of separation.

We tried to identify the feasibility of an efficient controller's reaction in the available timeframe following an STCA activation. We tried to answer questions like "What is the adequate amount of vectoring?", "How long do we have to decide and react?

The following principles were established:

- **STCA is not a loss of separation, the alert takes place 120 seconds before separation minima might be breached;**
- **It is recommended that vectoring instructions should be provided to ensure separation minima;**
- **If minimum distance is projected to be 0 NM (if no vectoring provided), this is considered as the most severe situation. Full horizontal separation minima must be regained in the time available;**
- **Minimum response time for ATC – 7 seconds,**
- **Time for communications exchange (Avoiding Action instructions) and aircraft manoeuvre (considering the aircraft inertia) – 23 seconds.**

HERE ARE SOME OF THE LEARNING POINTS WE EXTRACTED:

OPPOSITE DIRECTION

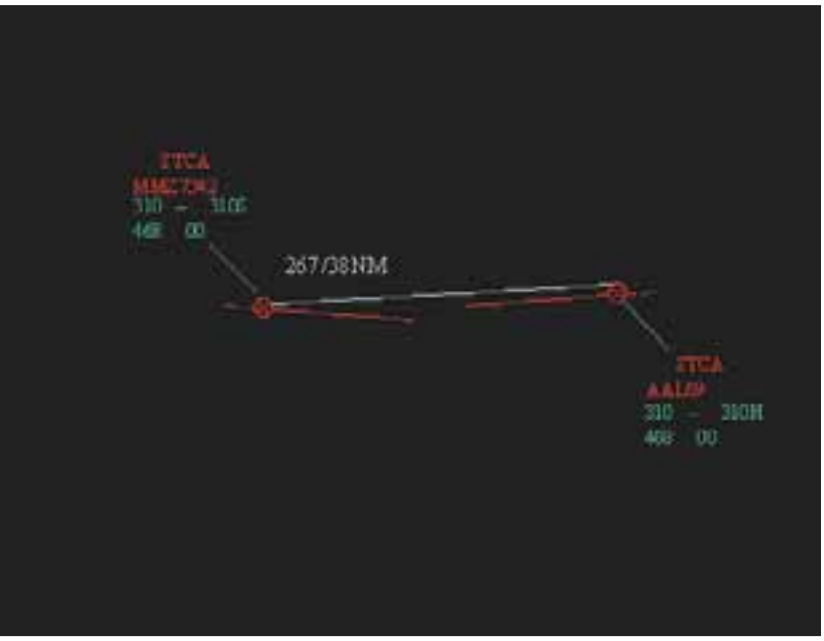
- Climb or descent instruction may interfere with ACAS;
- Consider turning both aircraft;
- Consider the exact crossing geometry – in the case above right turns are preferable;
- Visual acquisition of the conflicting traffic by the pilots is unlikely even in VMC due to the high relative speed;
- Provide sufficient turn magnitude, since a small turn may indicate lack of urgency to the pilot;
- The turn direction should preferably be the same – both turned to the right or both turned to the left;

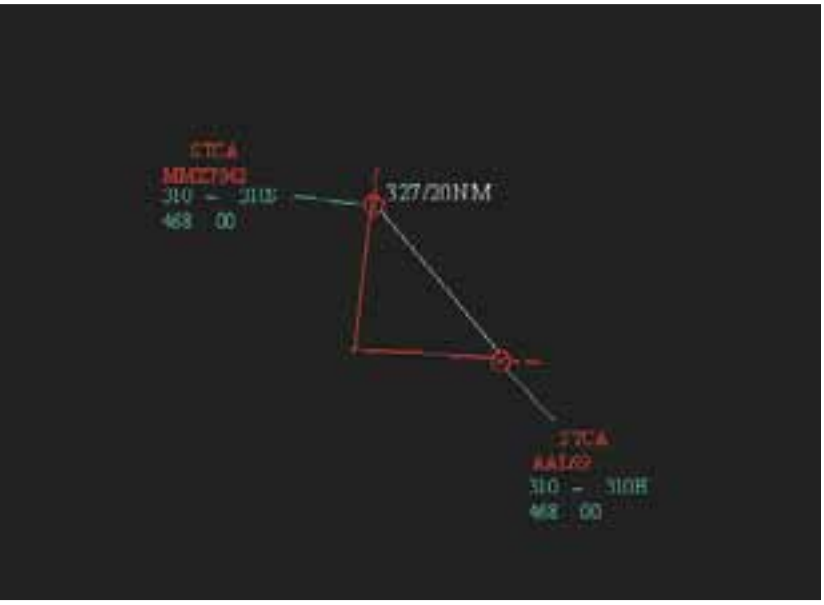
CROSSING TRAFFIC

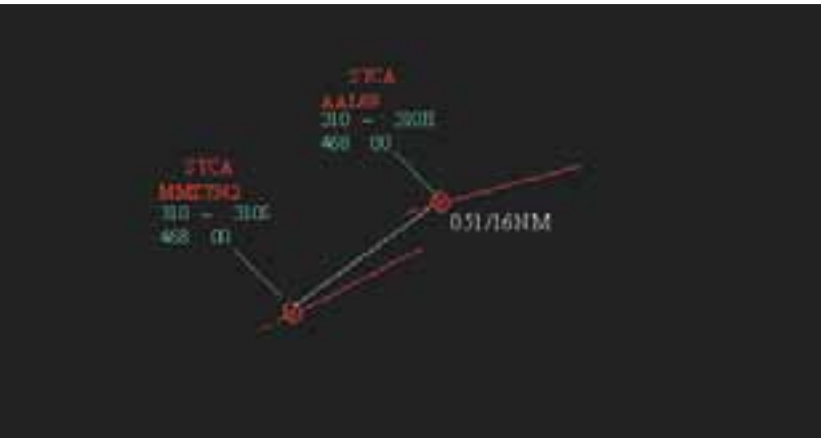
- Climb or descent instruction may interfere with ACAS;
- Consider turning both aircraft;
- In certain conflict geometries turning only one aircraft may result in a head-on encounter;
- Visual acquisition of the conflicting traffic by the pilots is possible;
- Turning one aircraft behind the other is often better than turning one aircraft ahead of the other;
- The turn direction should preferably be the same – both turned to the right or both turned to the left;

SAME DIRECTION

- Consider descending and/ or turning one or both aircraft;
- Visual acquisition of the conflicting traffic by the pilots of the second aircraft is possible;
- Descending and/or turning the second aircraft first is preferable;
- If turning both aircraft, the turn directions should preferably be opposite;







Finally, practical training was conducted in the SIMATM with each participant carrying out three simulation exercises which incorporated all the potential conflict cases addressed. These simulation exercises validated the proposed strategies for modifying flight profiles to avoid effective loss of separation, using the assumptions referred to above.

With the experience from the simulations, we recognised that loss of separation is avoidable in most cases. This conclusion was valid provided that adequate change of flight profiles took place no later than 60 seconds before the time of estimated minimum distance.

Nevertheless, and as anticipated by the instructor's team, this single simulator exercise alone was clearly insufficient to provide the fellow controllers with the required training for the establishment of a routine for the response to STCA situations. In their final report, the instructor's team recommended that training of controller response to STCAs should be periodically performed. Regular training should be included in the ATC refresher courses.

The provisions applicable to a loss of separation, both in the ICAO PANS-ATM and in the Portuguese general and local procedures, require the controller to continue issuing instructions to regain, as soon as possible, the separation minima infringed (or apply a different type of separation).

Personally, I've been involved in preparing and conducting the annual refresher training for fellow controllers' ACS ratings in Lisbon ACC since 2003, and the course last year was by far the most successful one. To my mind, unusual situations and contingency refresher training is somewhat like defensive driving training, in the sense of "driving to save lives, time, and money, in spite of the conditions around you and the actions of others". We save lives and avoid creating psychologically, emotionally and socially affected human beings.

Never give up! Our latest training was concluded with a unanimous "Yes, we can!" followed by a "Therefore, we must"!

Practice makes perfect

By Charles Rizzo

A famous Australian trumpet player was invited to give a pep talk at one of the prestigious private schools in Melbourne Australia. During the question and answer session, the principal of the school, wanting to drive home for his students the importance of studying and practicing, asked the trumpet player how often he practised the trumpet. To the principal's surprise and the students' delight, he responded "Never!! I play the trumpet every day at clubs and get paid for it".

To a certain extent this applies to controllers who keep improving their skills after formal training simply by going to work every day and performing their functions. Many controllers rightly believe that, "practice, practice, and more practice" are keys for continuous improvement and this is where the competency assessor plays a pivotal role.

Controllers improve by experience, by encountering difficult situations and learning how to deal with them or avoid such situations the next time they encounter the same or similar situation. Controllers improve only if they maintain a professional attitude at work and have a genuine desire to learn.

Charles Rizzo

is a team leader Continuation & Development Training at at EUROCONTROL's Upper Area Control Centre in Maastricht. He is an experienced Tower, Approach and Area ATCO with operational experience in Malta, Middle-East and Australia.

However, experience in performing the daily ATC routine alone does not suffice. The type of experience also matters and controllers will improve by experiencing difficulties and learning how to overcome them. Due to the difficulty in taking controllers off operational duty, little formal training is available to controllers after they become qualified, apart from refresher training and Team Resource Management. Controllers continuously learn both how to do things and how not to do things by observing other controllers working.

Many controllers these days may go through lengthy periods without ever having to handle any traffic situation which presents anything out of the ordinary. (Many controllers describe their job as 90% boredom and 10% sheer panic!!). This may reinforce the need for the controller not only to maintain his existing skills, but to upgrade existing knowledge and skills especially in dealing with unusual situations, in degraded systems and in emergencies, so that when something unusual occurs, safety is not impaired.

The ops room environment makes continuous learning more difficult as it is not conducive to improvement. The inherent risks and safety considerations associated with the job make live training in emergency procedures impractical. And let's face it; refresher training and computer-based instruction may be considered with scepticism by the controllers. In our experience many of the controllers have not even attempted the dedicated computer-based refresher training modules!!

Refresher Training generally occurs in a simulator environment which is a calm and safe environment. This type of environment is designed to be conducive to learning, and it allows the controller to practice skills and emergency procedures in an efficient manner.

It is now more common practice to include a degraded systems module as part of the refresher training. The refresher training for the controllers at MUAC includes 2 hours of simulator exercises with degraded systems. Also, three times a week the controllers at MUAC operate with the back-up voice communication systems for training and to check the system

Yet actual work conditions associated with a real in-flight emergency are often quite unlike those found in the simulator environment. In fact, the time pressure, unfamiliarity with the situation, the uncertainty, and confu-

sion that occur under stress conditions due to a real in-flight emergency often create a substantially different work environment to that experienced in a normal training session in the simulator.

Thus, even when an emergency procedure is well practiced and learned in the simulator, when used for the first time in a live high stress environment, severe degradation in controller performance can be caused.

Training, therefore, should allow some degree of pre-exposure to the stress one would encounter in a live environment.

Furthermore, use of the skills acquired in formal training and now practiced in Refresher Training in a stress environment should allow the controller to adapt performance and develop strategies for dealing with this environment. Introducing stressors in emergency training reduces uncertainty and anxiety regarding the handling of emergency situations and increases the confidence of the controller in his ability to perform in this stress environment. Unusual circumstances and emergencies that have been experienced during training, under stress conditions equivalent to the operational environment, will be less distracting when faced in the operational environment for the first time.

Realistically there is a limit to the degree to which characteristics and stress of the training environment are similar to those of the operational environment. Many controllers, when attending refresher training, moan about the fact that the emergency training will never approach or capture the "life-threatening" feel of the real world. The controllers are aware that when they are doing emergency training, as part of their refresher training, that they are in a safe training environment.

However, a well-designed training simulation can be quite involving and can "feel" like the real thing without imposing extreme or unwarranted levels of stress on the controller. Moreover, an unwarranted level of stress, even done in good faith to capture the stress of a real life emergency situation, is not desirable. If stress, in the form of traffic workload, complexity and emergency situation, is too high in training, the controller may receive a negative training experience. We may have experienced situations where simulator training in general and refresher training in particular was used to find the breaking point of the controller.

Research has suggested that stressors introduced at a moderate level, compared to the stress encountered in the operational environment, during training can provide an effective and realistic representation of the operational stress environment.

Preparing controllers to perform under high-stress conditions, in unusual situations, in degraded systems and in emergencies requires the controller to be highly skilled, familiar with the stress environment, and to possess the special knowledge and skills necessary to overcome the deficits imposed by high-stress or high-demand conditions.

Traditionally, the focus of controller training has been on fulfilling regulatory requirements. Effective handling of traffic by the controller in unusual circumstances and emergencies was considered as an inherent by-product of the controller's technical skills training. However, a growing number of recent incidents and accidents in ATC and aviation have indicated that effective handling of emergencies requires more than technical skills (Kirwan et al, 2005).

Consequently, it is clear that the requirement to periodically provide all controllers with training for unusual circumstances and emergencies is not just a regulatory requirement. But is refresher training the best way for controllers to maintain and enhance their skills and improve the air traffic service provided?

After all, perhaps we cannot all play at clubs and get paid for it.

Safety net nuisance alerts – more than just a numbers game

By Rod Howell

The aim of ground based Safety Nets, such as Short Term Conflict (STCA), Minimum Safe Altitude Warning (MSAW), Area Proximity Warning (APW) and Approach Path Monitor (APM), is to enhance the safe control of aircraft by providing a timely alert to the controller whenever a flight comes into a state of higher risk – potential mid-air collision, collision with terrain, infringement of protected airspace or deviation from the expected approach path.

GROUND BASED SAFETY NETS

Short Term Conflict Alert – Intended to assist the controller in preventing a collision between aircraft by generating, in a timely manner, an alert of any potential or actual infringement of prescribed separation minima.

Minimum Safe Altitude Warning – Intended to warn the controller of an increased risk of controlled flight into terrain by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles.

Area Proximity Warning – Intended to warn the controller of unauthorised penetration of an airspace volume by generating, in a timely manner, an alert of a potential or actual infringement of the required spacing to that airspace volume.

Approach Path Monitor – Intended to warn the controller of an increased risk of controlled flight into terrain by generating, in a timely manner, an alert of aircraft deviation from the expected final approach path.

In the last three decades, Safety Nets have progressed from a novel concept to become more-or-less de facto standard components of the ATM system. Yet, despite these decades of operational use, certain aspects of safety nets operation still remain a concern – not least of which is the frequency of nuisance alerts.

The EUROCONTROL specifications for each of the safety nets define a nuisance alert as: an alert which is correctly generated according to the rule set but is considered operationally inappropriate.

Rod Howell

is an expert in ground-based safety nets and surveillance tracking at QinetiQ (UK). His work has included R&D and design for the NATS' Enhanced STCA system, technical advice to the EUROCONTROL SPIN Sub Group, and technical support to help a number of ANSPs optimise their safety nets systems. He is the primary developer of an AV tool (STRACK), which is used for tracking analysis, and PolyGen which is used in the production of MSAW surfaces.

Whilst a modest number of nuisance alerts can often be tolerated by controllers, too many nuisance alerts can have deep and far reaching consequences. It has been known for too many annoying alerts to cause controllers to turn down the volume of speakers, and tape up flashing lights! In the more extreme cases, the safety nets are intentionally partially disabled (e.g. in the TMA or below a particular flight level) or switched off completely.

Controllers and pilots need time to respond to and resolve a safety nets alert and therefore very short duration (i.e. just a few seconds) alerts are generally considered a nuisance. However, because there are such a wide variety of mid-air situations and operational environments a simple mathematical formula can't truly be applied to determine whether or not a particular alert was a 'nuisance'.

A number of common types of nuisance alert are easily identified:

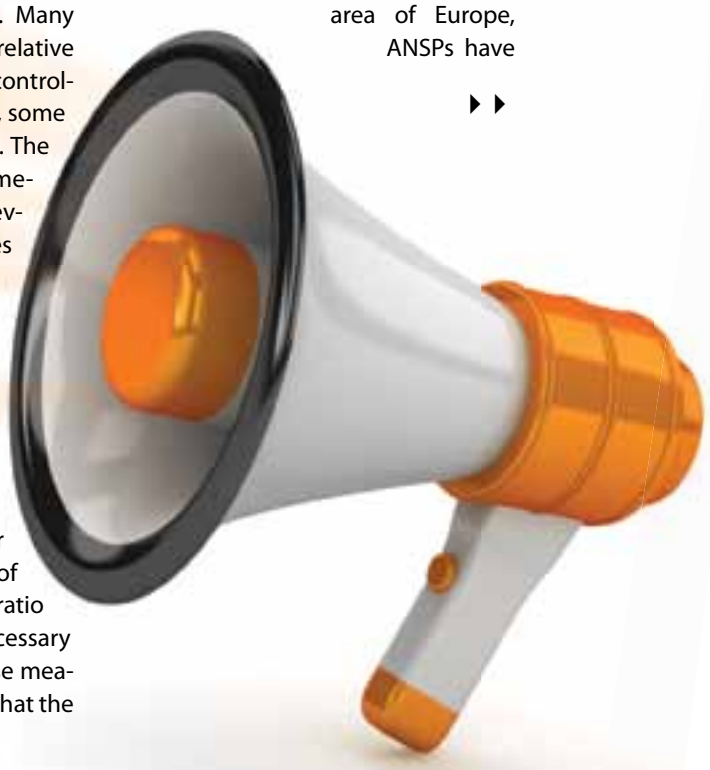
- Obnoxious Alerts – those that are louder, brighter, and / or longer than necessary
- Alerts which are not related to a real situation (e.g. due to surveillance errors)
- Alerts which only involve flights that are not of concern to ATC (e.g. military exercises, formation flights, mid-air refuelling)
- Alerts due to unknown RVSM status to which STCA applies an inappropriate vertical separation threshold
- Alerts which may appear on the display too late to be useful or annunciate intermittently due to poor set-up/tuning
- Alerts caused by aircraft converging rapidly (though still safely cleared)

The "annoyance factor" aside, it seems that a clear argument can be made that too many nuisance alerts can erode controllers' trust in a Safety Net and therefore lead to a late or absent controller response when a genuine risk arises. Anyone who doubts the well-known "cry wolf" effect should note how many people look out of the office window the next time a car alarm sounds in a car park. The analogy isn't perfect, because getting up to look out of the window requires a little more effort than looking at the traffic display, but it can still be concluded that if the nuisance alert rate is sufficiently high, the "cry wolf" effect will be there.

In addition to the potential erosion of trust, a high level of unnecessary Safety Net alerts will contribute to the risk that the controller may choose to complete a current or ongoing task before giving attention to the alert or may be distracted from a more important task or conflict situation. Many Safety Nets do not convey the relative urgency of the situation to the controller (and amongst those that do, some do it much better than others). The point is that an inability to immediately recognise which of several alerts is more pressing does have a safety implication.

Performance measurement

There are a number of measurements that could be made to quantify how well a Safety Net is performing - the number of alerts per day, the number of alerts per sector per day, the ratio of Nuisance (unwanted) to Necessary (wanted) alerts, etc. Whilst these measures might be useful to check that the performance of a Safety Net has been maintained over a long time period (months or years), they will not help to resolve any underlying issues with a Safety Net. Furthermore, none of these measures on their own can be used as a basis for Safety Net performance targets that can be applied across all types of airspace. Whilst in the core area of Europe, ANSPs have



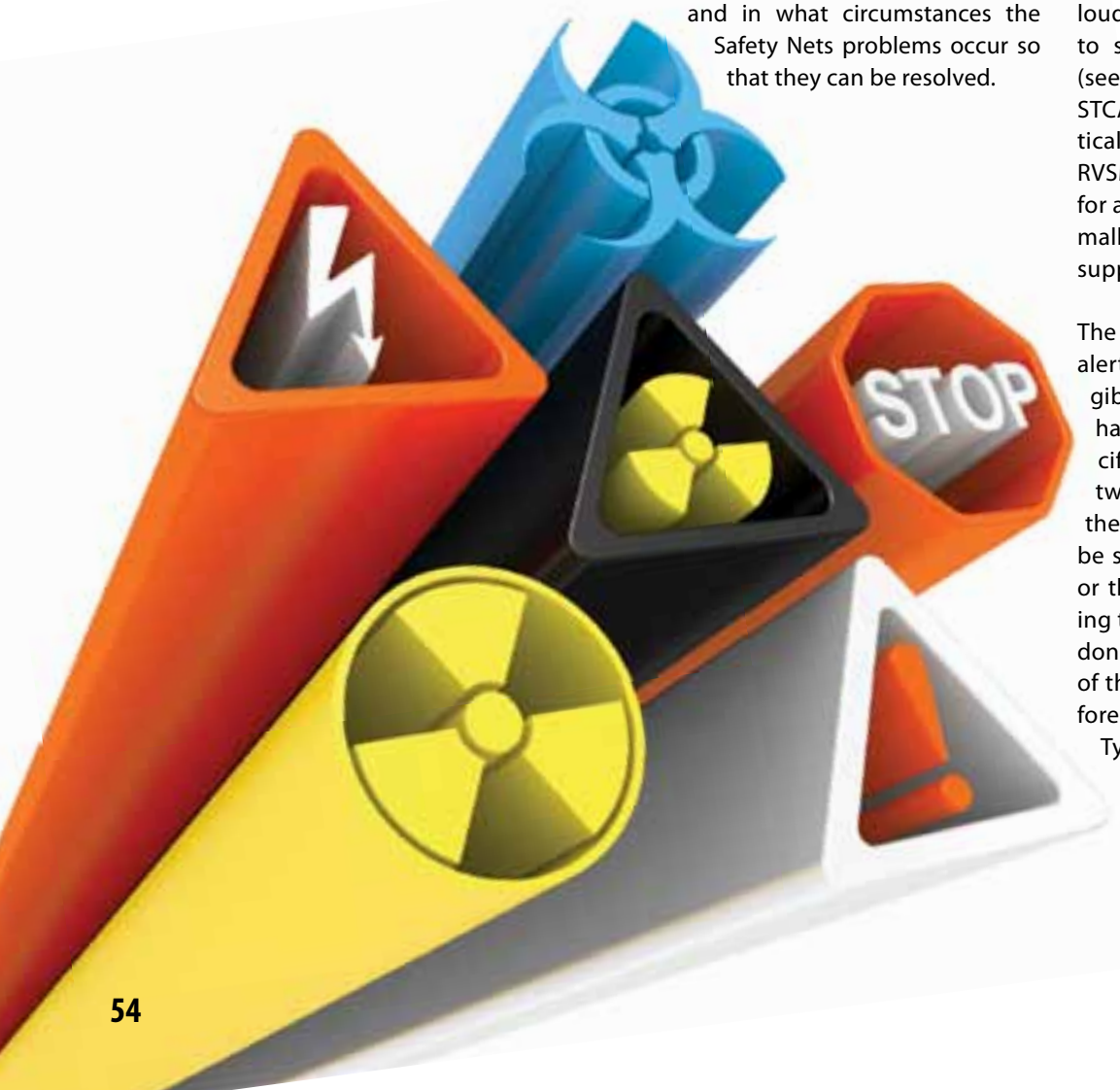
Safety nets nuisance alerts – more than just a numbers game (con'd)

worked hard to decrease the unwanted / wanted alert ratio, the absolute number of alerts per day is still relatively high. On the other hand, in the least busy airspace, a Safety Net might generate a low number of alerts per day, but a large proportion of these may be unwanted or nuisance alerts.

Far more important than the bare statistics is to analyse and understand what types of alerts are occurring; only with this knowledge can effective action be taken to reduce the number of nuisance alerts to a level that is acceptable.

A multi-disciplinary safety nets team within the ANSP organisation (or within each major control cen- tre) must be charged with tuning and maintaining the Safety Nets. This team should comprise an experienced engineer, en route and TMA controllers and safety staff. Communication is paramount – it is of fundamental importance that controllers and engineers share an understanding of the safety nets technical limitations and operational issues.

In addition, many ATM systems automatically record safety nets log files. The safety nets team therefore has access to the information regarding the numbers of alerts, and with a little analysis can reveal (to some extent) what types of nuisance alerts are occurring. These log files should be used to inform the engineer where and in what circumstances the Safety Nets problems occur so that they can be resolved.



Potential engineering solutions

Experience built up over many years of examining Safety Nets performance in various States has shown that many of the problems with them tend to fall into one of three categories:

1. Problems that require a change or improvement to the software
2. Problems that require a change to basic Safety Nets parameters
3. Problems that require a careful tuning of the alerting thresholds

The nuisance alerts that lead us to the first path include the obnoxious alerts mentioned previously (too loud, too bright, too long), those due to split tracks (surveillance errors) (see figure 1), and those caused by STCA applying an inappropriate vertical separation threshold when no RVSM status information is available for a specific flight. All these will normally require a fix from the system supplier.

The second category of nuisance alerts is caused when the basic eligibility and inhibition parameters have not been set up for the specific operational environment. No two operational environments are the same, so these parameters must be set by either the system supplier or the ANSP (preferably both, working together) – this should ideally be done during Site Acceptance Testing of the ATM system, and certainly before it goes into operational service. Typical symptoms of inappropriate basic parameter settings are STCA alerts for pairs of military aircraft undergoing exercises, and MSAW alerts for military or VFR flights.

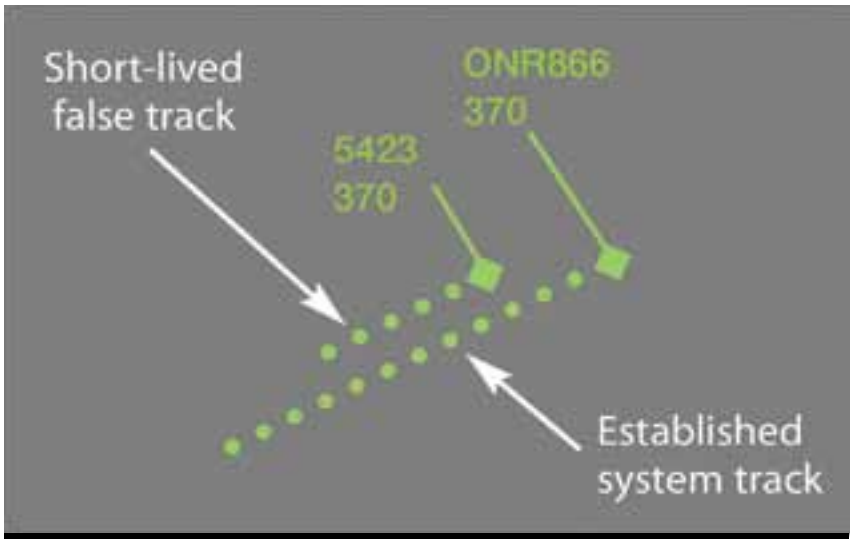


Figure 1 - a typical split track

The final category of nuisance alerts normally requires a deeper analysis of the precise circumstances that are causing them, followed by careful optimisation of the alert thresholds for all Safety Nets as well as the specific cases of the MSAW alerting surface, APW volumes and the APM approach definitions. Detailed parameter optimisation is most worthwhile when other causes of nuisance alerts have already been resolved. Alert log files and traffic recordings are invaluable at this stage. If they are available, then specific safety nets optimisation tools can be used as a means of fine tuning.

Importantly, the tuning of the parameters should not be left to engineers alone. Controllers should be widely consulted on any borderline wanted/unwanted conflict situations and the consensus view of the appropriate balance between alert rate and warning time should, where possible, be taken into account.

FIND OUT MORE ABOUT SAFETY NETS

This article provides a high-level overview of some of the different types of Safety Net nuisance alerts. It is based mainly on experience gained during visits to control centres around Europe and analysis of Safety Net alerts for a number of ANSPs.

EUROCONTROL's SPIN (Safety nets Performance Improvement Network) – a Sub Group of the Safety Team – is able to provide training seminars to European ANSPs, as well as support to States in the set-up / optimisation of their Safety Net systems. The SPIN Sub Group can be contacted at: safety-nets@eurocontrol.int

Does training play a rolein the battle against nuisance alerts?

The EUROCONTROL Specifications for the various ground-based safety nets have a specific requirement on controller training (see the box below). It is important that controllers know how the safety nets should behave and equally essential that they report when a safety net is not behaving as expected or as necessary for safe air traffic control.

Training of engineers can also play a crucial role. Engineers involved in system testing or system specification need to have a very firm grasp of what will be acceptable in terms of the safety nets system capacities, capabilities and performance. Furthermore, it is essential that system suppliers offer training and support to enable ANSPs to set up and optimise the safety nets before operational use, and to perform ongoing optimisation during the product lifetime.

REQUIREMENTS ON TRAINING AND COMPETENCE

In regard to requirements on training and competence, the EUROCONTROL Specification for STCA states:

The ANSP **shall** ensure that all controllers concerned are given specific STCA training and are assessed as competent for the use of the relevant STCA system.

Note: The primary goal of the training is to develop and maintain an appropriate level of trust in STCA, i.e. to make controllers aware of the likely situations where STCA will be effective and, more importantly, situations in which STCA will not be so effective (e.g. sudden, unexpected manoeuvres).

Comparable training requirements apply to **all** the ground based safety nets.

How can operational examples be used in training?

by Stanislaw Drozdowski

In ATC situations can develop rapidly: what was perfectly planned just seconds ago can turn into a situation which requires the full range of skills to handle. Controllers are trained to deal with several types of emergencies but sometimes their training is too theoretical...

A proper theoretical background is important but the practical application of the acquired knowledge will ultimately show if the training was successful. Familiarisation with real-life examples can help controllers to deal with non-nominal events. This article uses TCAS (Traffic alert and Collision Avoidance System) training as an example of how operational examples can be used to enrich controller training.

TCAS is an avionics system that works independently of ground-based systems to prevent mid-air or near mid-air collision[1]. If an imminent risk of collision is detected, an RA (Resolution Advisory) will be generated which tells the pilot the range of vertical speeds within which the aircraft should be flown to avoid a collision. Pilots are required to follow RAs and ignore any conflicting ATC instructions. Therefore, TCAS can have significant impact on ATC operations as it may cause pilots to depart from their current ATC clearance and, by doing so, TCAS is "removing" the controller from the loop. TCAS collision avoidance logic, which is subject to international standardisation, is complex and not always intuitive.

TCAS will save the day, won't it?

Some RAs are caused by level bust, pilot non-compliance with ATC or incorrect ATC clearance. TCAS provides a successful mitigation against these causes if pilots follow RAs promptly and correctly and the controller does not interfere with the RA manoeuvre by issuing instructions during the RA.

On the other hand, TCAS does not know the ATC clearance or pilot's intentions and, therefore, an RA will be produced based only on the extrapolation of the aircraft's trajectory. So, it happens that RAs are issued when the separation would have been maintained without the RA. These RAs are sometime seen by the controllers and pilots as nuisance.

Any excessive vertical speed before level off is likely to trigger an unwanted RA. Although the pilots are required to reduce the vertical speed to 1500 ft/min in the last 1000 ft before the cleared level, experience shows that often this is not done.

TCAS provides a successful mitigation if pilots follow RAs promptly and correctly and the controller does not interfere with the RA manoeuvre by issuing instructions during the RA.

The frequency of RA occurrence depends on the airspace type and complexity but RAs are rare. The average number of RAs per day in European airspace has been estimated at about 18, most of them RAs occurring in congested TMAs[2]. During the RA and immediately before it, the controllers are typically presented with a number of alerts on the screen. Most likely a Short Term Conflict Alert (STCA) will be displayed. It may be accompanied by other alerts, depending on the ATM system sophistication. Dealing with a complex but not so common situation is no doubt a stressful experience for which controllers need to be properly prepared.

TCAS Training

Controllers are typically introduced to TCAS during their ab initio training which should follow the requirements of European Common Core Content and Training Objectives as well as cover the topics recommended in the ICAO ACAS Manual (Doc 9863). While the ab initio training gives the trainees a good basis for understanding TCAS operations and related provisions, it usually provides few, if any, practical examples of TCAS events. TCAS topics are also covered during recurrent training for non-nominal situations.

Some training material is loaded with technical details and tests controllers on issues that

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1- For more information about TCAS see previous issues of HindSight: № 5: TCAS and STCA – Not Just Anagrams; № 6 Changes to ICAO rules regarding TCAS RAs; № 10: TCAS II and Level Bust).

2- Drozdowski, S., Dehn, D., Louyot, P. Monitoring of TCAS Resolution Advisories in Core European Airspace, Air Traffic Control Quarterly, Vol. 18, 2010.

How can operational examples be used in training? (cont'd)

are really not relevant for them. Sometime these courses are developed as "one-size fits all" and in one session they cover topics which are of interest to pilots and controllers while forgetting that each party has different roles and responsibilities during an RA.

TCAS training for controllers, especially in recurrent training, should focus on topics that matter to them in day-to-day operations. The training session should provide the minimum of technical information and maximum of practical application. We all know that we learn best from previous experience, so previous events should be used to enrich training sessions. There is a lesson to be learned in each event once it has been properly analysed. Real-life examples will tell us how others reacted, what kind of mistakes were made, how correct actions improved or could have improved the situation ("what if" scenarios).

While real-life examples from own airspace might be best, in the absence of these trainers may use other publicly available resources like EUROCONTROL ACAS II Bulletins (available from www.eurocontrol.int/acas).

Using real-life TCAS examples has additional training advantages. The circumstances leading to an RA typically involve some intermediate events from which additional lessons can be learnt: STCA generation (Was it timely?), controller avoiding instruction (Correct phraseology used? Effectiveness?), workload management (Were things done in the optimal order?), etc.

The two cases described next will provide an illustration of how real-life examples can provide an additional training resource.

CASE 1: descent clearance picked up by wrong aircraft [3]

Traffic is moderate in this en-route sector. An Embraer 195 is heading south at FL330 while a B777 is at FL320 heading west. When the aircraft are some 60 seconds from crossing, the controller instructs an aircraft in a different part of the sector to descend to FL270. Although there is no callsign similarity, this transmission is wrongly picked up by the Embraer crew who read back the descent instruction (using their callsign). This error is not detected by the controller and the Embraer starts to descend towards the B777 below.

A few seconds later when the Embraer is passing through FL328, the ATM system generates a Short Term Conflict Alert. The predicted horizontal distance is 0.6 NM. Almost simultaneously, RAs are generated in both aircraft: the Embraer gets a "Climb" RA while the B777 gets a "Descend" RA. Although the STCA alert is generated promptly, it is already too late to give the controller the chance to address the separation loss.

Both pilots respond to their RAs promptly and correctly and the vertical spacing between the aircraft rapidly starts to increase. Both aircraft pass each with a spacing of 0.6 NM and 1100 feet.

CASE 2: both aircraft cleared to the same level

Traffic is quiet is this typically busy TMA. An RJ85 is cleared after departure to climb to FL150 on a heading of 330 degrees. An A330 is flying on a heading of 300 degrees descending towards its destination. The predicted trajectories of both aircraft are expected to cross with a horizontal separation of less than 1 NM. The controller planned to clear the A330 to FL160 (1000 ft above the RJ85). However, he clears the A330 to FL150 by mistake.

Some time later, the controller instructs the RJ85 to turn right onto a heading of 345 degrees. When the aircraft are less than 2.5 NM and 2100 ft apart, STCA warns the controller of the impending conflict.

The controller issues avoiding action instructions to both aircraft:

"A330 turn right heading 360 degrees"

"RJ85 turn left heading 270 degrees."

He subsequently gives the A330 a further instruction to turn onto a heading of 035 degrees and provides traffic information to the RJ85 pilot.

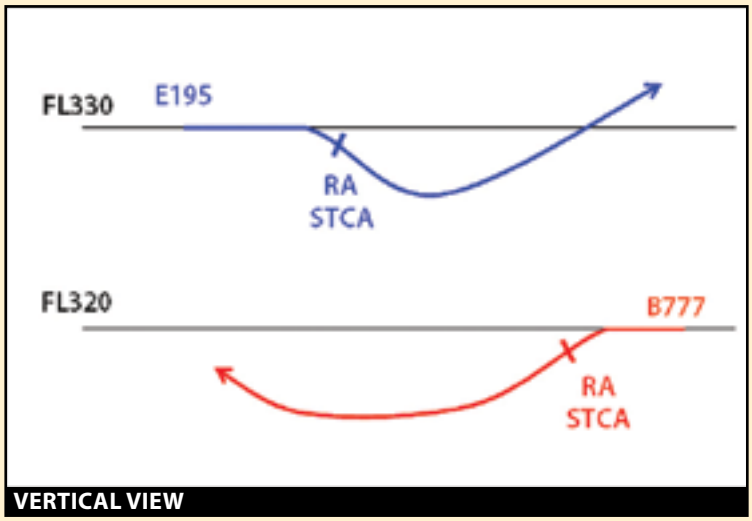
When the aircraft are 1.6 NM and 850 ft apart, a first RA is issued for the A330 – "Maintain vertical speed, crossing maintain". The A330 at this point is descending at almost 2500 ft/min and this RA tells the pilot to continue this vertical speed crossing through the level of the threat aircraft. Two seconds later, the RJ85 which is climbing at 1500 ft/min, also receives a "Maintain vertical speed, crossing maintain" RA. Both pilots follow their RAs and make reports to ATC.

RAs requiring the pilot to cross through the altitude of an intruder aircraft are rare and account for approximately 2% of all RAs[4]. TCAS is designed to select non-altitude crossing RAs if these provide the desired vertical separation. Only when

3- The events described in this article are based on real-life incidents. They have been de-identified here to support training. Descriptions of the events have been simplified and/or abbreviated for clarity and to facilitate the training process.

Even though the callsigns were not similar, one of the main contributory factors in this incident was callsign confusion. The controller did not notice that the wrong aircraft acknowledged the descent instruction – controllers should not underestimate risks associated with read-back (hear-back) errors. This event also highlights that STCA will not always provide a timely warning of an impending loss of separation.

In this case, both RAs were followed correctly and TCAS prevented a major incident (the predicted spacing without TCAS RA was estimated at 0.6 NM and 300 ft).



VERTICAL VIEW

that cannot be achieved will an RA with altitude crossing be posted.

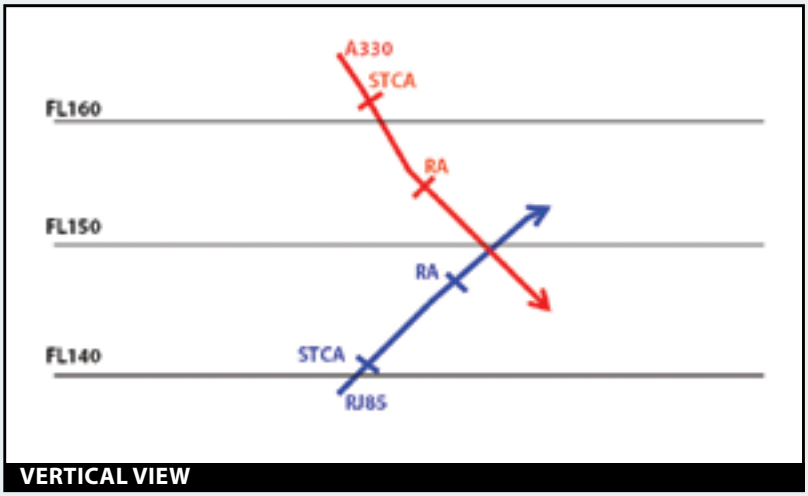
When the aircraft pass each other the A330 is over 600 ft below the RJ85 and both aircraft subsequently receive a "Clear of conflict" announcement.

In this event STCA did provide the controller with sufficient warning of impending separation loss. The controller reacted promptly to STCA by giving horizontal avoiding instructions. That helped to increase the horizontal spacing between the aircraft. Horizontal avoiding instructions will not contradict collision avoidance manoeuvres given by TCAS – this point should be emphasised during controller training. In this case TCAS issued crossing RAs – although they are rare, the controllers should be aware of them as these RAs are less intuitive than other RAs and may give the impression that the aircraft are being wrongly directed towards each other.

As in the case described above, both RAs were followed correctly and TCAS prevented a major incident caused by ATC error.

Conclusion

Real-life examples will complement theoretical TCAS training and will also provide more general learning points. Trainers should use them in the classroom – learning points should be discussed, actions analysed and discussed. Questions such as "what would you do differently?" or "was that an optimal solution?" would help to stimulate discussion and make the learning process interactive.



VERTICAL VIEW

4- EUROCONTROL EVAIR Safety Bulletin No 6, page 27.

A blend of training methods to increase the efficiency of ATC simulation and maintain consistent quality

eBriefing for ATC training

By Dragan Milanovski

"Just as shopping for groceries was a relatively simple affair fifty years ago, when there were fewer ingredients on offer, but is so much more of a struggle now when as a shopper you are bombarded with thousands of possibilities, so the selection of learning media has been made so much more complex with the arrival of dozens of online opportunities.

An abundance of choice makes it so much harder now for professionals to design learning interventions, which is perhaps why they so often keep it simple by sticking to familiar options – easier in the short term, perhaps, but undoubtedly missing a whole load of tricks."

Clive Shepherd

Dragan Milanovski

is an ATC training expert at the EUROCONTROL Institute of Air Navigation Services in Luxembourg.

Most of his operational experience comes from Skopje ACC where he worked for a number of years on different operational posts.

Now, his day-to-day work involves ATC training design as well as Initial Training delivery for Maastricht UAC.

Traditional cuisine - a familiar option

Briefings in relation to ATC simulation training are training events that take place immediately before the start of a group of exercises introducing new learning items. The event is delivered by, and mostly focuses around an ATC instructor. Usually, there is very little or only one sided interaction with the group of students. Not all the students are equally willing to contribute to the discussions.

A traditional briefing contains:

- information about the global objectives, traffic scenarios, airspace structure, activation of restricted airspace, CDRs in use, RWY in use, meteorological conditions, NOTAM, SIGMET, etc...
- a reminder/revision of the theoretical elements required for the simulation session;
- a detailed explanation of the new controlling method/ technique (if one is introduced).

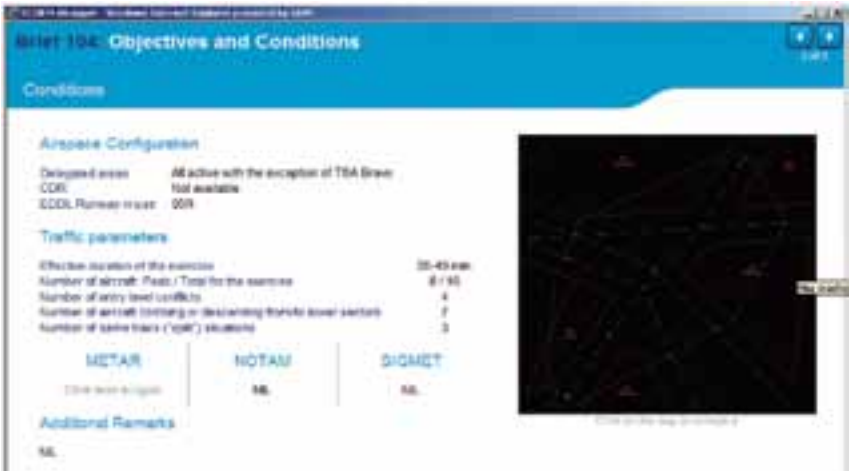
As such, briefings are a vital link between theory and practice. The better the briefings are, the greater the learning benefit is from the practical simulation, especially during the first few exercises within the series.

I am sure most of you can recall from your training days that there were briefings and briefings, even when delivered by the same instructor. Why? Well, let's have a look at the following example - let's say we have to deliver a briefing about using rates to ensure vertical separation of crossing track traffic. Taking the traditional approach the shopping list is very short; we need an ATC instructor and a classroom.

He/she will have to start on the morning before the simulator exercise is scheduled by informing the students about the objectives and exercise conditions based on a slide setting out the details such as the one shown.

There is nothing wrong with the approach taken so far, except the fact that valuable instructor time is spent on the information part of the briefing where the required information is passed to the students through lectures. There is very little added value (if any) when an instructor is delivering this part. Some would even argue that there is a greater learning effect when students acquire this information through self study. At least it gives them greater responsibility for their training.

Next, the instructor will have to remind the students about the theoretical knowledge directly related to the forthcoming simulation. In our example, these are: aircraft performance data, factors affecting aircraft performance (vertical speed in particular), application of vertical separation based on use of rates, etc. Let's say we have a very experienced instructor who is always motivated and well aware of the important bits worth mentioning. Even with these favourable conditions, when revising theoretical elements required for the session ahead, under time constraints, the instructor has to take a group ap-



proach. However, not all students in the group have the same understanding. Some will find this part very boring (I have seen this already 5 times during the lessons) – others will find it insufficient (I am not sure I understand this correctly, I did not have time to study, but I do not want to show this by asking now).

The situation is even worse when it comes to checking the students' knowledge. Usually, an experienced instructor will ask several questions to verify the students have acquired the right understanding. But here, a different instructor will ask different questions. This might be all right, but will the questions cover all the aspects? Will the instructor always ask the "right" students? One thing is for sure - the instructor delivering the briefing cannot ask all the students all the questions and then provide them with appropriate feedback individually.

Furthermore, the race against time does not allow the instructor to pay attention to details and dig deeper if necessary. I believed that when I left the classroom, I had a good indication of the students' understanding of required theoretical elements. Needless to say, very often I found that this was not the case, and I had to give more explanations after the simulation.

Additionally, the discussion about new controlling methods/techniques is not always sufficiently well illustrated, as the allocated time does not allow use of several examples. Even with the best preparation and intentions, it can happen that one or a number of details are omitted by the instructor. The instructor from the story will enjoy his coffee afterwards asking himself "Did I say that once a rate is assigned it has to be monitored on radar and followed up with corrective actions if necessary?"

Students' participation ranges from very active (always asking the right questions) to very passive (say yes to everything – do not ask questions). Sometimes, the instructor delivering the briefing will also "spice it up" with a bit of personal preference and use some of the time on "war stories". Believe me, this is in our nature, no matter how hard we try - we cannot avoid it. Yes, the students always find this amusing; however, the training value is very limited at this point in time.

Going back to our example, one instructor would say "always ask if the aircraft is able to maintain the rate before you assign it, once I had an incident where the pilot reported late that he was not able to maintain it, ok it was busy, but…" and that is how it starts. Another instructor would say "don't waste your time asking at all, just be realistic with the rates and rely on your knowledge, if unable the pilot is supposed to tell you…" I can think of several other pieces of advice here which I am sure we could continue to discuss for hours in order to decide which one is right / better. You must understand how difficult it is for the student to distinguish what is standard, common practice or a personal preference.

Finally, the training is organised in such a way that following the briefing the simulation training starts after a short coffee break. There is no time whatsoever to allow the students to fully grasp the concept before we actually require the use of it in simulation. In the worst case scenario, it takes two to three exercises before the student realises what is expected of him/her.

Due to the training delivery method (lesson/lecture with limited interaction) used in practice, we experience the limitations mentioned above. While traditional cuisine is appealing (familiar) and it does the job (you are not hungry after a meal), you cannot guarantee the desired nutritional values and you cannot cater for different styles.

The ever increasing "production pressure" on ATC training does not allow any room for slacking in a student's progress. Something needed to be done to increase the learning value of the first few training sessions following the briefing.

eBriefing for ATC training (cont'd)

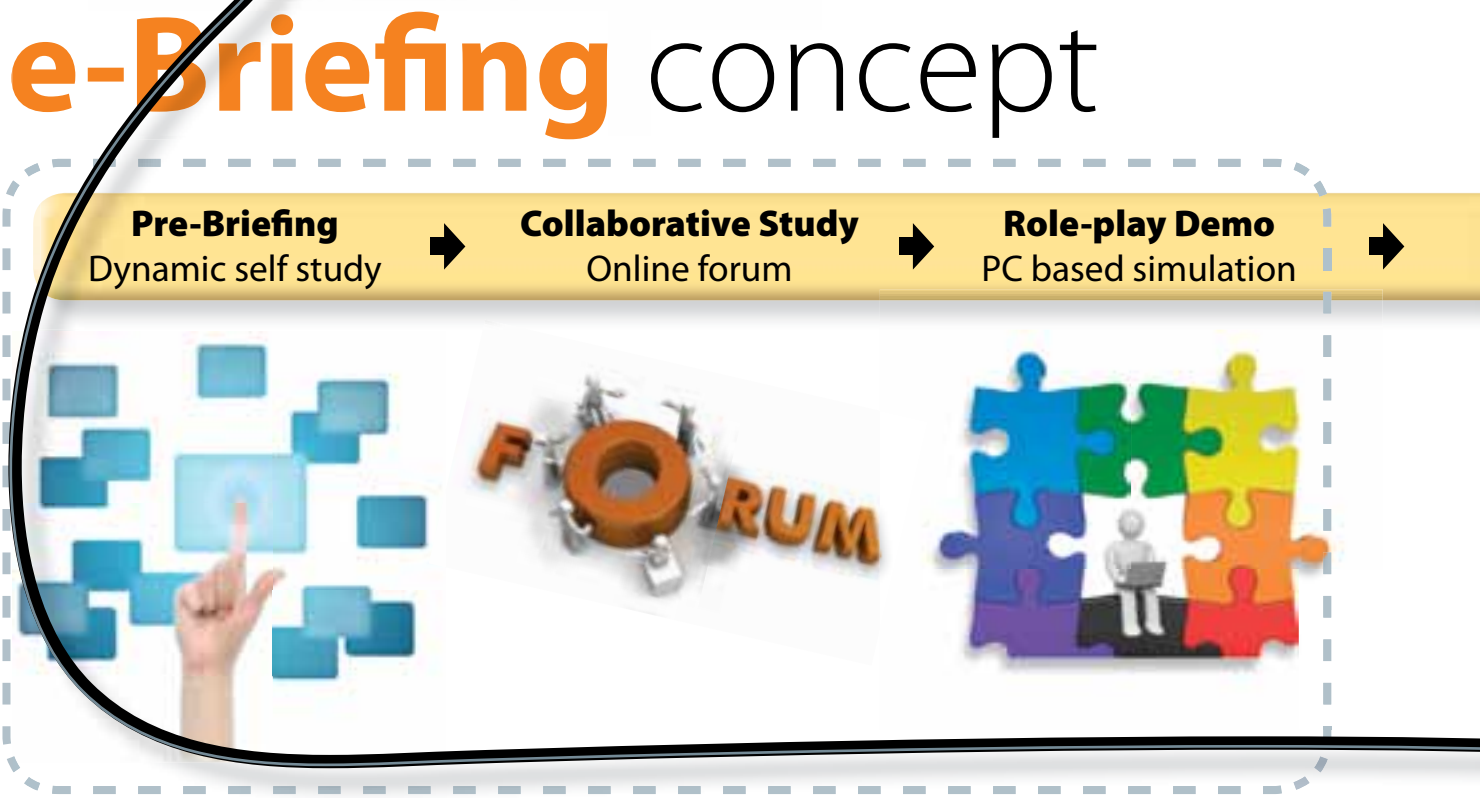
A list of ingredients: eBriefing concept

The new approach consists of the following items which together replace the traditional briefing:

- **Pre-briefing** – a dynamic self study module which takes place a day before the simulation.
- **Collaborative study period** – until the morning before the simulation;
- **Role play demonstration** – immediately prior to the simulation (facilitated by an instructor).

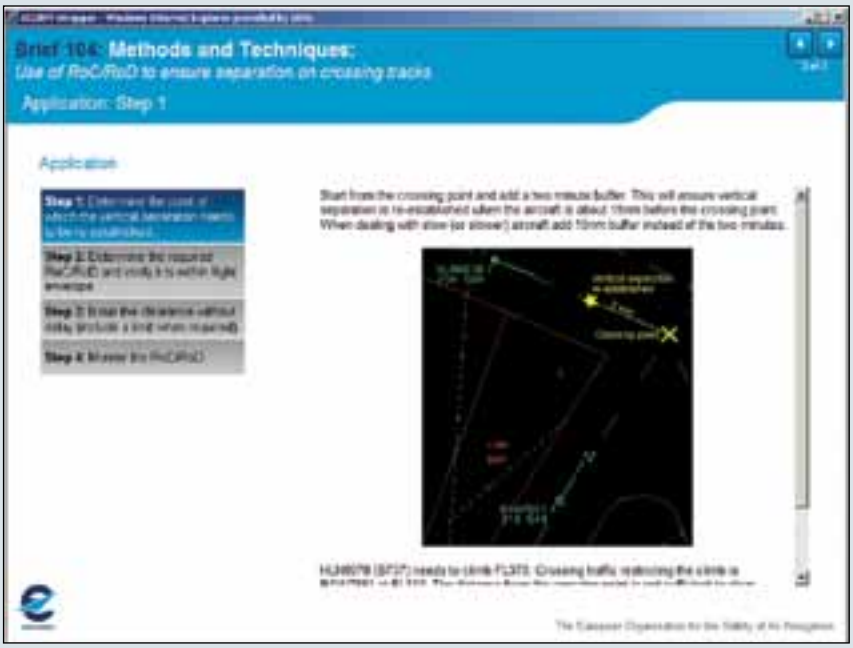
The Pre-briefing guarantees participation from all students. It is available online from any location, where students may, at their own pace, acquire the following:

- objectives and conditions (a small e-learning module covering the information part of the briefing);
- the controlling methods/techniques (explained in a structured way with numerous illustrations and examples as illustrated below - where students can take a personal approach to learning, as well as revising some of the theoretical elements required for the session);
- the new phraseology (with examples and explanations);
- recorded instructor demo (a video taken from the simulator where an instructor explains the application);
- FAQs;
- Questionnaire (online self assessment as also illustrated below, which provides individualised feedback to the answers given)



An online forum is associated with the pre-briefing for the students and instructors for the collaborative study. Students are encouraged to post questions and receive answers from their instructors. It gives an opportunity to the instructor facilitating the role play demonstration to prepare and adjust if necessary for the final part of the eBriefing. If it is necessary to revise some of the theory or just practice the new phraseology, there is now more time available to the student to digest this information, rather than just during a coffee break.

A typical question entered on a screen like that illustrated would be: "Is it better if I issue a rate limit (until passing FLxxx) right away with the restriction, or monitor on radar and then cancel the restriction once it is not required with a "resume normal rate of climb"? And as you might guess, two instructors will give you at least three different opinions on this.



ATC SIM Training

Time

eBriefing for ATC training (cont'd)

The role-play demonstration is an instructor-led training event where students may demonstrate the acquired knowledge by playing different roles in a group simulation taking place in the classroom on a PC-based simulator. A traffic scenario that may be solved in several different ways is presented to the students. Solutions are compared and pros and cons are discussed. This setup enables active participation from all the students in the group and enables the instructor facilitating the event to leave with better information regarding the group's theoretical understanding, in addition to ensuring that there is no misinterpretation.

Taking a new approach to briefings, the instructor from our example will encourage the students to find different options for facilitating the climb of ABC123 to FL370 to take account of the need to cross DEF567 at FL330. For example:

1. Issue a clearance to ABC123 to FL370 and assign 1500 fpm or greater until passing FL340;
2. Issue a clearance to ABC123 to FL320, monitor the rate and decide later whether to continue the climb further or wait for the cross;
3. Issue a clearance to ABC123 to FL370, monitor the rate and assign a rate restriction if required;
4. Establish radar separation by vectoring and then issue a clearance to ABC123 for climb;

Students will try to execute the solutions in a group simulation using the knowledge they acquired from the pre-briefing. Then everyone can see the differences and compare the pros and cons.

Then a student will probably say "well, what if ABC123 reports unable to maintain 1500 fpm later on?" The situation can easily be created (a few clicks) on a PC-based simulator and the discussion continues…

Designing the content is a huge and demanding task, but you can look at it as a "one-off investment".

Cooking a four-course meal: Implementation

You can guess that the shopping list is quite long; however, everything you need is at least available. Designing the content is a huge and demanding task, but you can look at it as a "one-off investment" of training design expertise which has immediate benefits. The idea also needs the utilisation of four independent software systems:

- A system that will support dynamic content delivery (Learning Content Management System). Organising the briefing items on a separate platform is very important for easy management and ensures flexibility later on. Adding or removing briefings or briefing items is now manageable with very limited expertise and effort. All changes are automatically tracked and are available for future reference.
- A system that will provide user management and smooth delivery (Learning Management System), whilst tracking students' activities and ensuring easy reporting (self progress reporting as well as group reporting and comparisons).
- A system to manage, deliver and store the online questionnaires.
- Finally, a realistic, flexible and easy to use/control PC-based ATC simulator with pause, immediate rewind / fast forward functions and instant change of aircraft position / heading / speed etc. This is very important as the objective is to compare several solutions to one situation or create a scenario based on students' questions.

His briefing must be very good...
I often find myself listening to him.

We found that ensuring that these four different software packages worked in harmony without "hiccups" was quite a challenge. Thanks to the expertise and support of the e-learning team, we now have the concept working in practice and, so far, it has not failed to deliver.

Eating a well balanced meal: Benefits

This non-conventional approach to briefings helped us to overcome the limitations listed above and to significantly contribute towards higher efficiency during the practical simulation training.

Students are now more involved in the process of preparing themselves for the simulation sessions. They are able to understand that being involved means easier acquisition of new skills in practical training. Their contribution during briefings is also a valuable feedback and motivation for the instructors and training designers who do their utmost to create a successful and pleasant learning environment. Overall, we can say that students are now showing greater commitment to, responsibility for and ownership of, their own training. Many believe this is crucial for success.

Initial experience shows that the students are highly receptive to the concept. This is confirmed by their significant effort (well above the expected) and the consistently positive comments which are obtained through confidential student feedback. The learning effect is greater if one enjoys the learning process.

An added benefit of the eBriefings is that the briefing items are now available to the students and reusable at any time later on. Revising a controlling method/technique is now just a click away. This is a huge advantage over classic briefings where, once the instructor walks out of the door, the briefing is over and usually methods/techniques are not revised.

Instructors are able to use the same system (with less detail) for self-briefing prior to the simulation. Pedagogical guidance is also included (support, key elements). This enables greater flexibility in allocating instructors to a course whilst facilitating consistent and high quality training delivery from one course to another.

Finally, an important safety culture of ensuring a proper self-briefing prior to assuming operational duties is addressed early in the training of the future ATCOs, which is not the case using the traditional approach where instructors are responsible for briefing students until relatively late in training or sometimes until validation.

Aftertaste: Conclusion

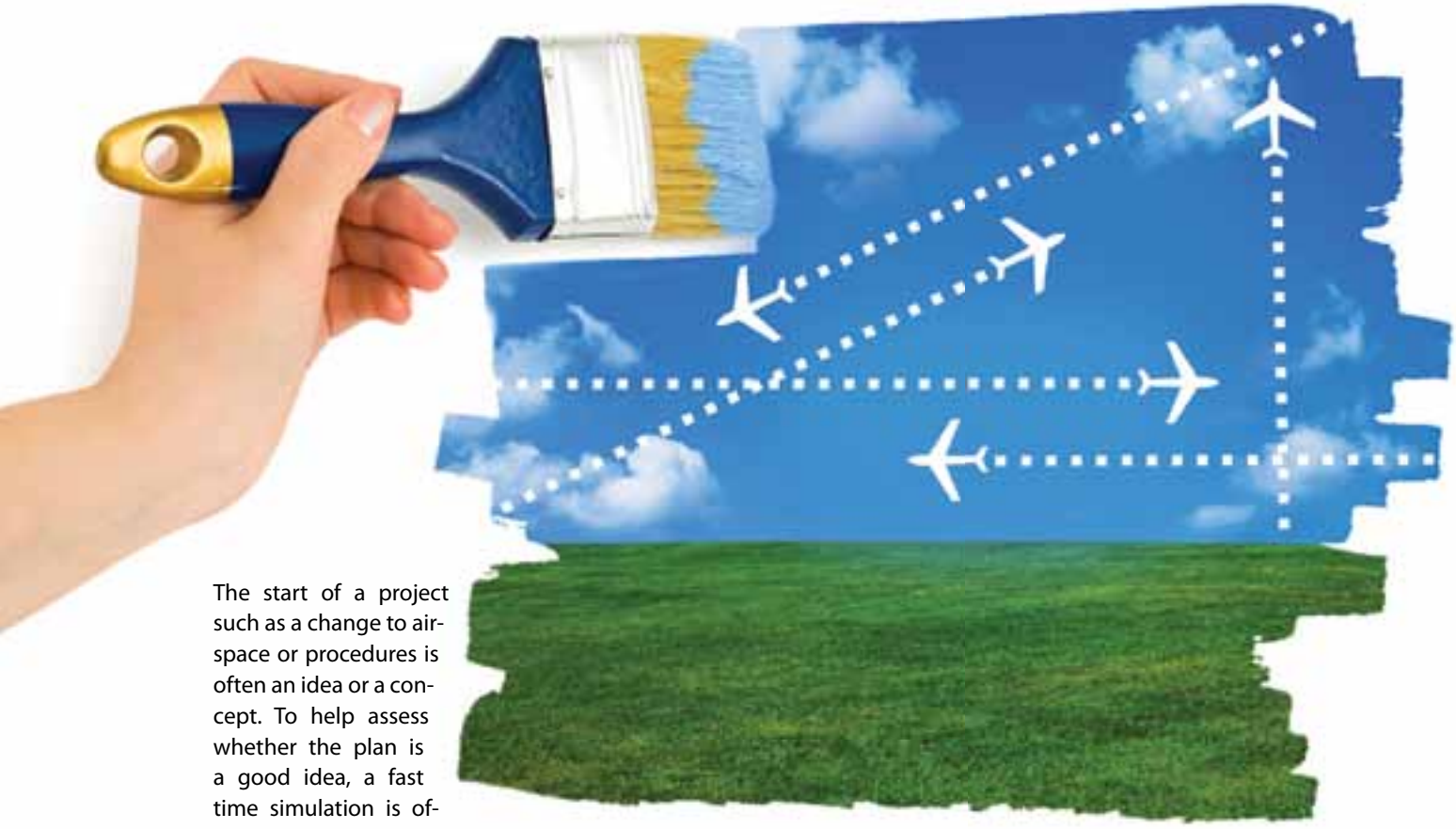
Replacing the traditional briefings with blended learning is not about replacing a meaty dish with a vegetarian, nor is it about offering a choice of dishes. It is more about offering a gastronomic dinner where every single detail is well thought out, where taste and nutritional value cater for different styles. Not to mention the bottle of wine...

The eBriefing concept does not completely replace face-to face training with e-learning, just as it does not reduce overall training time. However, it certainly allows more effective use of instructor time in the classroom. Since learning retention is much higher (80%) by "doing" rather than listening (5 – 10%), the potential for self briefing using eBriefing is immense. I also believe that it makes the ATC simulation training a lot more efficient, more sustainable and more enjoyable for the students.

Designing simulations

by Emil Karlsson

Most people think back to their training when they hear the word simulator. Today the use of simulators is much wider than only for initial/refresher training of controllers.



The start of a project such as a change to airspace or procedures is often an idea or a concept. To help assess whether the plan is a good idea, a fast time simulation is often used to analyse the likely effect of the change. Such a fast time simulation helps to validate the expected benefits as well as identify drawbacks. Often, the result of a simulation is further questions which might need more simulation to get an answer.

Once a new concept is considered mature enough to be considered for implementation, the next step is often a real-time simulation to get further details of the effect on both controllers and systems. Any major change also needs a safety case and here, the outcome of a well-designed real-time simulation is a vital aid for the decision whether or not to finally implement. Depending on the outcome of the safety case, staff might need training before implementation and here too, the real-time simulation is a valuable tool.

Most people are not aware of the amounts of data and work needed to create a real-time ATC simulation. After all, most of what is shown on the simulated radar screen is not that different from any other "normal" day at work - it might be a little different in traffic load or contain experimental traffic flows, but often nothing spectacular.

The difference between a simulation and any normal day of work is of course that there are no real aircraft with pilots and passengers flying around, just a computer that generates radar tracks. This data feeds other computers which do a more or less realistic job of replicating the ATC system components and their interaction both with each other and with adjacent ATC systems. Ideally a fully manned replica of both the online system and the neighbouring systems is used since this will give the realistic behaviour that everybody is looking for. However, with all the demanding

budgetary requirements around at the moment, this is not always the case.

The result of this cost-benefit balance in respect of simulation design may be a stand alone "look alike" simulator or a replica which runs the most important parts of the ATC system in full and simulates the rest. In the second case, the external world such as tracks and flight plan messages needs to be created and "fed" into the ATC system. One of the problems of this is that any ATC system (both the local and the neighbouring) is completely dependent on inputs from either controllers or flight data staff and the effects of those sometimes time-critical inputs is harder to simulate. Both types of simulation have their positive and negative aspects.

As with many things in life it is hard to take anything from Mr. Cost without also affecting the life of Mrs. Benefit negatively.

A free-standing "look alike" simulator often gives more freedom for the creation of scenarios and simulation of the external world, whereas a replica running a "live" system gives more realistic behaviour including the "touch and feel" but also adds the requirements and restrictions of the real world into the simulation. For example a flight might need to have a proper entry in the area of responsibility and for that to happen, a correct flight plan and ACT system message has to be received, otherwise a manual input of flight data might be necessary. Of course, this is not convenient if the simulated sector is 45 minutes' flight time away from the entry point, especially since many live systems are understandably not designed to run faster than real time.

With the help of competent simulator operators, the actions of real-life pilots, surrounding controllers and flight data staff can be simulated to a high level of realism but here we are again often knocking on the door of that old couple Mr. Cost and Mrs. Benefit. People and their training are always expensive so for each feature, the decision has to be made whether, and to what level, the human element is going to be needed. Maybe the feature can be simulated reasonably merely by manipulating data. The typical example of this is the work of flight data staff, which in many cases can be excluded by injecting error-free messages and keeping to tested scenarios. Another step in this direction is to replace controllers with trained simulator staff for the surrounding sectors and environment. Some go even further and use voice recognition as a complete replacement for or as a means to reduce the number of 'simulator pilots' required. As with many things in life it is hard to take anything from Mr. Cost without also affecting the life of Mrs. Benefit negatively, but if you do manage it, you can be sure it will be worth the trouble.

The problem with the past future

All simulations face the problem of time passing by although it can be handled in different ways. Most simulations are aimed at the future - trainees will work the future traffic and it is future airspace which needs validation or future systems which need testing. In the operational world, airspace may change every 28 days and the control systems often evolve at a similar pace. One example of how to manage this in the simulator environment is the early training phases where a fictitious airspace is often used. This enables complete control over the contents of the simulation and ensures that all the training objectives are met. In this way the simulation does not have to be adapted, unless for training reasons. Another benefit is that it saves time for simulator staff, since every upgrade

Designing simulations (cont'd)

I've told you that the new Simulator is SUPER-realistic! Even when it fails, it does it like the real system!

means changes to systems and/or flight plans.

Later in the training sequence, during Unit training, the airspace becomes part of the objectives and the question of realism becomes more critical. Still it would be hard to achieve a high level of training if procedures and airspace were continually changing throughout the course. In this case the solution is often to freeze reality at the start of the course and stick to this version until the course is finished. Here, the selected type of simulator also has an impact. A stand-alone simulator has a strong point in that it does not evolve unless this is necessary, whereas when "feeding" a live system, evolution at some point is inevitable because components lose compatibility with each other or with older airspace. The benefit is that most of the components for upgrade are available "off the shelf" from the operational world. In some cases such as system testing, the simulation has to fully reflect a future situation. The airspace, traffic and the "feeding" simulator all have to be kept ahead of time so that they can communicate in a realistic way. Often those simulations are created by using traffic pictures from the past adapted to reflect the expected future traffic picture.

When simulating future airspace or operational concepts, the implementation date can be so far in the future that no accurate data exists. In those cases, the simulation must use system components from both the past and the future. When a simulation project is started, the system version might be for next month and the generic airspace and traffic from last week is then superimposed with the changes that are expected to take place maybe years later. At the time the simulation is up and running, the airspace and traffic it was based on is already months old and the system may soon need to be upgraded. Sometimes the simulation itself might need to be updated before it is even run for the first time just because of the extent of operational changes taking place during development.

Sometimes it is advisable to run a simulation which represents a reasonable step into the "past" but still has a high certainty of realism and consistency. Sometimes, too, it is necessary to project the systems/traffic picture into the future despite the inevitable eventual losses of accuracy.

One of the most important factors for the outcome of a simulation irrespective of its use is the pre-analysis. A good pre-analysis which produces a clear and shared view of what is to be achieved is the cornerstone of any successful simulation. A properly designed simulation can then itself become a cornerstone for a safety case, an ab-initio course or the development of new airspace or system functionalities. The question: "What is the purpose of the simulation and how is it best achieved." needs to be asked and answered every time, preferably with as much detail as possible.

It all boils down to the familiar generic solution of "it depends". Everything can be simulated, but of course some features require more development and/or imagination from the user than others. The only way to consistently take the right route through this maze of choices is to first figure out where you want to go. It should not be forgotten that the real focus of a simulation is always the processes going on inside the heads of the participants rather than what is actually displayed on the screen. A well-prepared scenario will frequently make a huge difference. Realism alone is never the only goal of a simulation; it is just one of the factors that need to be taken into account in order to satisfy whatever the objectives of a particular simulation are.

Training for and providing top performance!

Usually, when it all goes wrong for the pilot(s) and their QRH says 'land as soon as possible", ATC can be relied upon to set to and provide the best support they can. Training should promote minimising both other aircraft R/T and R/T with the incident aircraft unless responding to calls from the latter. It may include 'clearing the skies' to give the best possible routing to a landing (but not always the shortest track distance unless the aircraft is at a low altitude already). And of course much, much, more. Controller performance in these circumstances is usually of a high standard - they know they can ease a difficult situation.

Even so, a thoroughly-investigated incident can often still find opportunities for 'safety improvement'. One of many such examples is featured here. A successful response to all unexpected situations needs a blend of properly applied SOPs set in a fully understood real-time context. It's the latter where the right sort of training really comes into its own.

On 27 July 2006 ATC at Barcelona were presented with CRJ200 which, climbing through FL235 14 minutes after departure to Basel, reported the sudden loss of thrust on one engine and indications of fire which were not extinguished by the use of the available engine fire extinguishers. There were no reports from the cabin of the indicated fire appearing likely to spread beyond the engine but this was clearly a case where the aircraft needed to get back on the ground as soon as possible.

In fact, traffic late in the evening was light and the weather was good. The aircraft was provided with instructions to runway 25R and landed just over 12 minutes after the failure and fire indication occurred - the (genuine) annunciation of engine fire ceased only 3 minutes before touchdown.

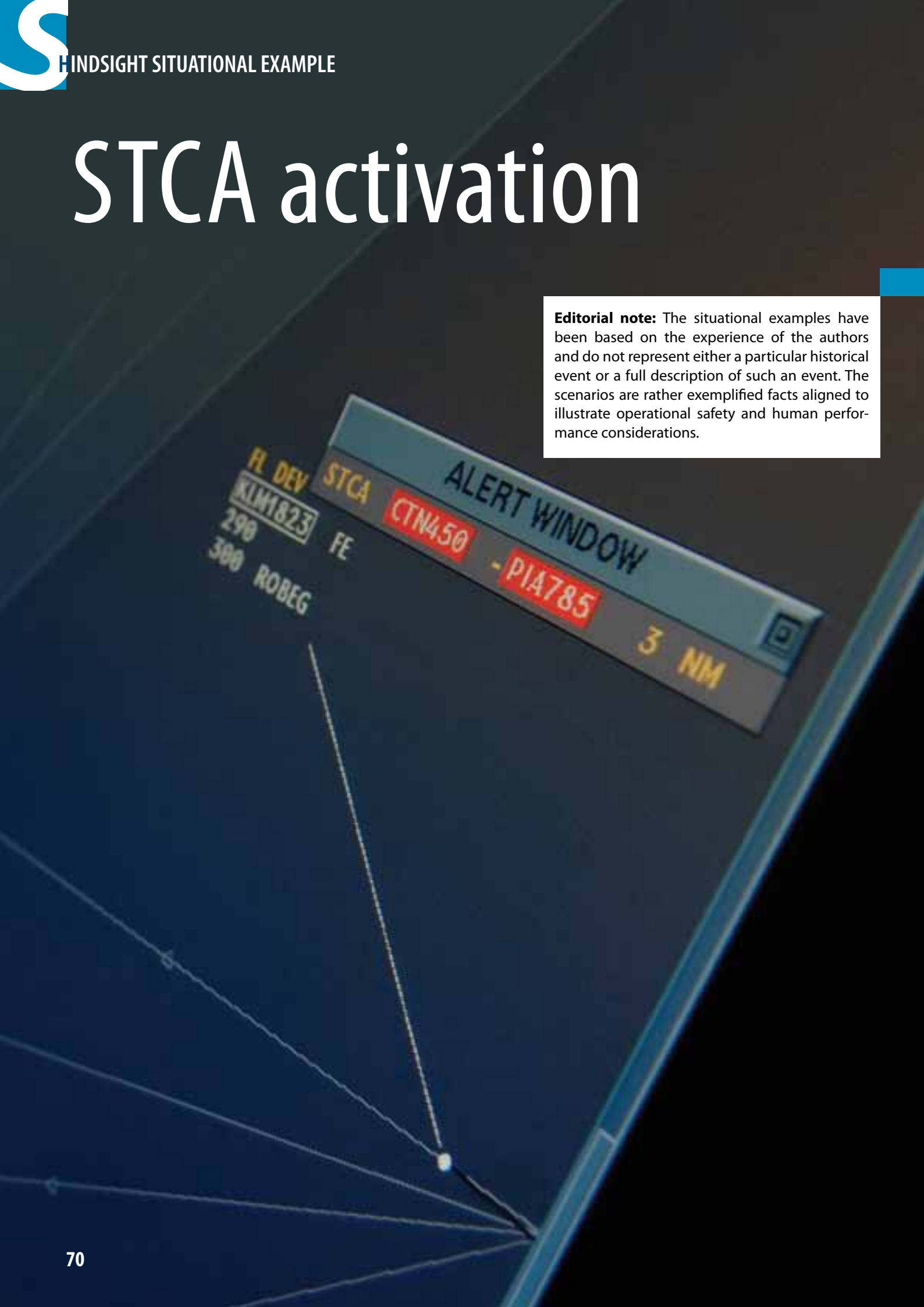
The fire had continued despite the use of the extinguishers which are designed to ensure such fires are extinguished because the firewall between the 'hot section' of the failed engine and the gearbox zone to the rear had been breached during the explosive failure caused by a disintegrating (faulty) fan blade.

As you might expect, almost all the Report by the CIAIAC was about the airworthiness origin of the problem and the crew's response to it. ATC service was described as good except in one respect - the issue of overly complex instructions for a non-precision approach. CIAAIC commented that such emergencies require "short and concise instructions" rather than those given which had involved transmissions of up to 14 seconds at a time and "contributed to the agitation of the crew".

So, despite a good performance by ATC, there was still room for improvement. You can read a longer summary and access the official report in English to see the (minor) reference to ATC in context at http://www.skybrary.aero/index.php/CRJ2,_en-route,_east_of_Barcelona_Spain,_2006_(AW_FIRE_LOC)

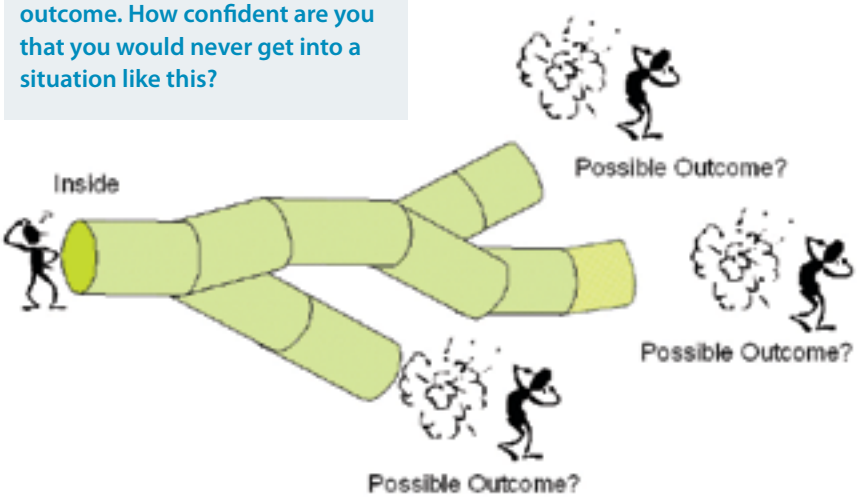
STCA activation

Editorial note: The situational examples have been based on the experience of the authors and do not represent either a particular historical event or a full description of such an event. The scenarios are rather exemplified facts aligned to illustrate operational safety and human performance considerations.



THE FACTS

Read the story as it develops, position yourself in the context without knowing the actual outcome. How confident are you that you would never get into a situation like this?



You're an on-the-job-training instructor in a major Area Control Centre (ACC). Together with your trainee you started the day in the simulator department of your ACC, where you guided him through an exercise scenario that was situated in the sector where you work. After a break, during which you debriefed your trainee on the exercise, you're now both in the ACC operations room.

Your trainee has taken over from a radar controller, assuming responsibility (with your consent) for the air traffic in a high level sector - the same airspace as in the simulator exercise. The traffic load is moderate to high, but the trainee is at a stage of his training where he can be expected to handle it. There is another controller at the radar console, sitting next to your trainee, who is the planner/coordinator for the sector. His role is mainly to coordinate handovers to or from adjacent sectors via the intercom system, and to prepare the flight progress strips that your trainee uses to keep track of the traffic in the sector.

After about half an hour on position you observe that your trainee clears Airline907, a Boeing 747-400, to climb to Flight Level 390. You know that the trainee can give this clearance because a conflicting aircraft on a crossing track has passed the track of the Boeing 747, but you're also aware that the climb to FL390 will put it in conflict with another aircraft at that level that has just entered the sector. Your trainee is aware of that aircraft too, for he accepted the handover just a few moments earlier.

What would you do?

You decide to give the trainee some time to resolve the problem before intervening in the situation. Even while this thought is forming in your mind, your trainee instructs the aircraft that just entered the sector to descend to FL350 which will resolve the conflict. This instruction is not acknowledged however, for the aircraft is not yet on his frequency. The trainee repeats the instruction to the aircraft to descend to FL350, and again there is no response from the aircraft (for the same reason).

Apparently the controller at the adjacent sector, physically situated a short

STCA activation (cont'd)

distance away from your sector's console in the same operations room, has not yet transferred the aircraft to the frequency of your sector. Normally the planner/coordinator would contact that other sector and ask them to tell the pilots to change to your sector's frequency, but you see that the planner/coordinator is absorbed in another task and may not even have noticed the communication issue.

What would you do?

You call out to the controllers at the adjacent sector (a few steps away) and after getting their attention you tell them that they should transfer the aircraft to your sector's frequency. You receive a "thumbs up" from them, and sure enough a few seconds later the aircraft checks in with your trainee. He immediately instructs the aircraft to descend to FL350, which this time is acknowledged. Although this still resolves the conflict between this aircraft and Airline907 in a timely manner, you're not happy as an instructor about the way your trainee handled it.

What would you do?

Since it is relatively quiet in terms of R/T communications you start explaining the things that went well and the things that could have gone better in this situation to your trainee. While you are doing this, the Short Term Conflict Alert starts flashing at the radar display. You look at the screen and you see Airline907, passing FL367 and still climbing to FL390, turning towards the flight path of Airline958 - a Douglas DC10 at FL370 that you hadn't noticed before. The horizontal separation between the two aircraft is still more than the required minimum of 5 Nautical Miles, but seems to be rapidly decreasing.

What would you think?

You hear your trainee instruct an aircraft to descend to FL350, and you understand this instruction is for the DC10. But even though the descent instruction is acknowledged, there is no change in the Mode C read-out (height read-out) in the label of that aircraft on the radar display. Your trainee instructs Airline958 to turn right to heading 130, but this instruction is not acknowledged. He subsequently instructs Airline958 to turn right heading 140, but again there is no response. Meanwhile the two aircraft are getting really close!

What would you do?

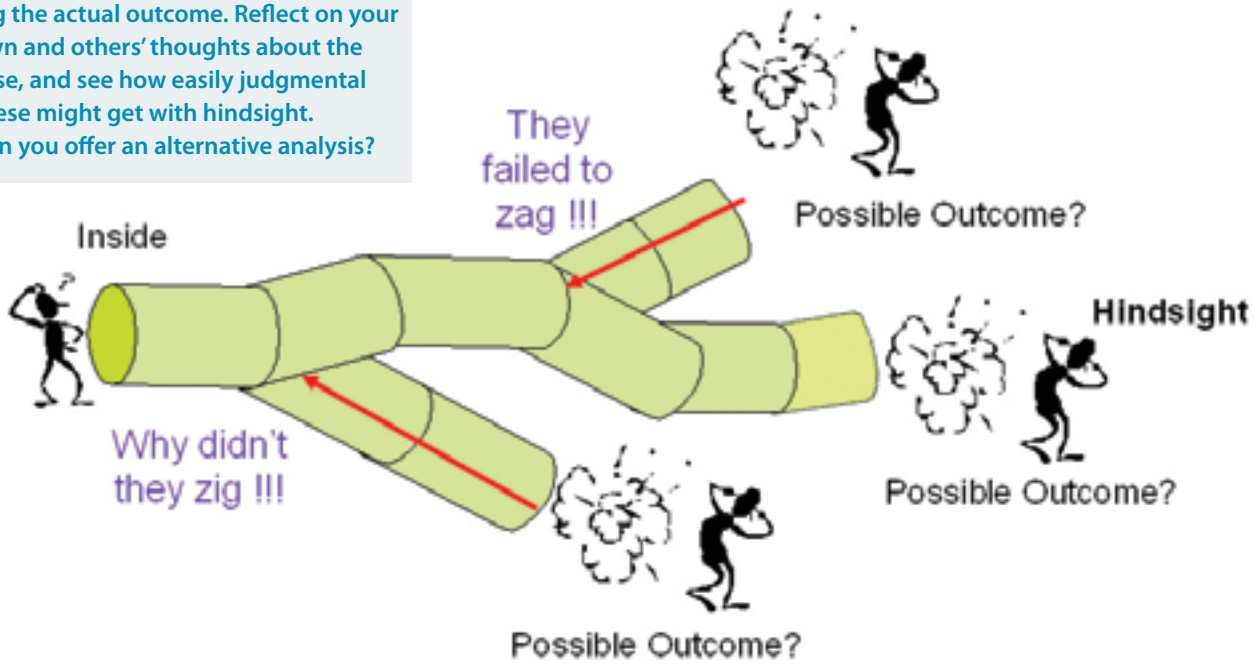
You quickly reach for the transmit-button and you want to tell Airline958 to start its descent but what you actually say is: "Airline957 begin descent!" There is no response to your transmission. The next thing you see is that now both Airline907 and Airline958 are descending, with both Mode C read-outs showing FL367, still on converging tracks. Your next transmission is "Airline907 climb and maintain FL350" but again there is no response. You see that both aircraft are continuing to descend, that the Mode C indications are almost similar, and that the radar plots are about to merge.

What would you think?

A little later Airline958 transmits that they were following a TCAS Resolution Advisory to descend but now are climbing again, which you acknowledge. Shortly afterwards, also Airline907 reports clear of traffic. This you acknowledge as well, while trying to understand what just happened.

DATA, DISCUSSION AND HUMAN FACTORS

This section is based on factors that were identified in the investigation of this occurrence. Read the story knowing the actual outcome. Reflect on your own and others' thoughts about the case, and see how easily judgmental these might get with hindsight. Can you offer an alternative analysis?



Simulator training

To start off their working day, the instructor and her trainee spent about one hour in the radar simulator. The training exercise that they conducted was situated in the same airspace where they would be continuing the on-the-job-training later that day. The instructor and the trainee had done this particular exercise together once before already.

In simulator training it is not unusual for instructors to provide feedback to their trainees during an exercise. Many advanced ATC simulators have an option to "freeze" the exercise, i.e. to pause it, but it is left to the discretion of the instructor to decide whether to use that option or to provide feedback in real time during the exercise.

Because the trainee had done the same exercise before already, it is likely that the instructor provided most of her feedback during the exercise without pausing the simulator.

The instructor and the trainee had a break of about two hours after the simulator exercise. They spent a few minutes at the beginning of the break to complete the debriefing on the exercise. After the break they went to the operations room of the ACC to do on-the-job-training in the same sector where the trainee had worked during the exercise scenario.

On-the-job-training

The trainee handled the traffic without any problems during the first 30 minutes at the radar console. When Airline907 (the Boeing 747-400) checked

STCA activation (cont'd)

in on his frequency, he initially cleared them to climb to FL350 because of a conflict with a crossing flight above. He also cleared Airline907 to fly directly to a waypoint further down their route. The planner/coordinator meanwhile coordinated with an adjacent sector, to which Airline907 would be transferred later, that the aircraft could climb to its final cruising level, i.e. FL390. This information was written on the flight progress strip for Airline907 by the planner/coordinator so that the trainee controller could see it.

Continuing to work his traffic, the trainee accepted the transfer of an aircraft that would be entering his sector at FL390.

This aircraft potentially was in conflict with Airline907 once that flight continued its climb to FL390, but since the new aircraft was not far from its destination it would have to descend anyway. The potential conflict with Airline907 therefore could easily be resolved by descending the inbound aircraft from FL390 to a lower Flight Level.

Transfer of communications

In this ACC the transfer of responsibility for flights is organised as follows: the transferring controller makes a system input that results in a "hand-off" indication in the label of that flight at the display of the receiving controller. The receiving controller makes an input to accept the transfer, which can be seen by the transferring controller on his display. The transferring controller then instructs the pilots of the flight concerned to change frequency to that of the receiving controller.

That time however the transferring controller did not give the instruction to change frequency to the flight directly after the transfer had been accepted.

Conflict detection and resolution

After the trainee had seen that the crossing flight above was clear of the path of Airline907, and in keeping with what the planner/coordinator had written on the flight progress strip, he decided to instruct Airline907 to climb to FL390. And recognising the potential conflict with the inbound aircraft, for which he had accepted the transfer and which was now in his airspace, he instructed that aircraft to descend to FL350.

When there was no reply to his descent instruction the trainee made another transmission, instructing the aircraft to descend to FL350, but again there was no reply. He briefly looked at the planner/coordinator, who seemed to be busy preparing flight progress strips while talking on the interphone system with another sector.

The instructor had watched the actions of her trainee. She had been aware that the inbound aircraft had not yet checked in on the frequency, and was mildly surprised that he climbed Airline907 before being in contact with the inbound flight. When the trainee tried to give an instruction to the inbound flight, she understood his plan and also identified the mistake in its execution.

She decided to let the trainee continue to work, but made a mental note to discuss this situation with him later.

Distraction

Because the instructor saw that the planner/coordinator was busy with other tasks, she turned to the adjacent control position (a short distance away) and reminded the controller there to instruct the inbound aircraft to change frequency to that of her trainee.

Meanwhile the trainee had accepted the transfer of another aircraft, Airline958, a DC10 at FL370. He had made the appropriate marking on the flight progress strip, and Airline958 had checked in on the frequency of the trainee without delay.

Since the trainee at that time was focusing more on the unresolved potential conflict between the inbound flight and Airline907, it is plausible that he hadn't yet consciously integrated the presence of Airline958 in his traffic picture.

The instructor had not witnessed the transfer and check-in of Airline958, because she was communicating with the controller at the adjacent control position. For the same reason she may not have noticed the added flight progress strip for Airline958 at the working position of her trainee.

Task prioritisation

When the inbound aircraft finally checked in, the trainee immediately instructed the aircraft to descend to FL350, which was acknowledged. He now at last had resolved the potential conflict with Airline907, but not in a way that impressed his instructor. As it was relatively quiet on the frequency, the instructor decided to discuss the trainee's actions with him straight away.

Her decision to provide feedback immediately after the event, and with the trainee still at the control position, may have been related to a similar way of doing this in the simulator (where they both had been earlier that day).

While the instructor was discussing the event with the trainee, they both were caught by surprise when the Short Term Conflict Alert (STCA) started flashing on the radar display. Their surprise turned into disbelief when they saw how close the two aircraft highlighted by the STCA already were.

The STCA in the radar system at this ACC was designed to activate about three minutes before a theoretical collision could occur. Both the instructor and the trainee had experienced STCA activations before, in situations where there was enough time after the alert to resolve the conflict without a loss of separation.

In this case however the STCA became active after Airline907 started a turn when arriving at the waypoint to which they had been cleared directly. The turn brought Airline907 into the flight path of the opposite Airline958 at FL370. Since Airline907 at that moment was passing FL367 in its climb to FL390, the STCA was triggered with only about one minute left before collision.

Performing under stress

After the trainee had recovered from the initial shock caused by the STCA, he realised he needed to take action immediately. His first impulse was to level off the Boeing 747-400, but he discarded this idea when he remembered that this aircraft was climbing and that it would probably continue to do so for a little while before a manoeuvre to level off would be effected by the pilots. He therefore decided to instruct the DC10, which was in level flight, to descend instead.

The R/T recordings showed that the trainee actually started a transmission to Airline907, but that he broke that off after the callsign by saying "disregard". He then continued his transmission by saying "Airline907 descend and maintain FL350, begin descent due to traffic". This instruction was acknowledged by Airline907 without delay.

Confusing the callsigns of two conflicting flights from the same airline may have been the result of the psychological stress that the trainee experienced when the STCA activated during the debrief from the instructor about the earlier event.

Neither the trainee nor the instructor noticed that the call had been directed at, and acknowledged by, Airline907.

The planner/coordinator later stated that he noticed the instruction was given to Airline907, which he wasn't expecting, but he thought that resolving the conflict could work that way too so he didn't speak up about it at the time.

STCA activation (cont'd)

When the trainee didn't see any change in the Mode C read-out of Airline958 on his display, he instructed the DC10 to turn right to a heading of 130 in order to try and resolve the conflict that way. Because there was no reply to this instruction the trainee again instructed Airline958 to turn right, but this time to a heading of 140. Again there was no reply to his transmission.

The instructor at that point took over from the trainee, with the intention of emphasising the need to descend to the DC10.

She thus was planning to act in line with the solution that the trainee had arrived at as well, which from an ATC perspective was a logical solution in that situation.

At that time she was convinced that the descent instruction given by the trainee had been directed at, and acknowledged by, the DC10 (Airline958).

While she was preparing to speak, she noticed on the radar display that the Boeing 747-400 (Airline907) had reversed its climb and now in fact was descending. This was not what she expected.

When she made her transmission, this is what she said: "Airline957 begin descent!" There was no aircraft on the frequency with the callsign Airline957, so her call remained unanswered.

Mixing up the digits of the flight numbers 907 and 958 for two conflicting flights from the same airline may have been the result of the psychological stress that the instructor experienced when the STCA activated during her debrief to the trainee about the earlier event.

The stress may even have increased because of the - in her perception - unexpected change from climb to descent of the Boeing 747-400.

Five seconds later, the instructor made another transmission in which she said (according to the R/T recording): "Airline907 climb and maintain FL350".

Although she used a correct callsign, the instruction itself would seem inappropriate for at that time the Mode C read-out of Airline907 indicated FL366 and descending.

This transmission may be another indication of the psychological stress level experienced by the instructor at that time.

There again was no reply to that transmission, and the Mode C read-outs of both aircraft showed that they were both descending at about the same Flight Level towards the same point in space.

The instructor and the trainee took no further actions. After about 15 seconds one of the aircraft (later identified as Airline958, after analysis of the R/T recordings) reported that they were following a TCAS Resolution Advisory to descend but now were climbing again, without using its callsign.

This call was acknowledged by the instructor, by using the words: "Airline908, roger".

There was no aircraft on the frequency with the callsign Airline908, which again may be an indication of the stress level she was experiencing.

When subsequently Airline907 reported "clear of traffic", she acknowledged this correctly by saying "Airlne907, roger".

FLIGHT DECK PERSPECTIVES

NOTE: this section addresses some selected aspects that strictly speaking are outside the ATC domain, and therefore may seem out-of-place in this text. It is only included to enable a more comprehensive understanding of this complex occurrence.

The pilots of the Boeing 747-400 (Airline907) had already noticed the contrail of the other aircraft when the distance between the two aircraft was still more than 35 Nautical Miles (NM). At a distance of 25NM the other aircraft was displayed on their Traffic Alert and Collision Avoidance System (TCAS), and the crew was aware that the altitude of the other aircraft was not much different from their own altitude.

The pilots of the Douglas DC10 (Airline958) had also seen the other aircraft, both by its contrail and on their TCAS display, at a range of about 13NM. They could see the aircraft turn towards them, at about the same altitude as their own, and the pilot flying had already disengaged the autothrottles in anticipation of a TCAS Resolution Advisory.

Because the Boeing 747-400 was in a climbing left turn, it would have been difficult for the pilots of both aircraft to accurately judge the position and flight path of the other aircraft relative to their own.

When Airline907 was turning left over the waypoint, they realised that the other aircraft was quite

close. They then received an ATC instruction to descend to FL350 due to traffic, and even though they were still climbing they decided to follow the ATC instruction immediately. The captain stated later that since he felt the controller was handling multiple aircraft with a grasp of the whole traffic situation, he didn't challenge the instruction but disengaged the autopilot and autothrottles and began to descend manually.

While executing the descent manoeuvre, the pilots of Airline907 heard a TCAS Resolution Advisory that said "climb, climb, climb"[1], but since they already were committed to descend the captain decided to continue doing so.

The pilots of Airline958 also received a TCAS Resolution Advisory, which said "descend, descend, descend", and since they were expecting it they started their descent without delay. A little later the TCAS advisory changed to "increase descent, increase descent", so they made the aircraft descend even faster. By looking outside they realised that the other aircraft was descending as well, and that there was a real risk of collision. Because they could see the top side of the other aircraft they thought it had to be lower than them, so at the last moment both pilots of the DC10 began pulling the yoke which saved the two aircraft from colliding.

1- both aircraft were equipped with TCAS II version 6.0.4a, not the currently mandated 7.0. Version 7.0 would not make any difference to the outcome, but version 6.0.4a repeated the aurals "climb, climb, climb" and "descend, descend, descend" three times, unlike version 7.0 (twice).

HERA KEY WORD ANALYSIS

Note: This section is offered as an alternative way of analysing the occurrence. Key words from the Human Error in ATM (HERA) methodology are presented with a brief explanation of how they relate to the occurrence.
For more information about HERA, see [HERA item in Skybrary]

Distraction
The trainee controller was distracted from the traffic situation by the debriefing by the instructor on how he had handled the situation a few minutes earlier. The instructor also had been distracted from monitoring the student's traffic when she turned to communicate with the other control position about the transfer of communication of an aircraft.

Preoccupation
The trainee controller had become preoccupied with resolving the conflict between Airline907 and the aircraft entering the sector that wasn't on his frequency yet. The instructor may have been preoccupied with her desire to debrief the trainee shortly after that conflict had been resolved.

Monitoring failure
When the instructor turned her attention to the working position of her trainee again (after communicating with the other control position), she didn't reacquaint herself with the traffic situation but began to debrief her trainee on the previous situation.

Similarity of information
Both the instructor and the trainee confused the flight numbers of the two aircraft that were involved in the STCA activation. The aircraft were from the same airline; their company callsign and the first digit of their 3-digit flight number were identical.

Integration failure
The trainee failed to integrate Airline958 in his traffic picture after he accepted the handover of this flight and acknowledged its presence on his frequency.

Failure to consider side effects
The instructor can be seen to have failed twice to consider the side effects of her actions. She didn't take account of the fact that her trainee might accept a transfer of traffic while she communicated with the other control position. She also didn't sufficiently realise that the traffic situation would continue to develop during her debriefing of the trainee, and that her trainee might not be able to divide his attention adequately between the traffic and her debriefing.

Intrusion of thoughts
The trainee's initial reaction to the STCA activation was to instruct Airline907 to descend. But while starting to make that transmission, he realised it would be more effective to instruct Airline958 to descend (since that aircraft was in level flight, while the other one was climbing). When making the related transmission however, the trainee used the callsign of Airline907 again without realising it. Similarly, when the instructor intervened she was processing the unexpected information from the Boeing 747-400's Mode C that this aircraft was descending rather than climbing. This may explain why she mixed up the digits of the flight numbers in her transmission.

STCA activation (cont'd)

Contextual conditions (in no particular order)

- Traffic and airspace
- Pilot-controller communications
- Team factors
- Organisational factors
- Unusual situation
- On-the-job-training
- Inadequate Team Resource Management (TRM) training
- Job-related distraction
- High anxiety/panic
- Support from planner/ coordinator
- Work scheduling

Prevention Strategies and Lines of Defence

It may not be a good idea to schedule instructors and trainees to work in a simulator as well as in the operations room during a single shift. No matter how good the quality of the simulator is, for an air traffic controller there will always be a subtle difference in attitude between handling the traffic during a simulator exercise and handling live traffic. If the first part of a shift is spent in the simulator, and the second part working with live traffic in the operations room, there is a risk that the simulator attitude persists throughout the second part of the shift. Training schedules and operational schedules therefore should be designed to avoid combinations of simulator duty and operational duty in a single shift.

During on-the-job-training the instructor should try to restrict feedback to a trainee to short comments, hints and/or instructions if possible. Detailed discussions about traffic situations should be held away from the operational working position, preferably in a dedicated briefing room with suitable tools for the instructor to use.

If the controllers of this ACC had received Team Resource Management (TRM) training, it would have been more likely that the planner/coordinator would have voiced his concern when he noticed that the descent instruction was given to the climbing aircraft. In the same vein, he and/or the instructor might have acted differently when the controller of the adjacent sector didn't promptly transfer an aircraft to the frequency of the trainee.

Controllers should receive detailed information about the design logic of any system component that is designed as a safety net, e.g. STCA. If the controllers in this scenario had been aware of the fact that their STCA mechanism did not take the intended flight paths into account, they might have been less surprised to discover that after the STCA activation there was only limited reaction time available to prevent a loss of separation.

In this scenario the pilots of Airline958 did not inform ATC that they were following a TCAS Resolution Advisory until after the conflict. The pilots of Airline907 were following an ATC instruction and decided to ignore the TCAS Resolution Advisory they received, which also was not communicated to ATC. Partly as a result of this event the airline and the Air Navigation Service Provider concerned have improved their TCAS training programmes for pilots and controllers since then.

KEY POINTS

During an on-the-job-training situation a Short Term Conflict Alert activated while the instructor was explaining the flawed handling of an earlier conflict to the trainee, causing acute psychological stress for both of them. The instruction to descend to one of the aircraft by the trainee was not given to the aircraft for which it had been intended, yet it was properly acknowledged by the (other) aircraft that received it. Both the instructor and the trainee did not notice this discrepancy. When the instructor tried to intervene she confused the digits of the flight numbers of the aircraft involved, with the result that her instruction was directed at a non-existing flight and thus had no effect.

With one aircraft descending in compliance with the ATC instruction, and the other aircraft descending in response to a TCAS Resolution Advisory, the risk of a collision became very real. A collision was avoided because the pilots of one of the aircraft changed their vertical flight path at the last possible moment.

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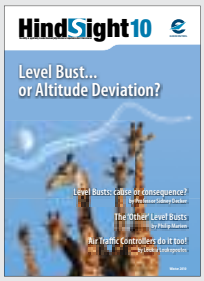

In the next issue of HindSight:
Emergency and unusual situations in the air

EUROCONTROL

Putting Safety First in Air Traffic Management

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