HindSight29

The ability or opportunity to understand and judge an event or experience after it has occurred

EUROCONTROL

GOAL CONFLICTS AND TRADE-OFFS

TRADE-OFFS AND TABOOS
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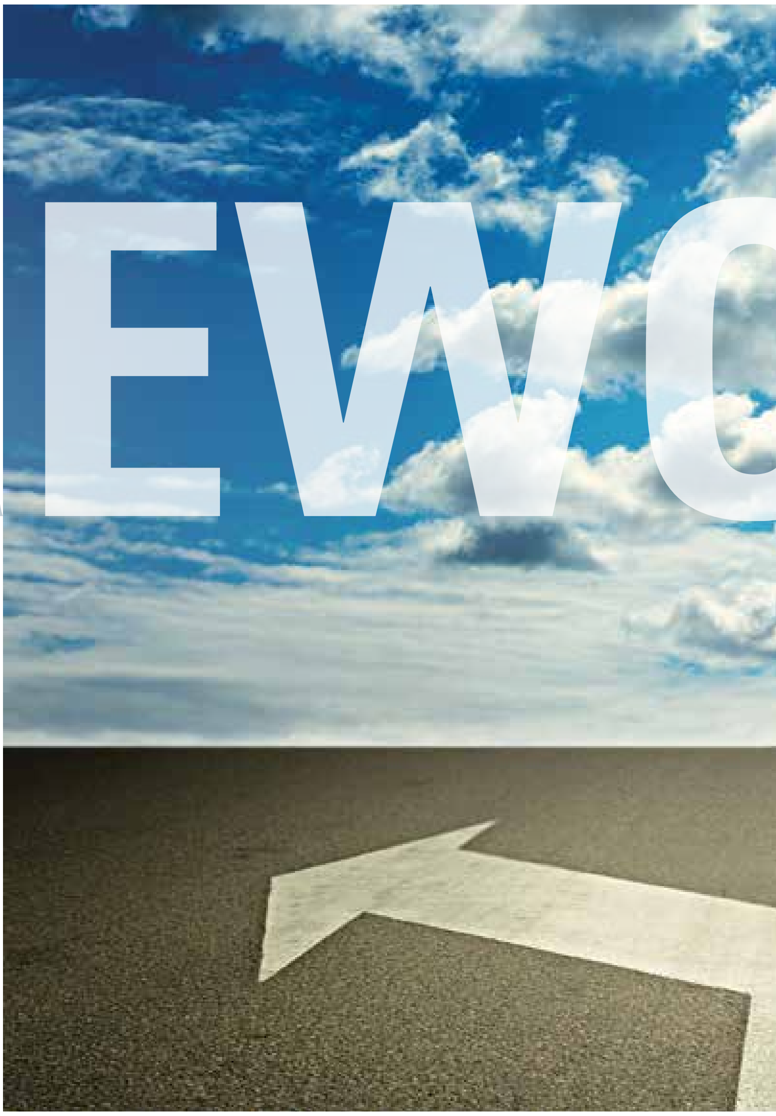
Winter 2019-2020

FOREWORD

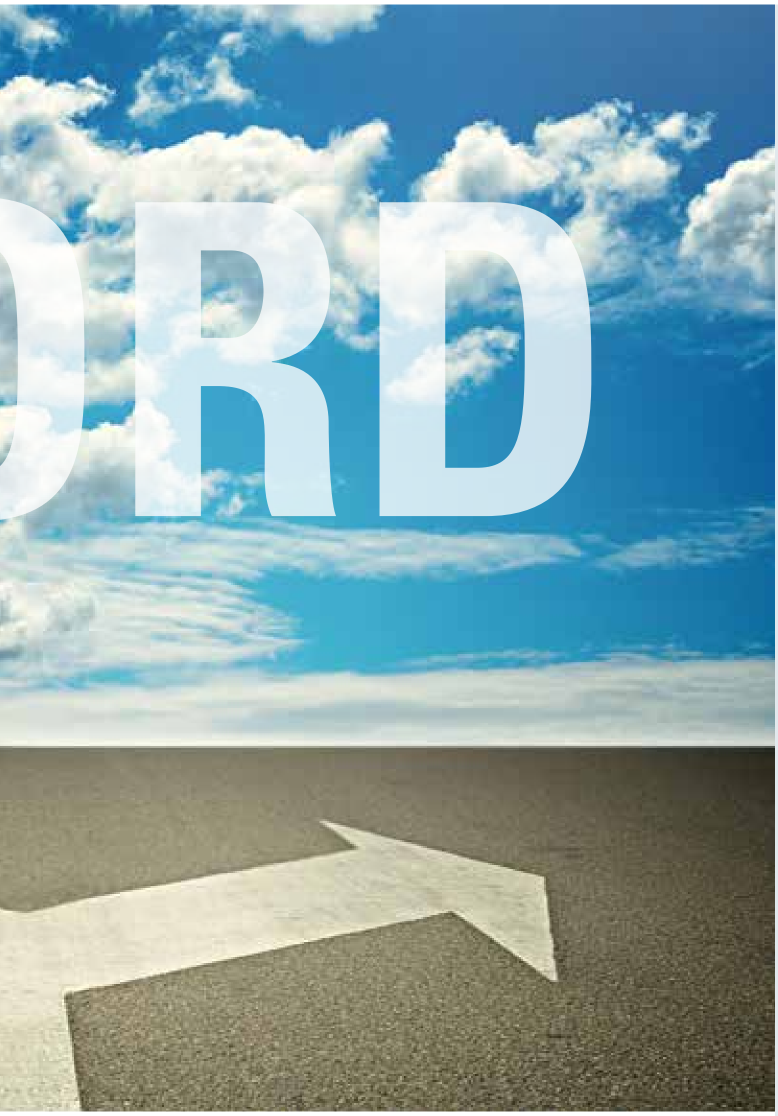


Iacopo Prissinotti is Director of the Network Management Directorate as from 1 July 2019. He brings to this role over 30 years of experience in air traffic management and air navigation services, occupying a series of senior leadership roles in strategic, technical and operational roles.

My career in aviation started in 1985 in the Italian Air Force, as an air force officer and air traffic controller. Subsequently, I joined ENAV. During that time, my goals were much as they are in ATC today. We were taught to ensure a safe, orderly and expeditious flow of air traffic. I worked as an operational ATCO until the year 2004 in all the main air traffic control positions: ground control, approach and en route. As a controller, I had to balance different goals relating to safety and productivity. Nowadays, controllers have further environmental considerations, which were far less prominent then. Depending on the situation, different trade-offs were necessary, and the timeframe to make them was never long – usually seconds.

From the mid-2000s, to 2019, I was responsible for ENAV's international strategies. I had to co-ordinate all ENAV international projects, cooperation initiatives and participation in European and international bodies and organisations. The goals and trade-offs moved up to a strategic and international level as many different interests were at stake.

This led to my current role, as Director Network Management. My ultimate goal is to promote operational and technological improvements and co-operation between all ATM stakeholders. We have to prepare for a future that can meet the level of traffic growth and its variations over the coming decades. But with an increasing focus on the environment and capacity, we must not take our eye off the ball when it comes to safety.



I have learned over the years that goal conflicts and trade-offs apply in every aspect of air traffic management, from tower controller decisions on optimum use of the runway, to national and European-level decisions about routes and airspace. Safety-capacity, cost-efficiency, environment and security all interact. They form part of decisions at different levels, and in different time-frames, but the decisions are all ultimately connected. Air traffic control is in my blood, and I always consider how decisions made at national and international level affect controllers in operational units and pilots in cockpits.

To be effective in balancing the different goals, we have to communicate and collaborate effectively at all levels. *HindSight* is part of that. Via this magazine, 1000s of readers get an understanding of the worlds of air traffic controllers and pilots, and others whose work is relevant to the safety of air traffic management.

Iacopo Prissinotti

WELCOME

Welcome to Issue 29 of HindSight magazine – the EUROCONTROL magazine on the safety of air traffic management. The theme of this Issue is 'Goal Conflicts and Trade-offs'. For this magazine, and you the readers, safety is a particularly important goal. But it exists along with several other goals, including the environment, capacity, cost-efficiency, and security. The importance of each goal, and how we work to achieve them, changes depending on the situation, in the short and long term.

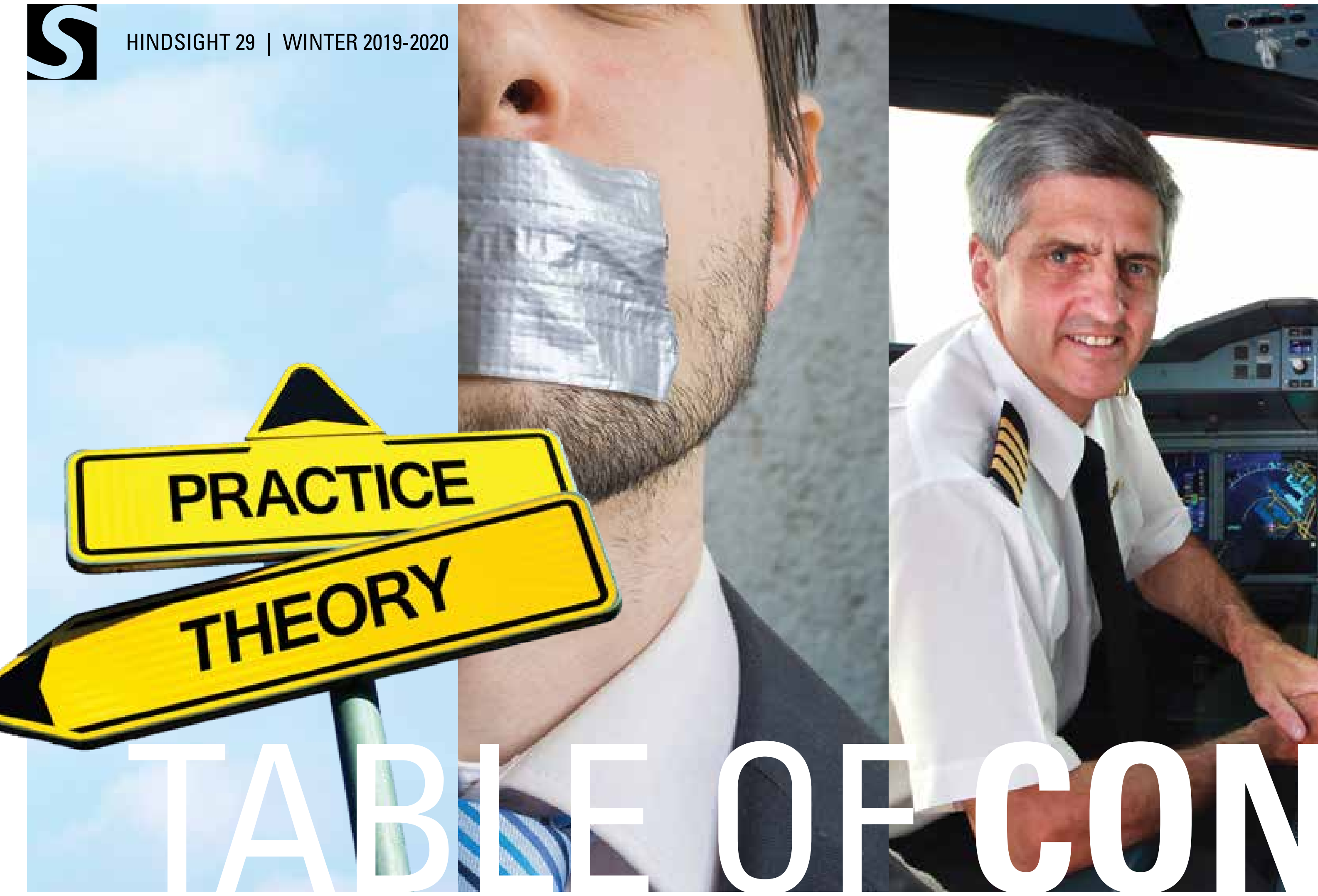
In this Issue, we have a fantastic range of articles from air traffic controllers, professional pilots, human factors and safety management specialists, as well as specialists from other industries to give some outside perspectives. HindSight is written primarily for air traffic controllers and professional pilots, and others with a professional interest in the themes, especially those who support safety and front-line work. For operational and non-operational staff alike, it is important to hear from others, in other places, and roles: controllers, pilots, safety management specialists, designers, engineers, and managers at all levels, in all parts of aviation. It is important to understand the reality of front-line work and how the aviation system – and society more generally – affects this reality.

With HindSight, we hope to help create conversations about the themes and issues. Do your operational and non-operational colleagues know about HindSight? Would you be willing to ask them, and encourage them to subscribe? Search 'SKYbrary HindSight' for details, and if you need paper copies for your Ops room, then please get in touch.

This Issue – as usual – blends articles on the reality of work. The articles are written by air traffic controllers and professional pilots, and those who study or make decisions about work and safety. We have more articles from pilots than usual, and we know that this will be appreciated. The authors address a number of questions about goal conflicts and trade-offs, such as: What goals influence human and system behaviour? How do they affect us and the aviation system more generally? What trade-offs do we need to make to resolve the dilemmas that we face? How does safety fit into the picture? How can we talk about these issues openly?

HindSight writers contribute freely. It is how they give back to the aviation community and travelling public, and keep up their professional development. This is something mentioned in this Issue by Captain Richard Champion de Crespigny – captain of QF32. In fact, professional development was a critical influence on the outcome that day.

The next Issue of HindSight is on 'Wellbeing'. This is a topic that can be more difficult to discuss than 'hard' safety topics, but it is one that has real consequences for individuals, families, organisations, and the public. What are your experiences when it comes to wellbeing and safety? Let us know, in a few words or more, for Issue 30 of HindSight magazine.



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All *HindSight* articles are peer-reviewed. Thanks to Svetlana Bunjevac, Radu Cioponea, Anders Ellerstrand, Florence-Marie Jégoux, Alexander Krastev, Tony Licu, Captain Ed Pooley, and Captain Karel Mundel.

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CONTACT US

HindSight is a magazine on the safety of air traffic management. The success of this publication depends on you. Please tell us what you think. And even more important, please share your experiences with us. We would especially like to hear from current controllers and professional pilots (the main readership) with a talent for writing engaging articles.

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Alex Bristol
CEO skyguide

INVITED FOREWORD

Goal conflicts and the need to make trade-offs are nothing new to executive teams in any organisation, airlines and ANSPs being no exception. It is, however, an uncomfortable place to be when such decisions involve safety, where the possible consequence of making the wrong decision could be extremely severe. The classic goal conflict for us is that of safety against cost-efficiency (closely followed by safety versus capacity). It is one of which we can very easily be accused, and which is very difficult to refute, even with quantitative evidence. Often, decisions can only be considered 'good' a decade or two later. And if something goes wrong, well, there are always enough people around to say, "I told you so".

We had a situation when I arrived in skyguide, in which I believed that we had – over a period of years – reduced the safety margins in the operation at Zurich Airport too much. The operation was still tolerably safe (otherwise we would have stopped it, of course), but I was concerned that the political environment, in particular noise considerations, had taken too much priority over safety considerations. We approached the partners on the airport, explained our dilemma and, with their agreement, made certain adjustments. We reduced some capacity, reintroduced calibration flights during night hours, and so increased the safety margins to more acceptable levels. My lesson: when you first come into a new environment is a good time to question what you see; if you do not like it, act, and take the stakeholders with you.

It can be difficult to spot that drift into the danger zone while you are part of the system itself. That requires constant self-challenging and a very open ear to all sorts of people who are trying to tell you things. These important things are often filtered out along the communications chain, especially in a larger hierarchical structure. Another reason to make sure that the top team members spend time at the front-line.

I think an even bigger challenge is the much subtler one of deciding how much spending on safety is enough. If you have an accident the answer will always be, "it was not enough". But how do you determine this without the benefit of hindsight? I find this challenge a really difficult one, and one which requires open, honest and level-headed conversations. It requires good management judgement based on all the facts and opinions you can gather. It is also a reason why I believe that, although you do not need to be an ex-ATCO to be an ANSP CEO or an ex-pilot to be an airline CEO, it is really important to have someone in the senior team who does have operational experience, to make sure that the voice of operational experience is heard in such conversations.

Goal conflicts and trade-offs are a natural part of business life, and are nothing to be afraid of. Their safe resolution requires excellent listening, creation of enough time for the right discussions, and clarity in the decision-making process.

As a last example, how about this dilemma we faced recently: do we spend 350,000 on a matter of pure compliance (and therefore secure ourselves against an audit finding), or do we spend that money instead on making a concrete improvement in safety? And if we decide for the latter option, how do we have the right conversation with our regulator for the authority to find our chosen path acceptable? What would you do?

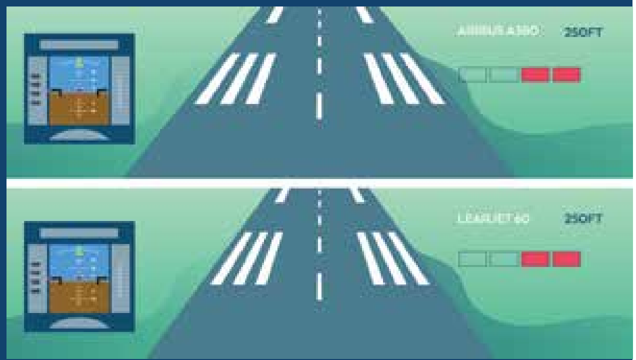
Alex was born in 1968 and educated in the UK; he has a Swiss mother and British father. He obtained his private pilot's licence in 1986 and his ATCO licence in 1996 (Heathrow approach), after studying French and German at Exeter University. He moved around a number of NATS sites from 2003 until 2009, being in charge of air traffic services at Farnborough Airport, Manchester Airport and Area Control Centre, West Drayton Centre (where he oversaw the move of the centre and its associated 500 families to the south coast of England), and Swanwick Centre. In 2009, Alex became Director Strategy and Investment and later also Director International Affairs. In July 2011 he left NATS to take up the role of Chief Operating Officer at skyguide, Switzerland. He was appointed CEO of skyguide from 1 July 2017. He is passionate about safety and finding ways to innovate in ATM to improve the customer experience. Alex lives near Geneva with his wife and 9-year-old son.

SKYclips

SKYclips are a growing collection of short animations of around two minutes duration which focus on a single safety topic in aviation.

There are SKYclips on the following topics

- Aimpoint selection
- Airside driving
- Callsign confusion
- Conditional clearance
- Controller blind spot
- CPDLC
- Helicopter somatogravic illusions
- Immediate departure
- In-flight fire
- Landing without ATC clearance
- Level busts
- Low level go around
- Low visibility takeoff
- Pilot fatigue
- Readback-hearback
- Runway occupied medium term
- Sensory illusions
- Speed control for final approach
- Startle Effect
- Stopbars
- TCAS - Always follow the RA
- TCAS RA High Vertical Rate
- Unexpected Traffic in the Sector
- Workload Management



Each SKYclip is developed by aviation professionals from a variety of operational, technical, and safety backgrounds.

Find the SKYclips on SKYbrary at
https://www.skybrary.aero/index.php/Solutions:SKYclips

Steven Shorrock
Editor in Chief of HindSight

THE REALITY OF GOAL CONFLICTS AND TRADE-OFFS

"Safety is our number 1 priority!" It's a phrase that's sometimes used by trade and staff associations alike, and occasionally by pilots when we are encouraged to listen to the safety briefing, or when a departure is delayed for technical reasons. But I've noticed something. Over the last couple of decades that I've worked in aviation, I am hearing the phrase less and less.

Perhaps this is something to do with the so-called 'rhetoric-reality gap'. There are two kinds of goals, which both relate to individuals and organisations. On the one hand, we have stated, declared goals. On the other, we have the goals that are evident from behaviour. In other words, 'the purpose of a system is what it does' (POSIWID) – a phrase coined by business professor Stafford Beer. The purpose of aviation is not to be safe *per se*, but to transport people and goods. In doing so, there are a number of goals. So how can we focus on what the system does and why it does what it does, in the way that it does? What a system does is subject to demand and pressure, resources, constraints, and expected consequences.

So let's look at the situation now. Demand is rising faster than at any time in history. According to Airbus, the number of commercial aircraft in operation will more than double in the next 20 years to 48,000 planes worldwide. And according to Boeing, 790,000 new pilots will be needed by 2037 to meet growing demand. But capacity is a critical concern. While average delays in Europe are down, capacity and staffing takes the lion's share of delays, according to EUROCONTROL data. Airports are another major part of the capacity problem. IATA chief Alexandre de Juniac said last year, *"We are in a capacity crisis. And we don't see the required airport infrastructure investment to solve it."*

Growing demand and increased capacity conflicts with environmental pressures. At a local level, this can be seen in the ongoing third runway saga at Heathrow, the busiest airport in Europe by passenger traffic. Despite receiving approval from Members of Parliament, expansion is opposed by local and climate groups. In Sweden, the word 'flygskam' or flight shame is becoming more than just a buzzword. Fewer passengers are flying to or from Swedavia's ten airports. At a global level, Greta Thunberg recently headlined the UN Climate summit. She was photographed arriving not by plane, but by yacht, fitted with solar panels and underwater turbines.

While aviation is particularly newsworthy with regard to climate change, the Intergovernmental Panel on Climate Change has estimated that aviation is responsible for around 3.5 percent of anthropogenic climate change, including both CO2- and non-CO2- induced effects. However, the media and public interest in aviation creates significant pressure. In 2008, aviation sector leaders signed a declaration committing to carbon-neutral growth from 2020, and by 2050 a cut in net emissions to half 2005 levels.

Unlike most goals, safety is a 'background goal' that tends to come into the foreground only when things suddenly go very badly wrong, or 'miraculously' right.

As well as capacity and environmental demands and pressures, there are increasing concerns about cybersecurity (e.g., GNSS spoofing) and drones. Then there are more familiar financial pressures. At the time of writing, Thomas Cook, the world's oldest travel company, collapsed and Adria Airways suspended flights.

And now we come to safety. Accidents remain few in number, and flying continues to be the safest form of long distance travel. But 2018 was a bad year for aviation safety, with 523 on-board fatalities, compared to 19 in 2017, according to IATA. Accidents involving B737 MAX aircraft raised new questions about safety at all levels. Unlike most goals, safety is a 'background goal' that tends to come into the foreground only when things suddenly go very badly wrong, or 'miraculously' right.

This is only one way in which goals differ. Some goals have a short-term focus, while others are longer term. Some goals are externally imposed, while others are internally motivated. Some goals concern production, others concern protection. Some goals relate well to quantitative measures, while others don't. Some goals are more reactive, while others are more proactive. Sometimes, goals are compatible and can work together, while at other times they conflict and compete for resources and attention.

Goal conflicts create dilemmas at all levels, from front line to senior management, regulation and government. Dilemmas create a need for trade-offs and compromises. These decisions are influenced by how we perceive capability, opportunities, and motivation. There are many kinds of trade-off decisions. A familiar trade-off to everyone is between *thoroughness and efficiency*. Too much focus on either can be a problem. Day-to-day pressures tend to push us toward greater efficiency, but when things go wrong, we realise (and are told) that more thoroughness was required. Another familiar trade-off is between the *short and long-term* – the acute-chronic trade-off. Combined with pressure on efficiency, short-term goals tend to get the most attention. And we trade off *individual and collective needs and wants*, or a focus on *components and the whole system*. All of these trade-offs have implications for goals relating to safety, security, capacity, cost-efficiency, and the environment. To understand them, we need to understand five truths.

Five Truths about Trade-offs

1. Trade-offs occur at all levels of systems. Trade-offs occur in every layer of decision making, from international and national policy-making to front-line staff. They occur over years and seconds. They occur in the development of strategy, targets, measures, policies, procedures, technology, and in operation. They are often invisible from afar.

2. Trade-offs trickle down. Trade-offs at the top, especially concerning resources, constraints, incentives and disincentives, trickle down. If training is reduced for cost or staffing reasons, then staff will be less able to make effective trade-offs. If user needs are not met in a commercial-off-the-shelf system, staff will have to perform workarounds.

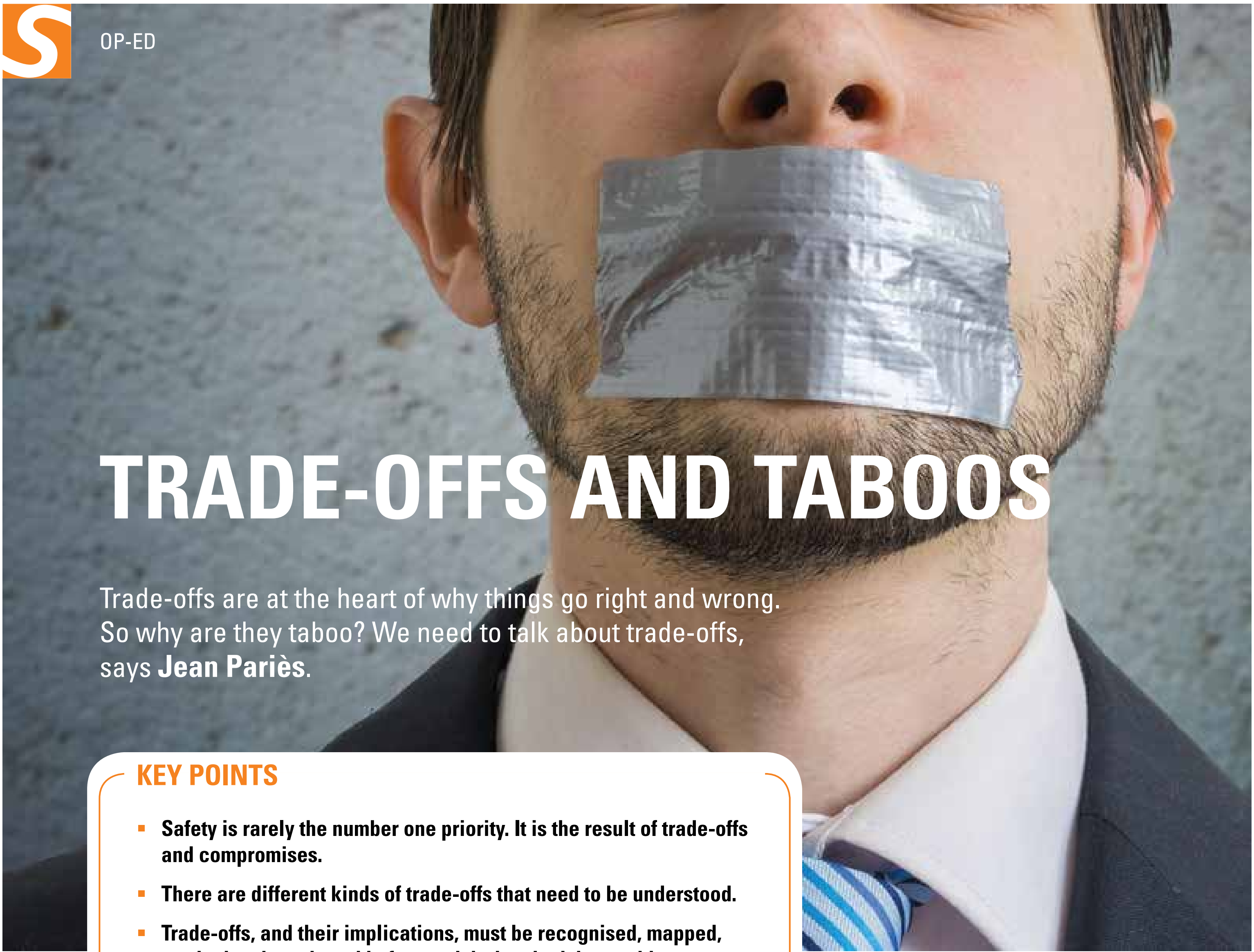
3. Trade-offs combine in unexpected ways. Trade-offs made strategically, tactically and opportunistically combine to create both wanted and unwanted outcomes that were not foreseen or intended. We often treat this simplistically.

4. Trade-offs are necessary for systems to work. Trade-offs are neither good nor bad. They are necessary for systems – transport, health, education, even families – to work. And most trade-off decisions can only be made and enacted by people.

5. Trade-offs require expertise. Trade-off decision-making often cannot be prescribed in procedures or programmed into computers. Decision-making therefore requires diverse expertise, which in turn needs time and support for development. In effect, expertise is about our ability to make effective trade-offs.

An interesting thing about trade-offs is that they are tacitly accepted, but rarely discussed. Might 'Safety first!' risk making us complacent about safety? Reality always beats rhetoric in the end. So we have to talk about goal conflicts and trade-offs. Let us bring reality into the open. S

Goal conflicts create dilemmas at all levels, from front line to senior management, regulation and government. Dilemmas create a need for trade-offs and compromises.



TRADE-OFFS AND TABOOS

Trade-offs are at the heart of why things go right and wrong. So why are they taboo? We need to talk about trade-offs, says **Jean Pariès**.

KEY POINTS

- **Safety is rarely the number one priority. It is the result of trade-offs and compromises.**
- **There are different kinds of trade-offs that need to be understood.**
- **Trade-offs, and their implications, must be recognised, mapped, tracked and monitored before and during decision-making.**

In safety critical activities such as aviation, nuclear, rail, or the chemical industry, the communication from senior executives frequently includes expressions such as "*safety is our top priority*" or "*we never compromise on safety*". These are nice slogans, and they may suggest commitment to some. But they do not correspond to reality.

The reality, in fact, is exactly the opposite: safety is always the result of trade-offs. If safety were the absolute priority, we would simply not accept risk, and we would stop aeroplanes, trains, nuclear power plants, and some surgical operations. Safety is therefore a compromise between the social utility of the activity in question, and the risk it generates, which cannot generally be reduced to zero. But this trade-off is usually taboo, like a trade-off between saving patients from cancer or making profits from cosmetic surgery. We tend to be repulsed by balancing something sacred and something secular. Nevertheless, these kinds of trade-offs happen every day. So the question is: should we reject them, or manage them?

If safety were the absolute priority, we would simply not accept risk, and we would stop aeroplanes, trains, nuclear power plants, and some surgical operations.

If we examine things more closely, this global compromise mentioned above breaks down into several kinds of trade-offs.

Most often mentioned is the trade-off between safety and productivity. It has become fashionable to assert that there is no competition between productivity and safety, because the features that make an organisation effective, such as rationality of processes, clarity of roles and procedures, honesty, transparency, trust, commitment, empowerment, justice, and so on, also make it safer. While that may be true, it does not mean that there is not, at the same time, a certain amount of friction. When we 'run' faster, we are generally more productive and less safe.

The same goes for the trade-off between safety versus comfort at work. Numerous and well-trained teams, the absence of stress, and a nice work environment, are obviously conditions for both comfort at work and safety. But rigorously following the procedures, remaining alert constantly, stopping to think, checking and rechecking, is stressful in real-world conditions. Grouping or ungrouping control sectors affects the free time of ATC staff, but also safety. Grouping consecutive days and nights of work to then enjoy several days of rest, or simply enjoy the evening before work, may be favourable to personal life and family, but not to safety.

Then there are the trade-offs between different types of risk. Remember the old argument against wearing a seatbelt: "yes, but in case of a fire I will be a prisoner". Without even realising it, we constantly manage these kinds of compromises. Cognitive compromises between thoroughness and speed of execution, between the details and the big picture, between indecision and impulsiveness, between instability of decision and mental rigidity. Tactical compromises between the risk of not strictly respecting the required separation between two aircraft and that of triggering a go-around at peak hour. Between continuing one's activity when one does not feel quite right, and overloading colleagues by leaving one's post. Handling traffic involves tactical compromises.

Trade-offs must be recognised, made as explicit as possible, and treated as such to keep the system safe enough.

And then there are strategic trade-offs, some of which are played out across the entire system. Trade-offs must be made between short-term and long-term goals. And between conservatism and innovation: in general, innovating increases risks in the short-term, but decreases them, sometimes considerably, in the long-term. The history of aviation is a good illustration of this, with a momentary rise in the frequency of accidents found during the introduction period of almost every new generation of aircraft. We must find the right setting between the audacity necessary for the future and the prudence necessary for the present.

But the trade-off that I probably find the most important – because it drives the fundamental safety strategy – and at the same time the most difficult to grasp, is the one that concerns optimisation and resilience, or adaptation and adaptability. Take the metaphorical example of the polar bear. This splendid animal is incredibly well adapted to an extreme environment. But the current rate of global warming is already threatening the existence of this species. Lesson: if you are very well adapted to your environment – 'optimised', economists would say – you are very efficient, but very fragile regarding changes in your environment. Robustness against the unexpected implies 'under-optimisation' – generalists, not specialists, adapt better to change. Hence the fashionable 'optimisation' processes may make operations better (more efficient, more reliable), possibly cheaper, and even safer within their adaptation envelope. Unfortunately, they also make them less 'resilient' outside of their adaptation envelope. And this can be significantly worse for safety.

Well, you will say, safety is the result of different compromises, so what?

The worst thing would be to deny the inevitable nature of trade-offs, even in the name of noble intentions. Trade-offs must be recognised, made as explicit as possible, and treated as such to keep the system safe enough. Whenever a decision is made in the organisation, the underlying decision-making must be clearly explained, without taboos. Decision protocols must be defined – and followed – to protect bottom lines in terms of safety. We must not say, after the decision has been made: "Here we are, now let's address the safety issues." Instead, we must address safety before and during making decisions, asking "What trade-offs are we actually making? What are we sacrificing? How do we compensate for it? What ensures that unacceptable safety lines are not crossed?" Furthermore, agreed trade-offs should be mapped, tracked and monitored, to avoid the accumulation of small setbacks that ultimately lead to the unacceptable. Trade-offs are the very essence of life. Do not make them taboos. Let's manage them instead. S

Jean Pariès graduated from the French National School of Civil Aviation as engineer. Since then, he has worked at DGAC France in air safety regulation, and Bureau Enquêtes Accident. As Head of Investigations, he led the technical investigation into the Mont Saint-Odile Accident, 1992. Currently Jean is CEO of Dédale SA. He has held a Commercial Pilot Licence with instrument, multi-engines, turboprop, and instructor ratings, and a helicopter private pilot licence.

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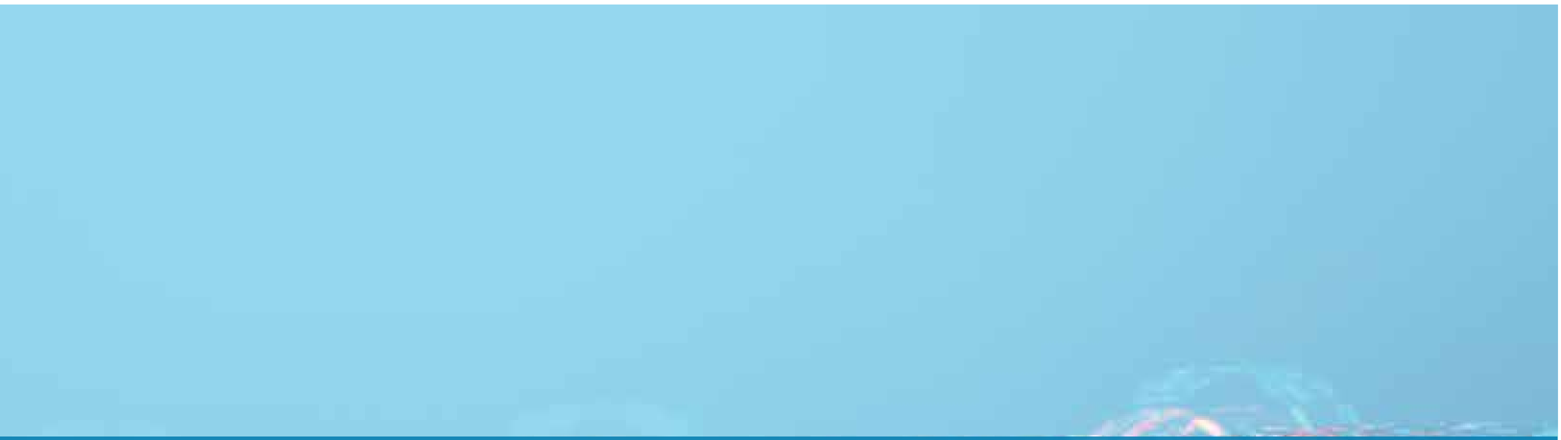
INVISIBLE TRADE-OFFS AND VISIBLE CONSEQUENCES

In a world of ever-increasing information, overload can be a problem. Since there is a constant pressure to be efficient, we cannot always be as thorough as we want or need to be. **Erik Hollnagel** outlines a number of strategies that we use to try to manage information, before it manages us.

KEY POINTS

- **We make countless small trade-offs throughout every working day. Because we make them all the time, and because they contribute to work going well, we soon stop paying any attention to them.**
- **Information input overload clearly represents a goal conflict between thoroughness and efficiency.**
- **We use a number of different strategies to allow the required or intended actions to be carried out as they should be, or at least before it is too late. These include: reduced precision, filtering, cutting categories, queuing, omission, decentralisation, and escape.**
- **These strategies usually serve us well, but may under certain conditions interact to produce unexpected and unwanted outcomes.**
- **While there are no easy solutions to this dilemma, we should at least try to be aware of it, and to pay more attention to the 'non-events' that are the foundation for work well done.**

Goal conflicts are a fact of life for all of us from the moment we wake up to the time we go to bed. In fact, even deciding whether to get up in the morning when the alarm sounds or to stay in a comfortable bed for another 10 minutes can sometimes be a goal conflict. The consequences of making the wrong trade-off when the day begins may at first seem trifling compared to the consequences of making a wrong trade-off during work, not least if you are pilot or an air traffic controller. In reality, the differences are not as large as they may seem at first glance, since getting out of bed too late simply is one trade-off among countless others that in combination eventually may lead to outcomes that were unimaginable – or at least not imagined – at the start.



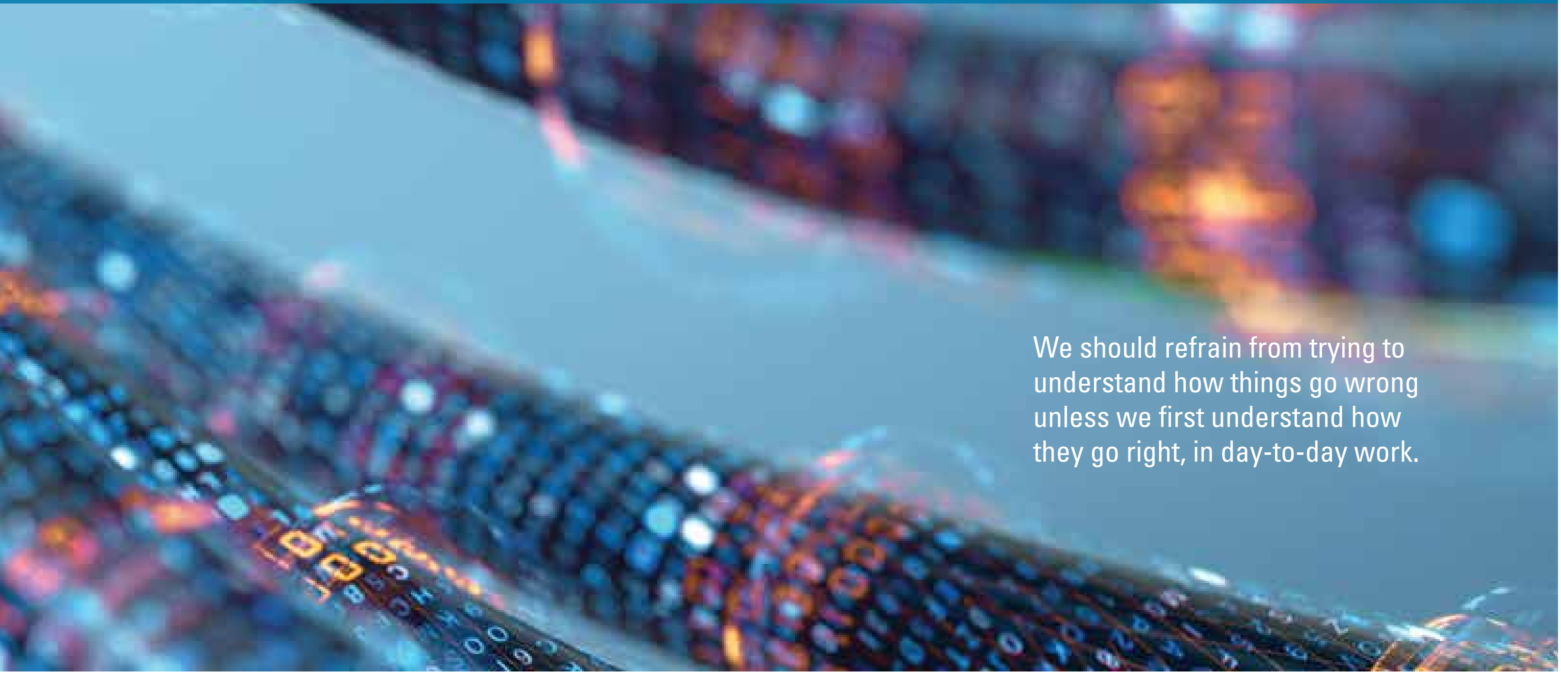
We always pay attention to the large goal conflicts – for instance the dilemmas between safety and productivity – since they, like accidents, are difficult to miss. But as Karl Weick astutely pointed out in his discussion of reliability (and by the same token safety) as "a dynamic non-event" (Weick, 1987), the non-events are not only easy to miss but in everyday life practically invisible. Yet they are invisible because we habituate or get used to them rather than because they are difficult to 'see'.

In the same way, we make countless small and smaller trade-offs throughout every working day. But because we make them all the time, and because they contribute to work going well, we soon stop paying any attention to them. This is understandable, if not quite forgivable, within the traditional approach to safety (Safety-I), which relies on linear cause-effect reasoning to backtrack from accidents to their causes. It is consistent with this way of thinking that there is some kind of proportionality between the value and magnitude of outcomes and the value and magnitude of causes. But it is widely acknowledged today that much of what happens around us can best be described and understood as if systems and organisations are non-linear and the outcomes are therefore 'emergent'. This has been expressed as the 'equivalence principle', which states that acceptable and unacceptable outcomes happen in roughly the same way.

In consequence of that, we should refrain from trying to understand how things go wrong unless we first understand how they go right, in day-to-day work. It therefore becomes important to understand the ubiquitous everyday trade-offs and the corresponding seemingly innocent goal conflicts, since they are the reasons why work usually goes well. Since getting up in the morning only takes place once a day, a better illustration is provided by a goal conflict that most of us are faced with many times a day, namely how to deal with an overload of information.

Information input overload

A crucial skill in our world today is the ability to manage the ever-growing streams of information that are forced upon us, and to do it in time, i.e., fast enough to allow actions to be taken before it is too late, or even just to notice the information before it disappears. This ability is put to the test in conditions where there is more information than can be handled, known as information input overload. Examples range from the alarm avalanche in a cockpit or a control room when a serious disturbance occurs, to the feeling of frustration that comes over us when we are confronted with the all too many (unanswered) emails that clutter our inboxes. Information overload is, of course, a relative rather than an absolute condition. It is not the amount of information as such that defines it, but rather whether there is more information that can be handled at the specific moment in time. This can occur if the rate of input increases, if the processing capacity decreases, or if both happen at the same time.



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A crucial skill in our world today is the ability to manage the ever-growing streams of information that are forced upon us, and to do it in time.

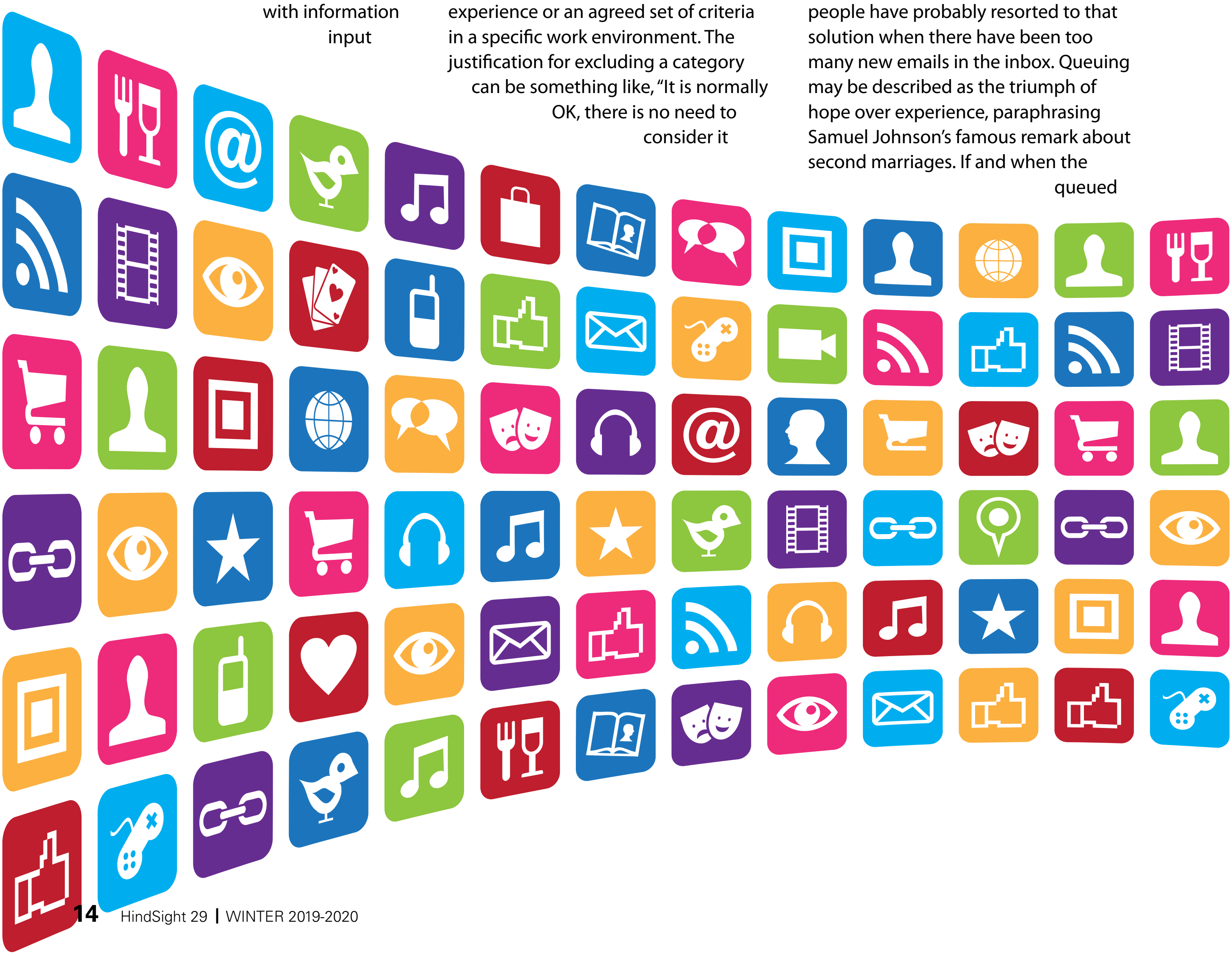
Information input overload clearly represents a goal conflict. On the one hand, there is the goal of at least looking at all the information that is presently available in order to know what is there ('thoroughness'). On the other there is the goal of having the necessary time and effort needed to identify and process the information that is necessary for the work at hand ('efficiency'). In the case of a disturbance, the conflict is between ensuring an adequate understanding of the situation and responding appropriately before it is too late. In general, it is the skill of detecting and keeping track of the signals in a sea of noise. The common trade-offs that people use to cope with information input overload range from reduced precision to abandoning the task completely. In between these extremes are a number of different strategies, which on the whole aim to allow the required or intended actions to be carried out as they should be or at least before it is too late.

Reduced precision: In this case it is important to reduce or compress the time spent looking at the input, but also important not to miss essential information. The solution is to scan all the input that is or becomes available, but to do it rather superficially. Even for input that is given a second look, the processing or reasoning is shallower than it should be, such as "it looks fine, no need to go further with that".

Filtering: If reduced precision is not sufficient, the next step is to filter the input by selecting some categories of inputs while ignoring the others. This is usually based on either personal experience or an agreed set of criteria in a specific work environment. The justification for excluding a category can be something like, "It is normally OK, there is no need to consider it now". This will obviously reduce the amount of information that must be looked at further, but like reduced precision it also introduces the risk that potentially valuable information may be missed.

Cutting categories: If filtering is also insufficient, the next step is to reduce the number of categories that are used. In the extreme this may result in a binary categorisation, such as "important/unimportant", "relevant/irrelevant", "safe/risky", "junk/not junk", etc. Cutting the number of categories reduces the level of discrimination since a smaller number of terms or values are used to describe the input. It may be justified if time or capacity restrictions are really severe and if it is sufficient to note only large variations.

Queuing: When it is impossible to deal with all the information at the moment, a possible trade-off is to queue it in the hope that there will be time and capacity to deal with it later. Most people have probably resorted to that solution when there have been too many new emails in the inbox. Queuing may be described as the triumph of hope over experience, paraphrasing Samuel Johnson's famous remark about second marriages. If and when the queued



items are taken into consideration, some kind of filtering is likely to be needed.

Omission: As the goal conflicts become more pronounced, so do the trade-offs used to resolve them. Simply omitting or removing certain parts of the input is a solution if it is recognised that there never will be time to catch up, hence no point in queuing. In these cases the goal of completing a task in time and without further disturbances is more important than the goal of keeping an eye on everything that happens.

The multiple minor habitual trade-offs that we learn to use serve us well, but may under certain conditions interact to produce unexpected and unwanted outcomes.

Decentralisation: In some cases, it may be possible to engage or employ additional resources to help with the input overload. An example in aviation is crew resource management which aims to make effective use of all available resources of the flight crew to assure safe and efficient operations. Generally, it requires that it is possible to activate additional resources in the situation when needed; these can be local or remote and human or technological (e.g., artificial intelligence for video surveillance).

Escape: In cases where the goal conflict between processing and responding is so serious that it seems unsolvable, the final trade-off is to escape from the situation altogether. This can either be in an actual physical sense, as in leaving the scene. But it can also be in a psychological sense by denying that a conflict actually exists, for instance by labelling it as 'fake news'. While this may bring a short-lived peace of mind to those involved it obviously does not solve the conflict, but is instead more likely to exacerbate it.

A slightly paradoxical consequence of the trade-offs to cope with information input overload is that the result may be too little information, also called information input underload. (An underload condition may also arise for other reasons, for instance that information is delayed or missing.) Just as for information input overload there are also some typical trade-offs to help deal with a lack of information, for instance extrapolating from existing data, frequency gambling ("this happens all the time"), and similarity matching ("it looks like X so it probably is X"). Solving the information input overload (or underload) goal conflict is, furthermore, usually not an end in itself but rather a means in the pursuit of other ends. Examples could be whether to continue with the current plan or modify it, whether to keep the same target or look for an alternative, etc. Whatever we do there always seems to be the need to sift through far too much information to find what is needed before it is too late. The multiple minor habitual trade-offs that we learn to use serve us well, but may under certain conditions interact to produce unexpected and unwanted outcomes precisely because they are trade-offs. While there are no easy solutions to this dilemma, we should at least try to be aware of it, and to pay more attention to the 'non-events' that are the foundation for work well done.

Post Scriptum: The concept of information input overload and the characterisation of possible coping strategies is very useful to describe the human condition in the industrialised societies in the 21st century. It is therefore remarkable that these ideas were presented nearly 60 years ago (Miller, 1960), when computers were only used by a minority of scientists and researchers, and where glass cockpits and e-mail were something no one had really imagined.

References

Miller, J. G. (1960). Information input overload and psychopathology. *American Journal of Psychiatry*, *116*, 695-704.

Weick, K. E. (1987). Organizational culture as a source of high reliability. *California Management Review*, *29*(2), 112-128.

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QF32: HOW IT WENT RIGHT

AN INTERVIEW WITH CAPTAIN RICHARD CHAMPION DE CRESPIGNY

When a normal day at work turns into an extraordinary day, where survival may depend on you and your team, you will need all of the elements that make up resilience. In this long read, **Steven Shorrock** interviews **Richard Champion de Crespigny,** Captain of QF32, about how things went right, when they could have gone so badly wrong.

It's the 4th of November 2010 and QF32, an A380, is taking off from Singapore bound for Sydney – a seven and a half hour flight for the 469 passengers and crew. There would normally be three pilots: Pilot in Command Richard de Crespigny, First Officer Matt Hicks, and Second Officer Mark Johnson. On that day, Richard was having an annual route check, and the crew were joined by Senior Check Captain Dave Evans, who was training, and Check Captain Harry Wubben. Richard briefed his other two pilots to focus on keeping the flight as safe as possible, and to not keep quiet or be distracted because it was a route check.

It was a flight that was characterised by many non-routine decisions and trade-offs. The first came after clearance to push back, when Richard noticed that that one of the Check Captains was occupying the seat that the second officer would occupy. After a short discussion, Richard ensured that a Second Officer sat where he normally would, in order to play his usual team role. *"It's vital in a team environment that every person feels psychologically safe to state concerns or in a critical situation, say 'stop'!"*

It's vital in the first 30 seconds of a crisis to act habitually to avoid the startle effect of fight, flight or freeze

Everything else was routine until four minutes after take-off, when engine number two exploded without warning, followed by a second explosion. *"It was louder than what I'd ever heard in the simulator. But it was obviously an engine failure."* At that point, Richard pressed the altitude hold button and pulled the heading select knob, reflecting the 'aviate, navigate, communicate' mantra that helps pilots to focus and prioritise. For the first 30 seconds or so, the crew concentrated on flying the aeroplane and got it under control, in the process discovering that the auto thrust had failed.

"We first concentrated on just flying the airplane", said Richard, *"because it's vital in the first 30 seconds of a crisis to act habitually to avoid the startle effect of fight, flight or freeze. Stay alive, keep above the mountains, and maybe then communicate. It was probably after 40 or 50 seconds that I told air traffic control 'Pan, Pan, Pan, Qantas 32, engine failure, number two engine, maintaining 7,400 feet, maintaining current heading. Stand by for instructions.'"*

ATC left the QF32 crew alone until the crew called for a new heading.

The damage

To those untrained in dealing with emergencies, the sense of calm control in the first half a minute may have seemed at odds the seriousness of the situation: 21 out of 22 aircraft systems were compromised – everything except the oxygen system, which was not needed because the aircraft was below 10,000 feet.

The damage list is extraordinary, and the full extent of damage and loss of capability was not fully known to the crew at the time. Electrics were down to 40 to 45%. Roll control was down to 35%. Brakes were down to 40%. There were holes in the wing and all of the leading edge slats and half of the spoilers were lost, increasing the stall speed significantly. The flight displays were in error. Anti-skid was broken.

None of the engines was operating normally. Two engines dropped down two layers of redundancy to the bottom layer. Engine number 3, which the crew thought was working normally, had dropped down one layer.

Critically, the aircraft was out of balance and leaking fuel quickly from the wing. *"We saw hydraulic pressure warnings and system failure warnings. The whole hydraulic system failed on the left-hand side. We had to shut down six out of eight hydraulic pumps."* Richard didn't find out until four months later that most of the warnings about the hydraulic and brake systems were wrong.

Around half of the computer networks had been compromised, and the lost parameters affected other systems. *"When a complex black-box system fails, you may not know why and you may not even know if or how you can fix it. When one complex system, with all its interactions, takes out other complex systems, you quickly get an avalanche of other failures. When a 'black swan' event happens, the Swiss cheese model doesn't apply."*

ECAM armageddon

The electronic centralised aircraft monitoring (ECAM) system is a computer program that monitors the 250,000 sensors and parameters on an A380, an aircraft with four million parts. When a message goes into the network system that something's wrong, ECAM checks a database of around 1240 checklists. During the initial seconds following the engine failure, Richard and his crew ignored the ECAM, focusing instead on flying the aircraft. After a brief period, he informed the crew that the aircraft was at constant altitude, heading and speed, that the thrust was under control and the aircraft was safe. *"I then said, 'ECAM actions'"*, explained Richard. *"That's a sign for co-pilot Matt Hicks to action the checklists. But that was probably 20 to 30 seconds after the engine had failed. There's no rush to go into ECAM. You absolutely must first get the aircraft under control."*

Richard compares ECAM to threat and error management (TEM), laid out in a linear progression. *"You first identify the threats and then you try to stop them. If you can't stop them then you try to fix them. If you can't fix them then you mitigate them. At the end of ECAM process, you know what systems have failed and you should have a mental model of the state of the airplane, how it will respond and how you're going to manage it."*

But 40 ECAM checklists queued up within the first second, followed by another 60 checklists over the next few minutes. Distraction was a major challenge to crew performance. *"The alarm bell was ringing continually. We cancelled it, and it came back. For every new warning, the master caution warning light illuminated and the aural alert sounded. These warnings pierced our senses. They're incredibly distracting."*

Another problem was the nature of interaction with ECAM. *"The overhead and lower panels were a sea of red lights. Checklists flooded the screens. We were running through nasty checklist after checklist without knowing how many more checklists lay underneath. And some of the checklists were not just wrong, but would have made our situation worse."*

As a result, Richard said that he eventually lost the picture and became overloaded, with insufficient capacity to make sense of the information. *"All these checklists coming in were filling up my mental model. I'd lost all my free mental space. I couldn't absorb more failures and I'd lost the ability to create the complex knock-on effects in my mind. My mental model of the aircraft had failed."*

The crew did around 100 ECAM checklists in the air and then another 20 or so on the ground. To put that into perspective, he said, a pilot in a simulator might do four ECAM checklists.

ECAM is prioritised but, as Richard explained, just like any computer system, ECAM caters for only the known situations that have been programmed into it, *"ECAM is generally designed to manage only the first layer of the failure. For instance, we lost 65% of our roll control and we had three increasing fuel imbalances that were each out of limits. ECAM doesn't combine those problems to predict whether we would retain control when we slowed and reconfigured to land. We'd lost 60% of our brakes but we were also landing 60 tons over our maximum landing weight. The computers couldn't calculate our correct landing performance. ECAM didn't warn us of a possible runway overrun."*

To make matters worse, QF32 has lost many sensors and in many cases couldn't differentiate a 'no signal' (because of a severed controller area network bus wire) from a 'zero'. This is why ECAM became compromised and confusing, indicating that some systems were functioning better (brakes) or worse (hydraulics) than they really were. Officials at the Australian Transport Safety Bureau told Richard that the fuel system was damaged so extensively

The decision to do the control check was critical. I think it was the most important decision that I made on the flight.

that ECAM checklists for the fuel system would never make sense. Other failure messages displayed and cleared quickly: *"We had a turbine overheat message that I didn't see because it came and went in a second."*

Still, ECAM gave essential information. For instance, faults with the hydraulics, electrics and the landing gear meant that the crew had to put the gear down using gravity, with special actions for the brakes because leading edge slats, spoilers and anti-skid were compromised. ECAM advised to apply the brakes only when the nose wheel was down on the ground, when there was less lift on the wings. The crew went through the ECAMs one at a time, building a shared mental model of the aircraft and planned the approach, a process that took around an hour of the hour and 50 minutes that the aircraft was airborne.

The crew faced several dilemmas. If they stayed up too long, fuel leakages from the wings would take the aircraft further out of balance. If they landed too quickly, they wouldn't know what the aircraft was capable of doing or how it would perform on landing. *"Your priorities change depending on the situation. You need to keep a shared* *mental model and situation awareness of what's happened and what is happening, and make the best decisions for the future."* As commander, Richard's sole concern and responsibility was the safety of the passengers.

But with the complexity of the situation and the loss of capability, the crew were concerned about control when they came in to land.

The control check

Controllability checks feature more in military than civil pilot training, and Richard credits this check with being critical to the safe landing of QF32. *"It's normal Air Force procedure that if your aircraft has a mid-air collision or has taken damage from an attack, and flight controls are affected, then you must determine the best configuration and the minimum speed that you need to land. I knew I had to do control checks at a safe height."* Flaps, slats and spoilers, as well as the landing gear, should behave as expected, so that the aircraft remains controllable while slowing down and configuring to land.

Richard explained that, while this procedure is habitual for military aviators, it wasn't documented in any Airbus manual or the airline's manual until after QF32.

He was aware that if hydraulics were lost, the flight controls could become saturated, with inadequate hydraulic power to move the controls quickly enough, or limiting the controls' effects. Either problem can induce a (rate-limited) pilot-induced oscillation. So while doing a controllability check, Richard monitored the flight control displays to determine that the flight controls were not saturated and were behaving as expected.

"The decision to do the control check was critical. I think it was the most important decision that I made on the flight." Recalling El Al 1862, he remarked that *"You need to study and learn from the past, so you don't repeat it".*

The Armstrong spiral

With fuel leaking rapidly, it was essential to understand the fuel situation. *"If you can't guarantee fuel, you can't guarantee flight",* said Richard. Both fuel computers failed and the fuel synoptic screens went blank. The crew reset the computers, but it didn't help. The fuel synoptic screen and ECAM made no sense. *"I said to the rest of the pilots, I'm looking at this fuel system and I don't understand it. Does anybody understand this fuel system? There was silence. At that point I realised that no one else understood the fuel system."*

> All these checklists coming in were filling up my mental model. I'd lost all my free mental space

Eight out of eleven fuel tanks were unusable. Both transfer galleries had failed. Half of the fuel pumps, including the jettison pumps and a jettison valve, had failed. With fuel control computer faults, the crew was unable to understand how the fuel system was working.

Fearing a loss of all the engines, Richard asked ATC for clearance to climb and for ATC to keep the flight inside 30 miles of the airport, to mitigate an all engine out approach to Singapore. He was positioning to enable the 'Armstrong Spiral', a procedure he named after Neil Armstrong's approach techniques in the X-15. The decision to climb to height was an intuitive reaction, Richard said, to thinking that the crew had lost the ability to monitor the remaining fuel.

Inverting the logic

Aircraft warning computers are 'glass half empty' machines: they tell you what is wrong. And on QF32 there were too many failures to diagnose and correct fully.

Richard decided to 'invert the logic'. He credits this idea to Gene Krantz, a NASA mission controller. *"During the Apollo 13 crisis, the mission engineers were melting down because they had lots of error messages. Nothing was making sense and the engineers were losing their mental model of the Apollo command module. So Gene Kranz yelled out, 'gentlemen stop wondering about what's failed and let's focus on what's working'."* Gene Kranz inverted the logic, and it worked. But to do that, you have to have a good foundation knowledge of your systems and the core layers of their technologies.

By inverting the logic, the QF32 crew turned a glass-half-empty approach to TEM into a glass-half-full approach. Instead of focussing on the myriad complicated failures, they focussed on the systems and services that remained. Richard reduced a complicated four million piece A380 down to a simple light aircraft. All they needed then, was enough fuel, wings, flight controls, wheels and brakes to land.

They had two and a half hours of fuel in engine one, and three and a half hours in engines three and four. That was enough. *"A great mantra in aviation is 'fuel gives you time and time gives you options'. You often have more time than you think, so in a crisis try to create time."*

Knowing that they now had two and a half hours to solve the many outstanding problems, the crew monitored the engines and fuel situation every five minutes. Every 10 minutes, they re-evaluated whether to stay airborne and continue ECAM checklists, or commit to and bracing themselves for an immediate landing.

The landing configuration

The crew now had to calculate landing performance, including where they would stop on the runway. Richard delegated the performance calculations to Senior Check Captain David Evans, who put all the failures into the computer. *"He put in about 12 failures. Normally, the most I've ever seen put in is two."* However, the computer would not calculate landing performance, even when David entered only the critical failures.

Richard was confident that the crew had the knowledge, training and experience to solve the known problems, and the decision-making and team skills to solve the unknown problems. *"I knew we had the tools and the brains on board to solve this. It didn't really worry me when Dave said it won't calculate it. In fact, I went off and gave a 10-minute public address* *to the passengers while Dave kept on working on it."*

After the public address, David announced that he had a landing performance. It would give a 130 metre margin at the end of the four-kilometre Singapore runway. Richard wasn't worried. *"When I got told 130 metres I thought 'that's great'"*, he said. Having researched the handling of big jets for a book, he knew how the A380 was certified and that the aircraft must be on the ground, touched down, within seven seconds from 50 feet. He was confident that the crew would do it. *"If you've done the research then all that knowledge, experience and training eliminates concerns that others might perceive as fears. This is why we must commit to a lifetime of learning. You must never stop learning."*

QF32 was on final approach, descending at 1400 feet per minute or 23 feet per second. The landing gear oleos are certified to a rate of 12 feet per second. There was now a choice of a hard and short landing, or flaring for a softer long landing that uses more runway.

"One of the pilots said to me during your approach, 'Rich, don't flare', because with a limited runway it's recommended to have a hard touchdown and just accept it – you can't float. But I if I hadn't flared, I would have destroyed the oleos, the wheels would have gone up through the wing, and we'd be sliding down the runway with sparks around leaking fuel. I knew I had to flare."

The aircraft was slow to flare and then over-flared. As the wheels got closer to the runway, Richard thought they might hit the runway so hard as to risk destroying the landing gear. *"So I used a technique that is not practised in any simulator. If it's going to be a heavy landing, then at the last minute you push the stick full forward to lower the nose. That raises the wheels around its centre of gravity. That in turn gives you an extra half a second floating in ground-effect, a cushion of air."* The rate of descent at touchdown was 160 feet per minute, and QF32 touched down five seconds after 50 feet – giving more remaining runway than calculated.

Shutting down the engines

When QF32 stopped, air traffic control instructed the crew to shut down the engines and call the fire service on a dedicated fire frequency. On shutting down the engines, the crew expected the APU to provide electrical power and compressed air for the air conditioning. However, problems with the air data computers meant that the aircraft thought it was still in the air. Both APU generators were inhibited from coming online. The aircraft now had two car batteries of power remaining and had lost nine out of ten cockpit computer sceens and six out of seven radios, including the radio that they needed to contact the fire controller.

The 20 or so internal and external wing leaks were even more of a problem now that the aircraft was level and the wing was flat. The holes that used to be above the fuel level were now below it. Around four tons of fuel was gushing out of the left-hand wing, close to very hot brakes. And with the radio problems, it took 30 to 40 seconds to contact the fire controller. "*When we did get in touch, we said 'Put water over the hot breaks, and put foam over the fuel'. They said, 'Well shut down the engines first.' And we said, 'We have!'".*

There was confusion about the status of the engine, Richard opened up the left-hand window and saw that engine number one was still turning. The crew tried more emergency shut down systems. None of them worked. *"I knew that there are two discrete sets of wires going to each of the high- and low-pressure fuel shutoff valves in the engine and the pylon. At that point, I realised they'd clearly been broken. Even the fire bottles, each with dual dedicated wire, didn't work. That wing must have been electrically destroyed. And then it sank in that the damage was far greater than we had thought."*

Evacuation or disembarkation?

On the ground, there were different perceptions in the cockpit about the best course of action, with fuel now pouring out on the ground near hot brakes, and an engine that wouldn't shut down. While the risk of fire was clear, the need for evacuation via slides, rather than disembarkation via the stairs, was less clear. The door sill of the A380 upper deck is eight metres above the ground. With rescue slides angled at approximately 45 degrees, descending onto a hot runway at Singapore, the risk of injury had to be balanced against the need for rapid escape. Richard remarked that there were risks associated with people attempting to take objects from the cabin, slipping on kerosene, approaching a running engine, being run over by a fire truck, or – worse – accidentally igniting kerosene.

Richard recalled the A330 evacuation at Gatwick in 2012 following multiple smoke warnings, which turned out to be spurious. Over 300 people had to be evacuated. Fifteen passengers were hospitalised. *"Our threats were enormous"*, Richard said, *"and this was now the longest most difficult decision that we had – whether to evacuate down slides and lose control of the passengers, or to let them go slowly down the stairs and keep control. The longer that decision took, the longer we stayed on the airplane, the more the brakes cooled down and more foam was put over the fuel."* After 10 minutes, the scene stabilised outside and the aircraft became inert for the next hour. The cabin crew were on alert to evacuate for the two-hour period after landing until the aircraft was fully deplaned – two hours of continuous decision-making. There were no injuries, which Richard also credits to the cabin crew: *"They were exceptional. That's what they trained for, and I am proud of them all."*

In his book, *FLY!*, Richard describes various ways to make decisions. *"The decision whether to evacuate or not was a really good slow decision. We used a decision model that is taught in the airline. It involves everyone's input. It's dynamic. You keep revisiting the decision, especially if things don't go to plan or if you find you're surprised."*

Briefing the passengers

After an accident, there are further decisions about briefing those affected, especially passengers. How much information do you give and how do you convey that information both while you're in the air and while you're on the ground?

For Richard, it was not a concern. *"Gene Krantz said when things are going well at NASA, you tell the media a whole lot, and when things go bad you tell them everything. Particularly today with social media, everyone with a phone is a reporter and they will be transmitting live as the incident happens. You can't try to hide it, and there is no longer a golden hour for companies to prepare for the media."* Richard was aware that if you don't communicate the facts, as the most knowledgeable party, then the media will. *"Take control in a crisis, get the facts out there, shut down the fears and rumours, and become the single point of contact"* is his advice.

Richard made several public addresses using the NITS checklist: nature, intentions, time, special requirements. *"NITS stops fear and panic. Fear and panic are caused by people not knowing what's happening, not knowing why, not knowing what's going to happen, not having any control, and not knowing who to turn to. The other thing that I did was not in any of my company manuals. I told the passengers go to the terminal and wait there for me."*

Richard followed the passengers to the terminal where he gave debriefs, with full and open disclosure, in two of the lounges. Each briefing lasted 45 minutes: 15 minutes of NITS, 15 minutes of group questions, and 15 minutes of individual questions. He gave passengers all the relevant facts for two reasons. First, when involved in an incident or accident, people need to know the truth. Second, Richard knew that the media would be waiting, and wanted passengers to feel able to correct misreporting. He also checked on the passengers' wellbeing, and found that there were no injuries. *"I took all the elements that create fear and panic then slowly and systematically dissolved them."*

The last thing Richard did was also not in any manual. He gave the passengers his personal mobile phone number in case they had questions or concerns. *"This is something that you would do if you had a daughter that you were leaving behind in a foreign country to go on a holiday. You would say, 'Call me if you've got a problem'."* He gave his personal guarantee to the passengers to provide full communication and attend to their needs. The combination of the full and open disclosure and the personal guarantee changed the perception of the incident outside the aircraft. *"I'm not aware of a single photograph of any QF32 passenger crying when they left the terminal. The passengers became the eighth team during the QF32 crisis. They took control of the media, delivered the facts, shut down rumours and protected my company's brand."*

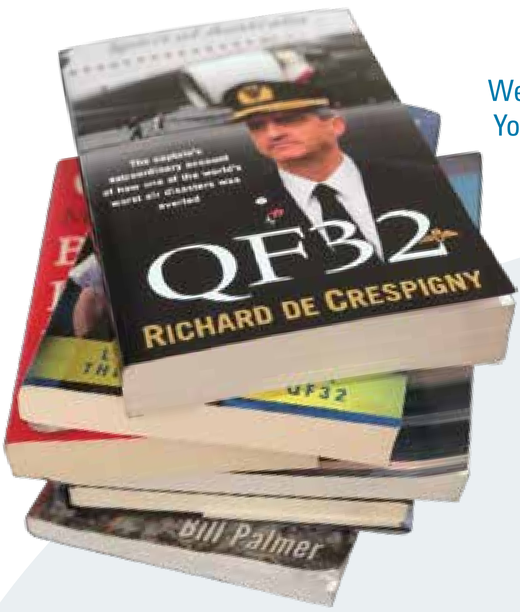
In 2011, Richard was awarded the Qantas Chairman's Diamond Award "for valour and/or selflessness so extraordinary, that the reputation of the airline has been enhanced in the eyes of other Qantas staff and the Australian public".

People in control

The story of QF32 is one of success against the odds, borne of deep expertise not only in how to fly an aircraft, but in how to manage risks and make decisions as a team when procedures and checklists are not enough.

This is why humans must always remain in control of systems. Only people can make dynamic trade-off decisions that can't be programmed into a computer. Pilots are responsible for their passengers and controllers are responsible for traffic separation. So pilots must always remain in command of their flights and controllers must always remain in command of air traffic. This being the case, tasks, technology, and environments must be designed for people, and people must have the competency and expertise to handle situations that we can foresee and those we can't, like QF32.

'QF32' was published by Pan Macmillan in 2012 (QF32.com). 'FLY! Life Lessons from the Cockpit of QF32' was published by Penguin Random House in 2018 (Fly-TheBook.com).



We must commit to a lifetime of learning. You must never stop learning.

DECISION-MAKING AT WORK: QF32 AND YOU

Steven Shorrock reflects on a conversation with **Captain Richard Champion de Crespigny**. What else might pilots, air traffic controllers, and others who work complex technology learn?

During a normal flight, many goals need to be balanced. Minutes into the QF32 flight, commercial goals were no longer part of the equation. Safety and passenger wellbeing fully occupied the minds of the cockpit and cabin crew. Still, trade-offs had to be made. The crew had to make trade-offs between shorter-term and longer-term goals, between thoroughness and efficiency, between monitoring and acting, between compliance and creativity, between diagnosing components and understanding whole systems, between a focus on what wasn't working and what was working, and between different kinds of risks. These trade-offs are relevant to normal operations, but become more critical in a crisis.

In his book *FLY!*, Richard discusses eight 'elements of resilience' that are relevant to trade-offs: knowledge, training, experience, teamwork, leadership, crisis management, decision-making, and risk. These are all relevant to trade-offs. On knowledge and training, Richard remarked that *"Pilots are not just key turners. They should understand the engines behind that key, down to the compressors, turbines and fuel system"* and *"It behoves pilots to understand the vast array of electronics and logic in our fly-by-wire aircraft so we retain confidence when things go wrong, to get our aircraft safely onto the ground."*

Active learning

Richard calls for active learning, and not just a reliance on experience. On this topic, he pulled no punches. *"Lots of highly experienced people make terrible mistakes because they become overconfident, lazy and normalise deviance. They have allowed their knowledge and skills acquired over many years to degrade or become legacy."* Sometimes, he said, experience can be a curse.

Referring to *HindSight* magazine and other publications, he said that experience is only good when combined with a personal commitment to a lifetime of learning. *"You need to read books and you need to read magazines like HindSight. Everyone must commit to a lifetime of learning to understand what's happened in the past, what is possible in the future."*

Making better decisions

Richard referred to different ways of interpreting situations and making decisions. He talked about the importance of understanding neuroscience and brain anatomy for understanding human resilience and making better decisions. He discussed the role of instincts, habits, intuitions and more deliberate decision-making processes, and gave examples of each on QF32.

It was clear that some decisions were fast, while others were slow. A question emerged about when to follow your gut feelings, and when to engage in more deliberate decision making. His first interaction with the Check Captain, and first response to the noise (pressing the altitude hold and pulling the heading select knob) were examples of fast, habitual decisions. Richard's advice, based on his understanding of neuroscience and decision-making, is this: *"Gut feelings come from our old, fast and subconscious brain that exists below the level of language. So if you're operating in your area of expertise and you've got a gut feeling, then it's probably intuition that should be believed. However, if you've got a gut feeling that's not in your area of expertise, then it may be based upon biases and illusions from our fast mind that could be wrong."*

A more deliberate decision-making process is the 'ramp technique'. This involves first asking the most junior person what they think, so that they won't be intimidated by the more senior team members. Working from the bottom up, you ask each person for their view, and only contribute your thoughts when everyone has spoken. *"Many of our decisions were ramp decisions. You'll find the decision will come out naturally by itself. A few times in QF32 I didn't need to say a thing. The ramp technique stops groupthink, stops intimidation, and gets the maximum number of ideas. It's super fast and can take just a few seconds."*

For other decisions, a slower decision-making process was evident, taking minutes or even up to two hours. This could be seen in the disembarkation decision. *"That needs everyone inputting, everyone discussing critically and interactively before the Captain ultimately makes the final decision. The decision should not be a surprise to anyone because it should have surfaced as the most logical solution."*

In fact, much of the decision-making was slow, helped by the fact that the crew had worked out how much time they had available. There were questions about why the crew stayed airborne for so long. Richard has no regrets. *"I think staying airborne for one*

hour and 50 minutes was exactly the right decision on that occasion. In cases where people come into land too quickly after they've got a crisis in a fly-by-wire aircraft, they sometimes get surprised. For a different situation, particularly when there's a fire, you would probably come to a different decision."

Training for expertise

This bring us to the question of how to build expertise and respond effectively in different situations. Richard is an advocate of 'armchair flying' or mental practice, popular among elite athletes. *"Armchair flying absolutely works. The interesting thing is that when you are doing armchair flying, the brain responds in real time as though it were the real thing. It's crucial that that we do armchair flying. It builds up habits and confidence, so improves resilience."*

But, he noted, there is also need for creativity. "*Most of the time pilots are procedural. We just follow the SOPs. You don't have to be creative. And that's fine until something goes wrong. When faced with a black swan event, we must solve problems we haven't been trained for."*

Pilots, air traffic controllers and other front-line staff can be prepared, he said, by keeping calm, prioritising and creating time before making complex decisions. *"We have to build a shared mental model, think outside the box, and maybe reverse the logic. We have to be creative to find novel solutions to problems that we never expected. This is a totally different skill set to being a procedural pilot."*

For this, he proposes more challenging simulation, where survival is questioned, and the only successful decision is one that gets you down alive. *"The military know that to create a resilient pilot, you must expose them to the environments and risks they will experience in war. And for that you need deliberate practice."*

Psychologist K. Anders Ericsson argued that expertise requires a life-long deliberate effort to improve performance in a specific domain. It is not so much the quantity of practice, but rather how one practises. Experts, according to Ericsson, break down the required skills and focus on improving those chunks of skills during practice or day-to-day activities, at more challenging levels. This, combined with aptitude, an intention to master a skill, feedback, and a support system is what produces expert performance.

"We haven't got there yet in training, but we need to go beyond deliberate practice, to train people so they can repeat difficult sequences stress-free, giving them the confidence that they have the skills and knowledge to handle the known events and the risk and decision-making skills to create novel solutions. That's what we must build in pilots and air traffic controllers."

But things won't always work out in the way that we would like. Training should provide a safe context for learning from mistakes. *"We must be humble and accept we will make mistakes"*, said Richard. *"We must fail fast and well. We must accept failures in the little things so we get the big things right."*

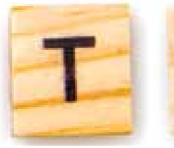
But sometimes, big things do go wrong, and when they do, post-traumatic stress is a risk. In *FLY!*, Richard includes a chapter about post-traumatic stress, relating his own experience and that of others, with explanations from neuroscience as well as practical advice. *"Every person will experience post-traumatic stress at some time in their life"*, he said, *"so they must know how to manage it, recover, and grow from it"*. We will return to this and other aspects of wellbeing in the next issue of *HindSight* in early 2020. S

RICHARD CHAMPION DE CRESPIGNY AM

Richard Champion de Crespigny is an Airbus A380 Captain with Qantas Airlines with over 20,000 flying hours. He was born and educated in Melbourne, Australia. He decided on a flying career at 14-years old when his father organised a tour of the Royal Australian Air Force (RAAF) Academy at Point Cook in Victoria. Three years later, he joined the RAAF Academy in 1975 and began flying a year later. By 1979, he had successfully completed a BSc in Physics and Maths, and a Graduate Diploma in Military Aviation. He continued in the RAAF until 1986, when he joined Qantas, where he converted to Boeing 747s. In 2004, he converted to Airbus A330 and in 2008 converted to Airbus A380 as one of Qantas' most senior captains.

Following QF32 in 2011, Captain Richard Champion de Crespigny was appointed as 'Member in the General Division of the Order of Australia' (AM) *"for significant service to the aviation industry both nationally and internationally, particularly for flight safety, and to the community"*. He has won a number of awards including Flight Safety Foundation Professionalism Award in Flight Safety and the Guild of Air Pilots and Air Navigators Hugh Gordon–Burge Memorial Award for Outstanding Contribution to Air Safety (both in 2011). In 2014, he was awarded Doctor of the University (honoris causa) at Charles Sturt University. He has written two books: the best-selling *QF32* and recently-published *FLY! Life Lessons from the Cockpit of QF32*.

MAKING SENSE OF GOAL CONFLICTS AND TRADEOFFS IN AIR TRAFFIC MANAGEMENT



Organisational decisions and goal conflicts are connected to controller and pilot trade-offs, but these trade-offs are rarely addressed explicitly in procedures and training. In this article, **Stathis Malakis** describes the nature of goal conflicts and trade-offs in air traffic management, with a number of insightful examples.

KEY POINTS

- **Organisational policies, priorities and pressures generate goal conflicts. Operational staff have to respond via trade-offs, workarounds and compromises to compensate for inadequate planning, time or resources.**
- **While individual demands and pressures can be successfully dealt with, in combination they produce multiple conflicts, which make work more difficult.**
- **Systems may be simultaneously cooperative over shared or global goals and competitive when it comes to local goals. Efficient local performance may be at the expense of common goals.**
- **As the window of opportunity gets smaller and smaller, we are forced to choose one option which favours a particular goal.**
- **Trading off goals requires deep knowledge and an ability to discern the range of applicability of options to a wide variety of situations. Developing this competency also involves trade-offs.**

Air traffic controllers know about trade-offs. Economic and performance pressures in the air traffic management system create the conditions for goal conflicts that get resolved with countless trade-offs every day. Work in the ops rooms is bounded by economic, workload, performance and safety constraints. In many cases, controllers have to make several trade-offs between interacting and conflicting goals, as well as between performance indicators placed on different outcomes of work.

Since goal trade-offs are usually not addressed in operating procedures or training, controllers may make operational compromises to compensate for inadequate planning, time or resources. These compromises should have been addressed by the organisation. Organisational policies and priorities generate goal conflicts, and controllers must respond via trade-offs in their work. These trade-offs relate to aspects of efficiency and thoroughness, planning horizon, team roles and work organisation.

A typical example from tower operations is when an aerodrome operator exerts pressures for more capacity. This is usually accompanied by other types of demands regarding changes of runways in use at certain hours of the day, enforcement of preferential taxi routes, and removal of air traffic flow restrictions in order to expedite traffic. The obvious aim of these pressures is to increase the efficiency of aerodrome and airline operations. Even though each individual demand can be successfully dealt with, their combination produces multiple conflicts that cannot be easily reconciled.

For example, if a departing flight is delayed for security reasons in the terminal building and misses its departure slot, the air traffic flow and capacity management system may allocate a new departure slot one hour later due to capacity restrictions at the destination aerodrome. Suppose that tower controllers become busy with a wave of departing aircraft and have to work above their capacity limits. This unexpected situation creates problems for the affected flight crew who need to take off as soon as possible because their destination airport is closing at night. To make things worse, the aerodrome operator informs the controllers that the parking stand of the delayed flight has been allocated

to another flight that just arrived and is waiting on the taxiway. All these economic, capacity and efficiency pressures leave controllers with a narrow space to manoeuvre and make decisions. In the end, the tower controllers would have to negotiate these perspectives and may choose to cancel the restriction to allow the flight to depart earlier and reach their destination aerodrome while it is still open.

Working in isolation, different control units may achieve efficient local performance at the expense of common goals.

Local and organisational trade-offs

Air traffic management is a domain where goals and constraints are not always well defined and controller trade-offs are very challenging. Hence, systems may be simultaneously cooperative over shared or global goals and competitive when it comes to local goals, which may be in conflict at different units. Working in isolation, different control units may achieve efficient local performance at the expense of common goals. For example, direct routings and vector shortcuts are always welcomed by flight crews and demonstrate the expertise of controllers. However, a controller who expedites arriving aircraft with direct routings to land at a congested airport, where no parking stands are available, is inadvertently exerting unnecessary pressure to tower controllers. Eventually, this can destabilise aerodrome operations. Additionally, safety-sensitive situations are generated by direct routings and vector shortcuts when flight crews end up approaching high and fast to a different runway; not the originally briefed and planned landing.

The window of opportunity

When controllers are not sure how to solve a problem, they may be simultaneously preparing for a few goals. They may have a preferred goal but, as they are not sure if it will work out, they can prepare some backups. As the window of opportunity gets smaller and smaller, they are forced to choose one option which favours a particular goal. For example, approach controllers faced with a complex arrival traffic flow may delay the sequencing of the arrival aircraft until the cost of replanning is too high, or even unsafe.

Similar examples can be drawn from flight crew decisions to divert or fly into adverse weather at the destination aerodrome. In this case, another option may be to choose an alternate aerodrome where the chances of bad weather are lower. Flight crews may try to delay their decision to the last moment in the hope that their preferred option would fall into place (i.e., continue to destination). But at the same time, preparations should be made for the diversion possibility (i.e., after a certain distance travelled to the destination aerodrome, fuel management issues may make a diversion extremely risky).

In the dynamic environment of air traffic management, goal trade-offs may also exist regarding when to commit to a plan of action. Controllers have to decide whether to take corrective action early, or delay their response and wait for more data to come in, to explore additional options and become more reflective. For example, an operational supervisor may delay a decision to accept normal levels of traffic after a surveillance system failure. The supervisor may prefer to work for a while in reduced traffic conditions in order to check the stability of the previously failed system, before resuming normal traffic loads. This is a precautionary tactic that usually pays off when the failure is not well understood and the systems are software intensive. In this sense, the supervisor faces a trade-off between (i) resuming normal operations early and facing a risky complication of the initial failure and (ii) waiting for more information and working with reduced traffic rates. This latter option will eventually increase the workload of adjacent units, generating delays and route diversions.

Competency for trade-offs

Effective management of trade-offs implies that controllers and organisations are competent in operating in both sides of the spectrum, despite the fact that different goals have their own requirements. Trading off goals requires a deep knowledge of risks and opportunities as well as an ability to discern the range of applicability of different options to a wide variety of situations. Developing this capability, however, comes at an increased cost of training so that controllers can acquire redundant skills for a variety of domains. Broadening the bandwidth of competences may be a good strategy to increase operational and rostering flexibility, for instance, but it also leads to increased demands for training.

> In the air traffic management system, organisational activities shape and affect the ways that controllers work and coordinate their efforts.

A characteristic example is the dilemma facing the multisector units when it comes to the training of their controllers in different sectors. A multisector unit may operate with many sectors which are by design incompatible in traffic demands, complexity, de-conflicting strategies, coordination requirements, weather patterns, communication, navigation and surveillance systems, and so on.

The training section – in line with the operational management – has a difficult decision to make concerning whether to train all controllers for all sectors or to provide tailored training between dedicated sector groups and selected controllers. The first option requires extensive training, and makes the progression of the controllers towards acquiring ratings and sector endorsements lengthy. But it provides operational flexibility as all controllers can work in any sector at any given condition. The second option reduces training needs, controllers develop in-depth expertise in their dedicated sector groups, work practices are better developed and communicated, and controller performance may be enhanced. But the margin of manoeuvre of operations becomes significantly lower as rostering gets more challenging. Additionally, system-wide failures and contingency plans can be better managed with the first option while day-to-day operation is smoother with second option.

Safety vs efficiency

In some cases, collision prevention is often in conflict with efficiency of operations. For instance, controllers may maintain a high safety record at the expense of efficiency, forcing airlines to spend more mileage and fuel – and hence also emissions – on their sectors. The result may be more delays and route changes, especially in the cases of bad weather, staffing issues and system-wide degradations.

Air navigation service providers strive to meet increasing pressures for performance and respond to new opportunities while lowering costs. This is usually achieved by transferring pressures to the operations rooms, forcing controllers to work faster, harder and smarter (i.e., relying on tradeoffs, workarounds and circumventions to balance conflicting goals). In the air traffic management system, organisational activities shape and affect the ways that controllers work and coordinate their efforts. Therefore, it is necessary to understand how the system performs as a whole, and how it achieves its goals and functions. Thus, making sense of goal conflicts and tradeoffs is a critical goal for safety, operations and research in the air traffic management system.

Stathis Malakis, PhD, is an air traffic controller working for the Hellenic Civil Aviation Authority. He holds tower, approach procedural, approach radar and instructor/assessor ratings. He holds a BSc in Mathematics, an MSc in Air Transport Management and a PhD in Cognitive Systems Engineering. He has published many peer-reviewed journal papers in human performance and safety in air traffic control.

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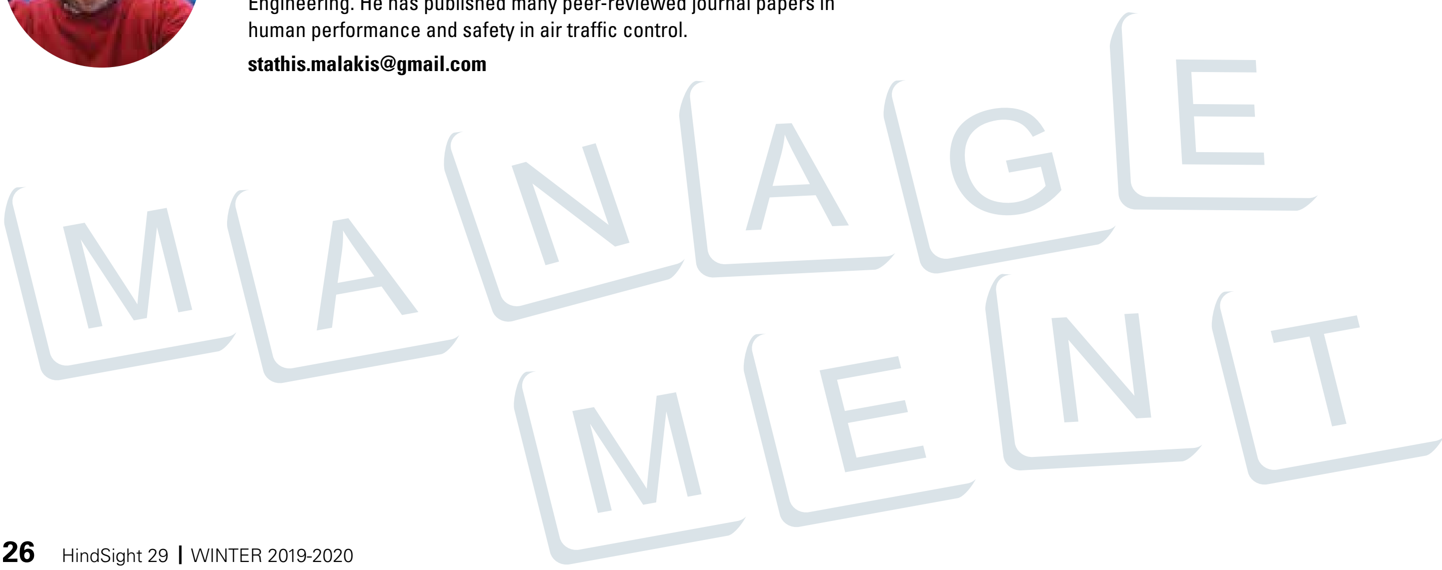


I AM NOT A MACHINE

Software is playing a bigger role in all aspects of aviation operations. But software cannot always take into account the real world of operations. In this article, **Julie Baltet** describes some of the limitations and implications of flight planning software for controllers and pilots.

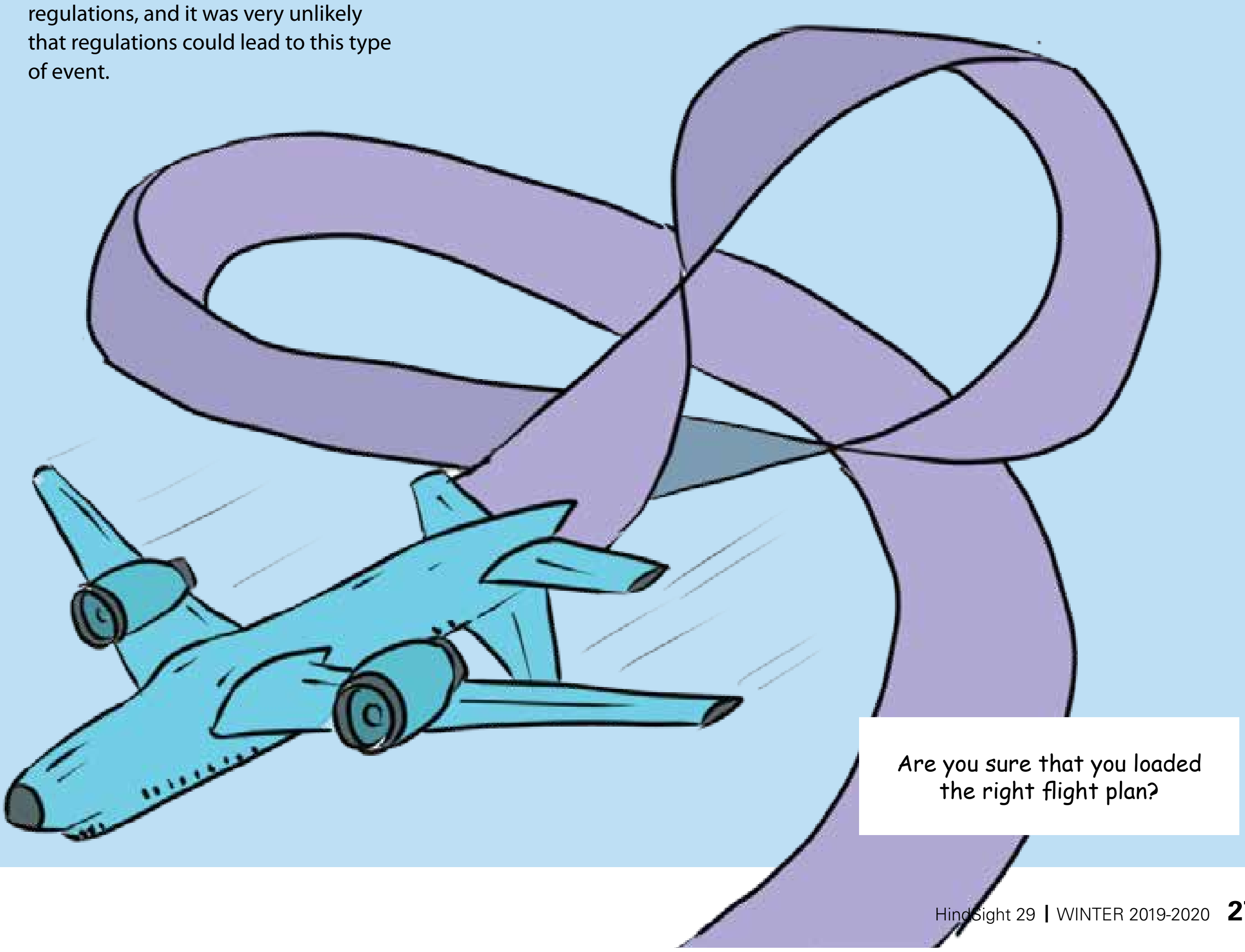
KEY POINTS:

- **The use of algorithms changes the working methods of every actor (airlines, ATC, ATFM, pilots) resulting in lack of understanding.**
- **Inventing working methods without cooperation between actors leads to instability.**
- **Training via crossovers sections helps to regain on trust and understanding between actors.**
- **Post-analyses and regulations have to take into account advice of the operational actors to improve the system.**

On 30 June 1956, two aircraft collided above Grand Canyon in the United States of America. Yet pilots and controllers had respected the rules and regulations, and it was very unlikely that regulations could lead to this type of event.

At the time, air traffic controllers were more like flight assistants. Separation provision was more the responsibility of the pilot, by visual contact.

ATCOs now provide separation for traffic that is increasing each year in number and complexity. This has led to the creation of networks and constraints. Pilots no longer choose their route. As the amount of flights and complexity of flight planning increased, companies delegated that job to planning operators. More recently, they integrated flight planning software that can deal with a huge amount of information, including cost data, to shift data, and meteo data. Even cruise flight levels are calculated in advance. Operational personnel in different functions have had to adapt to this software, from airlines to air traffic flow management (AFTM), and air traffic control.

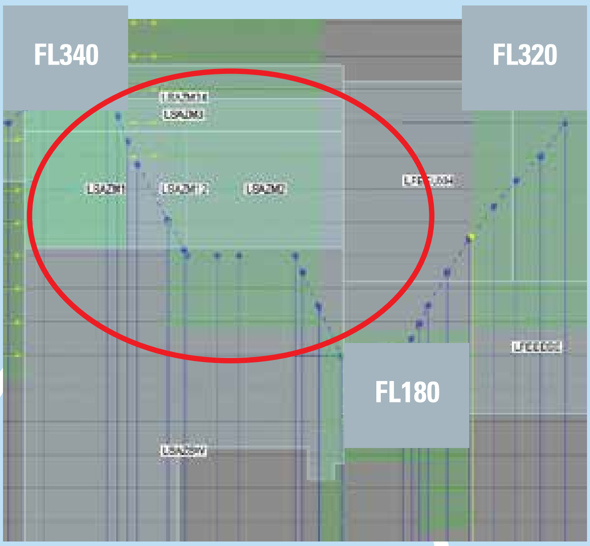


Airlines took flight planning software as a real improvement. They could take all data into account in their planning while reducing the costs for flight planning. The software allowed organisations to respect all route availability document (RAD) measures without having to learn them, and to find new routings that companies would not have considered. The software was so perfect that aircraft could zigzag across large areas of airspace while avoiding regulations.

It seemed the perfect match for airlines: fewer constraints and employees. Pilots just had to respect their flight plans. But sometimes it is unrealistic.

Here is an example of a flight plan requesting a steep descent and then a return to the original level in the middle of the route. This sort of flight plan involves more work for ATCOs and usually results in discussions or even arguments between pilots and ATCOs.

Route: N0452F360 LARKI G18 URNIL UL609 MES UG18 FSK UN128 RUGAS DCT LONTA UL608 DOLEV DCT VRANA DCT ULPIN DCT ROTAR DCT TAGIP/ N0439F320 P131 RESIA/N0444F340 UP131 ARGAX/N0400F240 UL613 HOC/ N0377F180 G4 HR/N0433F320 G4 LUL UT60 GIVOR UN853 SORAL/N0369F180 UN853 DIK N852 GOPAS/N0369F180 N852 LNO



In this case, pilots did not stick to their flight plan and became intruders in an ATC sector that was not filed. It resulted in so many overloads in ATC sectors that ATFM had to react. They tried to implement a RAD amendment to stop these sector intrusions. With the huge traffic increase, ATFM had to adapt to variability in the figures used to anticipate the traffic. In response, they invented methods to adapt and absorb the traffic. Yet, the algorithm is so sharp and reactive that it always finds the flaws in the system. ATFM and airlines engaged a race against each other: one trying to implement overload protection, the others trying to avoid them and their constraints.

Controllers and pilots are observers and guardians of the system, dealing with the flaws of it. They balance between multiple constraints generated by multiple stakeholders.

Instead of cooperating, they reacted without really understanding each other, which led to instability but mostly lack of understanding for pilots and ATCOs. Pilots did not understand flight plans made by algorithms and did not trust their efficiency. However, airlines asked them to comply even though the algorithm was wrong. As airlines had decreased their number of planning operators, the software left flaws unseen. Meanwhile, ATFM developed more measures and asked controllers to understand each of these measures. RAD measures were introduced to forbid flight plans that bring complexities into our area, such as descents due to wind efficiency at entry to new sectors. Measures were introduced to monitor intruders and to cap levels. ATCOs were asked to become 'intruder hunters', sometimes forgetting their first priority and even creating disputes between ANSPs.

After 10 years of racing, companies and ATFM finally took a step towards each other. To solve the problem of instability, companies and ATFM decided the only way to secure the system was to change the practices of ATCOs and pilots. The answer was 'fly as filed'. Every actor tried to do their best, but to solve a complex problem like this one requires time, understanding and trust, which in turn requires communication and training.

During these 10 years, methods changed every year. Training had to adapt continuously. In Reims ACC, for instructors, it meant having to interact with unmotivated and tired ATCOs. To create effective training requires a step back to clarify the new working methods. The best way to reduce the gap between the two worlds is crossover training. In Reims ACC, we decided to implement discussions between Air France pilots or Reims ATFM department with our ATCOs. It allows them to interact and discuss with each other. ATCOs and pilots were not the only ones to harvest the fruit of these debates.

During these sessions, ATCOs were able to explain the flaws that they see every day in the regulations. An air traffic controller provides separation, eases the flow of traffic, and tries to work in compliance with the policies, rules and procedures for all aircraft in his or her sector. All priorities and objectives are considered and controllers try to find the best balance. The problem is that each ATCO decision faces a pilot decision, which can originate from these constraints. The same for pilots who have to manage their flight: they have to deal with complex real life (passenger needs, fuel savings, and time for connections, etc). The type of flight plan shown above can result in many questions for ATCOs, as you can see in the drawing below.

Finding the right balance between all those considerations is as intricate as the flight planning system. And all of this affects controller decision-making. Controllers and pilots are observers and guardians of the system, dealing with the flaws of it. They balance between multiple constraints generated by multiple stakeholders. ATCOs and pilots need to be heard and understood by airlines and ATFM. 'Fly as you file' is a good way of creating stability. To integrate operational actors in post analyses and regulations will improve it. To trust them will help to erase the flaws of the system, even if sometimes it requires a clean sweep of some regulations, like in 1956. Time spent in discussions with front-line operators is never wasted time. S

Pilots did not understand flight plans made by algorithms and did not trust their efficiency. However, airlines asked them to comply even though the algorithm was wrong.

Julie Baltet has been working as an air traffic controller in Reims ACC since 2006. Feeling the need to learn more about HF, she became an HF facilitator for controllers in 2011. She joined the French HF team recently.

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GOAL CONFLICTS AND TRADE-OFFS
EUROCONTROL IANS COURSES

The EUROCONTROL Institute of Air Navigation Services (IANS), located in Luxembourg, develops and delivers Air Traffic Management Training, Services and Tools for Air Navigation Service Providers, Airlines, Training Organisations and Civil and Military State Authorities worldwide. Building on over 45 years of expertise, the Institute provides a wide range of training courses, services and tools – from general introduction courses on ATM concepts through to advanced operational training. Here are some courses that may be of interest to readers on the topic of goal conflicts and trade-offs.

Liability in ATM [GEN-LIABILITY]

The Liabilities in ATM course provides an overview of the different liabilities and their distribution among the ATM stakeholders (ANSPs, airlines, system manufacturers) and roles (ATCOs, pilots, system designers and engineers). Liability distribution becomes more and more problematic as the level of automation increases in socio-technical systems, like ATM. The adoption of new technologies (e.g., integration of drones in non-restricted airspace, remote towers, AMAN and DMAN, etc.) brings changes in the distribution and attribution of liabilities. Automation may make decisions or perform actions which are not directly under the control of the controller.

This course provides fundamental concepts and ready-to-use tools to support identification, analysis and resolution of liability attribution issues in organizations. It includes the analysis of case studies, including incidents and accidents. Case studies will be related to: integration of drones, new ATM technologies (e.g., Remote Tower, AMAN), cybersecurity attacks.

The course uses the Legal case, a methodology developed in SESAR and designed to collaborate with safety, security and human factors cases and support the overall ATM business case.

Objectives

At the end of the course, participants will be able to:

- Identify liability issues in ATM
- Analyse the impact of automation on liability distribution
- Analyse and manage liability issues in their organizations
- Develop a Legal Case to manage liability attribution changes in their organizations.
- Audience
- Staff from ANSPs, airlines, system manufacturers
- ATCOs, pilots, system designers and engineers

Aviation and the Environment [ENV-ENV]

This course provides a unique multi-stakeholder overview of the environmental impact of the aviation sector. It also addresses measures that can be taken to maintain the sector's current operations whilst securing its future sustainable development. The last part of the course demonstrates how collaboration and communication between stakeholders can be achieved by Collaborative Environmental Management (CEM). The participants will be given the opportunity to apply both their professional practices and the knowledge acquired over the course through a series of interactive sessions and practical exercises.

The 2020 package is a set of binding legislation to ensure that the EU meets its climate and energy targets for the year 2020. This package sets three key targets:

- 20% cut in greenhouse gas emissions (from 1990 levels)
- 20% of EU energy from renewables
- 20% improvement in energy efficiency

The targets were set by EU leaders in 2007 and enacted in legislation in 2009. They are also headline targets of the Europe 2020 strategy for smart, sustainable and inclusive growth. The EU is taking action in several areas to meet the targets.

Objectives

After completing the course, participants will have a broad overview of the aviation sector's contribution to the pressing environmental issues of the day, In addition, they will be equipped with the tools and knowledge to understand what ATM can do to enable the sustainable development of the aviation sector, in particular in and around airports..

Audience

This course is primarily designed for aviation sector personnel who have been recently tasked by their management with carrying out any type of environmental duties.

It may also be of interest to ATM managers from organisations such as air navigation service providers, national supervisory authorities, airports, airlines and ATM equipment manufacturers.

Building a Future ATM System [GEN-FUT]

This course is exploring different areas of the future ATM world taking into account existing and future challenges.

It covers general aspects (e.g., SES, SESAR 2020, SJU, EASA, SESAR deployment manager, latest version of the European ATM Master plan) as well as operational (e.g., major role of the Network Manager) and technical areas (e.g., CNS, AIM, ATM Architecture), without forgetting the airport environment and FEAST.

New topics about Remote Towers, RPAS, ATM Security, integrated CNS and GADSS (Global Aeronautical Distress and Safety System) are also included.

Objectives

After completing the course, participants will have an appreciation of how the future European air traffic management system may evolve.

Audience

This course is designed for personnel working in any area of ATM, interested by an overview of how the future ATM world might look like.

Other courses on relevant to goal conflicts and trade-offs:

- Inside ATM [GEN-ATM-INTRO]
- Management and Oversight of Changes: The Basics [SAF-CHG-BASIC]
- Management and Oversight of Changes [SAF-CHG-INTRO]
- Management of Changes for Industry [SAF-CHG-IND]
- Cyber security in ATM - Main threats and solutions [SEC-CYBER]
- Introduction to Air Traffic Flow and Capacity Management [ASM-ATFCM]
- Design and Assessment of Systems Using Human Centered Approaches [HUM-DESIGN]

Check the prerequisites and dates for each course, and register at EUROCONTROL Training Zone.
https://trainingzone.eurocontrol.int/

DO THEY CARE ABOUT SAFETY?

Different people have different goals but we don't always understand others' perspectives. **Florence-Marie Jégoux** considers how can we understand others' priorities and decisions, while avoiding assumptions.

KEY POINTS

- **We can easily be wrong about others' priorities and trade-offs.**
- **Priorities and trade-offs only have meaning in context.**
- **We need to make cognitive effort, and come together in groups, to understand the perspectives of others.**

When I was working as an ATCO, I often encountered behaviour from pilots and peers that I didn't understand. For instance, one evening in a busy tower sequence, a fighter pilot told me he was "short fuel" before entering the CTR. I asked if he declared pan-pan or mayday. "No, short fuel," was his reply. I had procedures for pan-pan, for mayday, but nothing for "short fuel". As a young ATCO, I did not know what to do with him, with the commercial IFR I had on final, and the microlight VFRs in downwind, in the crowded airspace.

ATCOs worked alone in this tower during the evenings, so I couldn't ask anyone. And this fighter plane was coming very fast, much more than my brain speed. I didn't want to take any chance of a crash, may it be in the air or on the ground. So I moved the IFR aside from final, stacked the VFR on downwind, and cleared the fighter pilot to final approach. When he was on short final, after traffic information, I cleared him to land, and he replied, "Finally, we're gonna do a chandelle."

What? They said they were short fuel, but they prefer to play in tower area, instead of landing, disregarding all the other traffic that I stacked? They don't care about safety!

After they did their chandelle over the city, they landed with my IFR on final and the VFR still in downwind and my hectic CTR. And I never got the phone call I asked for.

Can we really know about others' priorities if we don't debrief?

At other times, I had misunderstandings with ATCO peers in approach: "You told me that this plane would arrive via NW and it came via SW, it completely screwed my plans and my sequence!" What was not said aloud was: "Are you thinking about safety?"

Whatever our work, we tend to define our own priorities, which change over time: safety, performance, fuel consumption, time, spacing… And when our priority is not considered as much as we want, or in the way that we want, we tend to get upset at others.

But let's take another example: do you care about your health? Chances are you will answer, "Yes, of course". But do you adhere to recommendations doctors make about health? Sufficient regular sleep, food hygiene, moderation, not smoking, exercising, not drinking, etc? Chances are you will answer, "some, but not all."

That's the point. We all make trade-offs, all the time: cost-benefit trade-offs, performance-safety trade-offs, efficiency-thoroughness trade-offs, etc. We juggle priorities, and try to do our best, adapt and adjust with moving constraints. And other people make their own trade-offs, with their constraints, their priorities, which we are not always aware of. Can we really know about others' priorities if we don't debrief?

Now working as a safety analyst, I analyse safety-related events. I have now to pay attention again to this cognitive pattern, because seeing mostly events where safety is at stake, puts me at risk of so-called *déformation professionnelle* (Shorrock, 2013): "They don't care about safety!" It goes hand-in-hand with another cognitive bias: the "tendency to attribute the cause of events to front-line actors" (Amalberti, 2013) and the tendency to think from our point of view – work-as-imagined. It requires cognitive effort to see things from another's perspective. We are initially reluctant to make this cognitive effort, as shown for a long time in psychology, and more recently in neuroscience: reducing effort is a brain constant (Bohler, 2019), and we can see it as lazy, or as thrifty.

We have to find better ways to take into account the perspectives of others. Non-violent communication (Szczukowski, 2018) is a good way to understand others' points of view. Fortunately, our team also works across disciplines, with people from different backgrounds to enrich our own perspectives. We also study all stakeholders and the system as a whole to understand trade-offs that are made not only at the front-line, but also at other levels of the organisation. Trade-offs are universal throughout the aviation system. Understanding of trade-offs among all actors would improve safety. S

References

Amalberti, R. (2013) *Piloter la sécurité*. Paris: Springer.

Bohler, S. (2019). *Le bug humain*. Robert Laffont.

Shorrock, S. (2013, December 12). Déformation professionnelle: How profession distorts perspective [blog post]. Retrieved from https://humanisticsystems.com/2013/12/12/deformation-professionnelle-how-profession-distorts-perspective/

Szczukowski, M. (2018). Dr Jackal and Mr Giraffe. *HindSight*, Issue 26, Summer 2018, 31-33.

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GOOD JOB, EVERYBODY

The goals of capacity and noise abatement come to a compromise in the form of curfews. But that does not mean that the goal conflict is solved. Further trade-offs and compromises have to be made, but by operational staff, not policy-makers, as **Emmanuelle Gravalon** describes.

KEY POINTS

- **Inflexible curfew limits and associated time pressure can create the need for more compromises, which may bring many hidden risks.**
- **People are able to pursue several goals via compromise, balancing demands, resources, and expected rewards, but these can blur the goals, and the importance of the goals.**
- **Any action that brings about a pleasant situation tends to be repeated in the future.**

More and more European airports are subject to a curfew for noise abatement. We, air traffic controllers working on such airports, all have stories about curfews, and some of these involve safety. Here is one.

Around 9 p.m., the supervisor is contacted by an airline OPS specialist, who asks casually about the latest allowed landing time. Immediately, the supervisor knows he'll have to deal with curfew, time extensions and controversial decisions this evening… The flight in question accumulated small delays along the day, or was submitted to traffic regulations, or even has a small technical problem. Nowadays, the supervisor is not allowed to give any time extension, and has to transfer the question to airport operations.

Tonight, a short extension of 15 minutes is granted, corresponding exactly to the flight's ETA. At the other end, the crew is trying to gain precious minutes, pressing the cabin for quick preparation, asking the controllers for quick departure and any direct routing, flying at higher speed, asking for the shortest approach. The new ETA is five minutes earlier!

When he gets the flight on frequency, the approach controller asks to change the runway in use, to be able to allow the shortest approach. This means another controller has to modify the departure clearance of the last departing flight, which must also comply with curfew, and which was granted the same 15 minute extension.

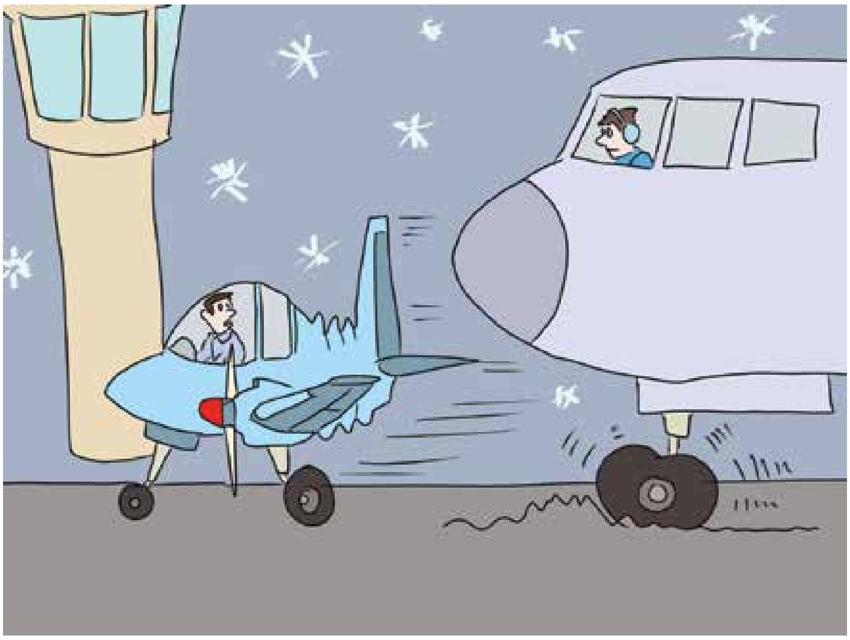
The departing flight is finally ready to taxi, shortly before the time limit, and (probably a bit stressed by time pressure) goes to the wrong holding point, according to his previous clearance. It's too late to have him all the way back to the runway in use. The tower controller decides to depart the aircraft from this runway, and asks for a strong speed reduction of the opposite arrival. The departure is given a sharp turn shortly after take-off and the arrival lands just in time.

Good job, everybody! Controllers are warmly thanked by both crews; they pass on thanks to all, back to the departure airfield. Both company OPS and ground staff are relieved, and can go home after a good day's work.

What's the problem in this story? The job was well done, and there was no loss of separation to be investigated.

Many stakeholders are involved in this type of situation. Let's have a look at who they are, and at their goals.

1. **Neighbours and politicians:** residents claim their right to silent nights, despite buying cheap houses close to an airport. Politicians decree curfew, in order to smooth neighbours' claims. Some curfews allow time extension, while others don't, and late aircraft have to divert.
2. **Airport authorities:** they are the link between politics and operations. Their goal is to comply as much as possible with a curfew. They'll have to report (and explain) to residents for each granted time extension.
3. **Airline OPS:** in case of diversion, the OPS staff will have to deal with an aircraft and its crew at the wrong airport the next morning and will have to reorganise the timetable, at significant cost. In case of flight cancellation, they will have to cope with disgruntled or angry passengers.
4. **Passengers:** they paid to be flown from A to B. To be stuck at A or diverted to C are not welcome options, and can cause significant disruption and stress for passengers.
5. **Airport ground staff:** they will have to stay longer to find solutions for the grounded passengers, and may well be subject to the stressed behaviour of passengers.



Good job! A little tight, but everyone is on the ground with a minute left until curfew.

6. **Cabin and cockpit crews:** postponed or diverted flight will disrupt their lives, both private and professional, and facing disgruntled and angry passengers is an unpleasant part of the job.
7. **Air traffic controllers:** our first and prescribed goal is safety in the form of collision avoidance. Our second goal is fluidity of air traffic: give each aircraft the best route to the destination according to other aircraft, to regulations, to weather, to technical troubles, to curfew... We also have to comply with environmental rules and please neighbours and politicians (rules such as curfew and stay on standard routing below 7000 ft).

Except for neighbours and politics, all stakeholders are staff, working and making decisions under time pressure. Some of their needs differ, but they have a common and main goal: get the passenger safely from A to B. This is actually two goals in one – "safely" and "from A to B".

In our tale, the goal "from A to B" is the common and main objective of all stakeholders. To reach this objective, staff have to deal with curfew time pressure. Time pressure adds some risks: at another time of the day, the departing traffic would have been redirected to the runway in use, or the arriving aircraft would first have landed quietly without a sharp speed reduction. So work-as-done, and what is considered acceptable, differs depending on time pressure. There are further risks, which may be less visible, in quicker-than-usual preparation. These relate to the flight, check and preparation of the aircraft, preparation of the cabin. Time pressure increases the risk that small mistakes, which would be detected and corrected in normal operation, pile up and lead to an incident, or at least an unpleasant outcome. The trouble is that all stakeholders are working under time pressure, giving less chance to detect mistakes: even if one actor had a doubt, he or she is subject to group pressure: *"Everyone went to such effort to be on time, I have to do my best as well…"*

Dealing with several goals is a human capacity requiring flexibility or adaptation. The human brain is always looking for efficiency: manage the best result possible using the minimum of resources. We balance others' needs and wants against our own.

Regarding ATC, there is a difference between "to provide (control) services" and "to render service".

- *Provide control services* means "manage traffic safely and efficiently": "Safely" is regarded as a mainly technical and regulatory matter: keeping separation between planes, applying rules and procedures. "Efficiently" is understood as managing the traffic without delaying any operations.
- *To render service* is a matter of interacting with others (controllers of adjacent sectors, pilots, airline staff, etc), and feeling useful or helpful, which is seen as efficient as well: that's the power of "good job!" and "thanks for cooperating!".

"Good job, everybody!" is one of the reasons why this story will repeat. These three words activate the reward effect. As research psychologists have found, an action that brings about a pleasant situation tends to be repeated in the future. 'Rendering service' can start to affect the 'control services' provided.

But the real problem in this story is the rigidity of the rules associated with curfew: these rules, made to provide comfort, transfer the responsibility of the neighbours' discomfort to ATC, and sometimes put safety at risk.

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FIFTY SHADES OF TRADE-OFFS: FROM ATC TO ANAESTHESIA

Trade-offs are a universal feature of all aspects of human work, safety-critical activities. **Ludovic Mieusset, François Jaulin and Sebastien Follet** provide examples from ATC and healthcare, and consider how we might better share experience on the reality of trade-offs

KEY POINTS

- **A trade-off involves least dissatisfactory balance between two or more goals.**
- **When there are two or more opposing choices, a trade-off involves internal factors, such as personality, self-confidence, and feelings, and external factors such as rules, time available, and support. Experience helps to weigh these up and make a decision.**
- **Sharing experience is key: it helps furnish a personal situation library, used as references in a trade-off decision**
- **As front-line practitioners in aviation and healthcare, we routinely make trade-off decisions. But some trade-offs bring feelings of uneasiness. Here are some examples, from the tower and the hospital, which show some the parallels in these very different environments.**

The tower

It's a busy evening here in my regional airport. As the Tower Supervisor, I am still struggling with slots, parking congestion, aircraft queuing at the holding point or being vectored to land. The pressure is easing up when I answer a phone call from the en-route centre: a flight linking the UK to Spain is having hydraulic problems. The aircraft is overflying the ocean at FL310 when the crew radio a PAN-PAN-PAN and asks for a diversion to my airport. I relay the information to my colleagues, and we apply the appropriate procedures up to a point: when do we stop all runway operations to help ensure the diverting aircraft will land safely?

On one hand, the problem is serious enough to push the crew to divert to the closest eligible airport. In my experience, hydraulics problems can be serious (handling problems, flaps/slats settings, undercarriage position and steering issues on landing roll). So, the runway must be available well ahead of the arrival of the aircraft to help the crew to cope with the incident.

On the other hand, the aircraft won't land for 20 minutes. It does not seem appropriate to block all departing or arriving so far ahead of time: the situation may become tricky, with slots missed, overcrowded aprons, and fuel minimums looming. And what may happen if some hydraulic fluid spills on the runway or the aircraft blocks it?

Finally, I have to decide. It's not easy, considering the pressure of the airport services and the ATCOs working that night (each with their own perception of the situation). No rule exists for this situation. No procedure is in place. I'm on my own. And whatever the decision is, it won't be completely satisfying.

The hospital

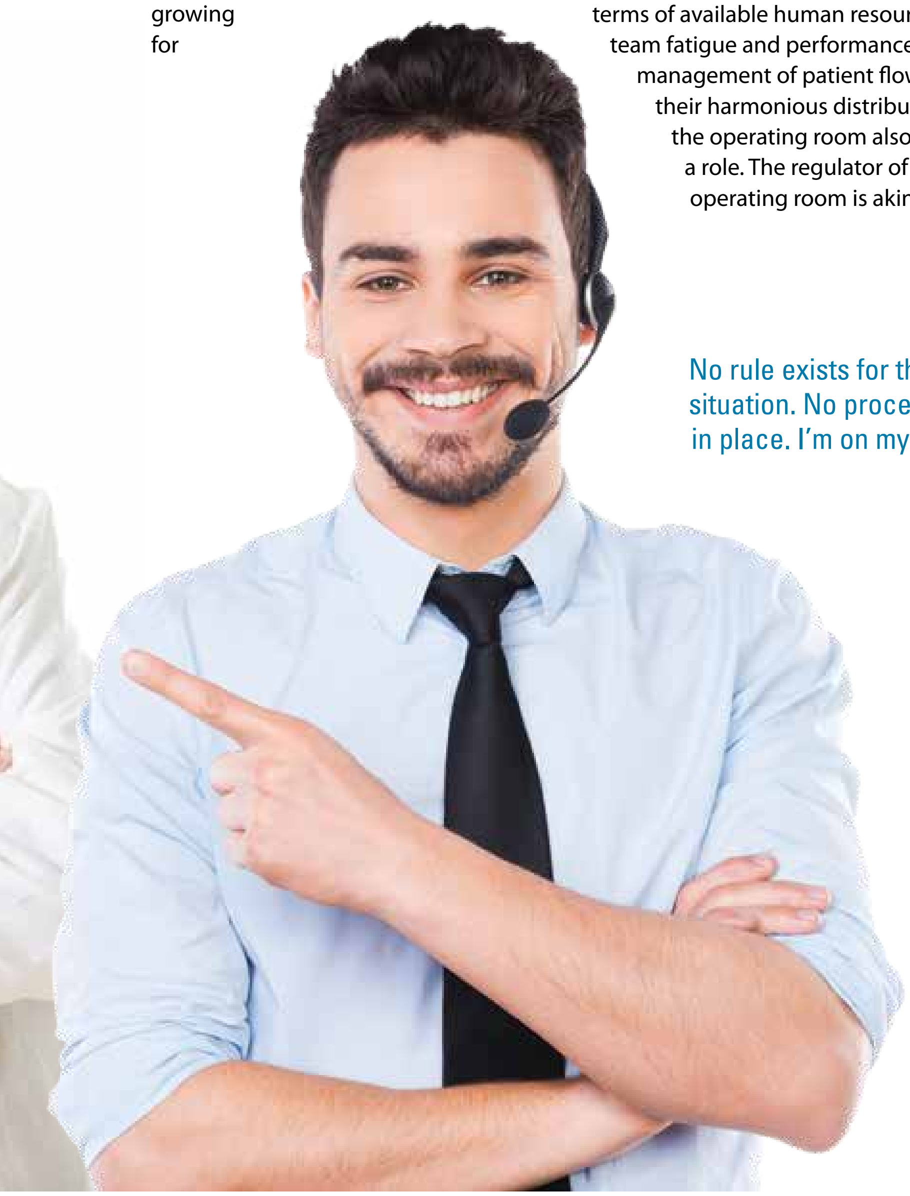
It's a typical day at this town hospital. Many patients are waiting for operations, and the surgical team is falling behind schedule. Patients are getting tired and unhappy, and pressure is growing for the operating team to try to keep up the pace. At one point, the team must take a difficult decision.

Should they carry out scheduled interventions during the on-call period (during the night), taking the risk of not being fully available for a vital emergency (team fatigue and operating room availability)? Or should they postpone the remaining scheduled interventions to be fully available for an emergency that may not occur during the night (leaving an unoccupied operating room unused, and facing dissatisfied patients who have been fasting all day)? Once again, whatever decision the team takes is not a satisfying one.

Often seen as a 'forced' compromise, the situation raises safety issues in terms of available human resources and team fatigue and performance. The management of patient flows and their harmonious distribution in the operating room also plays a role. The regulator of the operating room is akin to an air traffic controller having to have three aircraft take off with only one runway available. In this context, two elements to be considered in the compromise:

- the weight of the rules: the operating room code and recommendations of learned societies;
- the 'human', ethical, and medical arguments that introduce many considerations into the decision to proceed: the experience of a patient left fasting for hours on a stretcher (pain, suffering, anger, resignation), medical consequences related to cancellation (worsening of condition), delay in crucial treatment (e.g., chemotherapy), difficulty in rescheduling the surgical procedure, and more.

Resolving such trade-offs is not an easy task in the medical field. The 'no-go' is not as clear-cut as in other high-risk industries: not only because the consequences directly affect human life, but also due to the history of resilience, risk-taking and experimentation in healthcare. Indeed, the current state of medicine is a balancing act between trade-offs and the necessity to help everyone possible.



No rule exists for this situation. No procedure is in place. I'm on my own.

Back to the tower

Had the pilot declared a MAYDAY, no trade-off was possible: all traffic would have been stopped with landing priority. But with a PAN-PAN call, there are fifty shades of emergency. A tower manager is not a mechanic. His or her decisions are based on an understanding of the plane systems and whatever elements have been communicated. And determining the level of emergency for a PAN-PAN case is challenging.

Some hints may help handle the situation: pilot voice, rate of descent, trajectory, for example. Better radio communication will help the controller fully understand the situation: pilots should tell ATCOs what they need and what to expect (see Mieusset and Follet, 2018, *HindSight 27*). Also, brief instructions, encompassing information about the degree of seriousness and what to expect, should be developed.

▸▸

Trade-offs rely heavily on experience. Unless a controller has faced a hydraulic failure leading to a nose wheel steering problem, he or she may not imagine that such an incident can lead to a runway excursion or a blocked runway. However, since this situation happens regularly, every ATCO should have heard about it.

Luckily, I knew what could happen when an aircraft has a hydraulic problem. One of my co-workers shared his technical memos leftover from his military controller career with me. He even implemented them as a manager in a regional airport. So, with my knowledge, my personal experience, these memos, I decided to stop all the traffic when the PAN-PAN plane flew below FL80. I also asked airport services to be ready to perform a runway inspection in order to open the runway as quickly as possible. This decision was the least dissatisfying one in this case. Finally, the plane landed and taxied to its stand uneventfully. When all things were settled, we took time to discuss and share our experience with all the parties involved. I hope that this will help us to face the next trade-off with the same success.

Learning from trade-offs

Both examples are high-level trade-offs where safety is at stake, and perhaps show how we can and should learn from different industries. As operators, we are all eventually faced with such decisions, and there is no system dictating the right answer. You are surrounded by people with different priorities, so it is your responsibility to consider the pros and cons and make the final decision, unsatisfactory as it may be.

When there are two or more opposing choices, a trade-off involves reaching a compromise that influences the probability of an unwanted event occurring, or the consequences, or both. This will involve internal factors, such as personality, self-confidence, and feelings, as well as external factors such as rules, time available, and support. Your experience helps you to weigh these up and make the decision.

Such events show how important it is to share experience to learn how to act when facing trade-off decisions. There are two main ways of sharing experience. The first is direct conversation. This is efficient, and benefits from greater trust, but remains local. The second is large-scale exchange, at an organisational level. This is more global but less efficient, and suffers from lower trust. We need to be able to talk about trade-offs and share information, not only at a local level. So as a starting point, we have to acknowledge the reality of trade-offs.

A trade-off involves reaching a compromise that influences the probability of an unwanted event occurring, or the consequences, or both.

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François Jaulin is a mathematician and a physician in anesthesiology, intensive care and aerospace medicine. Co-founder and President of the French Human Factors initiative, Facteurs Humains en Santé (gifh.eu), he has been interested in human error in medicine for several years. He is a partner and co-founder of the first independent reporting platform in perioperative medicine, Anesthesia Safety Network. François also provides in situ medical simulation training with EmergenSim.

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Sébastien Follet has been working as an air traffic controller since 2002. In addition to his ATCO job, he is currently tower supervisor and HF facilitator in his ATC centre. Formerly, he has been instructor for controllers and in charge of various safety studies to implement new ATC equipment. He has a degree in Ergonomics & HF Basics from Paris Descartes University. This aviation enthusiast has been a private pilot since 2001.

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SAFETY SUPPORT FOR OPERATIONAL EFFICIENCY

Does safety always have to conflict with productivity goals? No, says **Maria Kovacova**, who describes how safety resources can also be used to support efficiency and overall system effectiveness.

In aviation organisations, safety specialists are not usually associated with improved capacity or efficiency. But safety does not always have to act against other goals. During my career in ATM safety, I have witnessed situations when safety practitioners, using safety tools and methods, have helped line management to balance operational performance and safety needs, sometimes optimising both goals at the same time.

One such situation concerned how to set the 'right' volume of traffic passing through sectors so that ATCOs can still safely manage and control the situation within their areas of responsibility. At the time of discussion, we were lucky; we had a few years of experience, and records from the EUROCONTROL automated safety monitoring tool (ASMT). This tool records different types of safety-related situations such as short term conflict alert (STCA) or pre-STCA. In the case of pre-STCA, where an ATCO solves a potential conflict, an STCA is not triggered.

At that time, the parameters of STCA were set as 5 NM (horizontal) and 90 seconds (triggering time parameter). The parameters for pre-STCA were set at 6 NM and 120 seconds. If one of these parameters were exceeded, the ATM system at the ATCO radar position generated a visual for pre-STCA and a visual and audio alarm for STCA. Safety experts identified during an internal safety audit that in some situations, the capacity of certain sectors was exceeded by 25%, and in some cases up to double the defined maximum capacity values (as set by EUROCONTROL).

Safety professionals and tools can be used to help ensure overall system effectiveness.

Figure 1: Number of movements and number of pre-STCA (illustrative data)

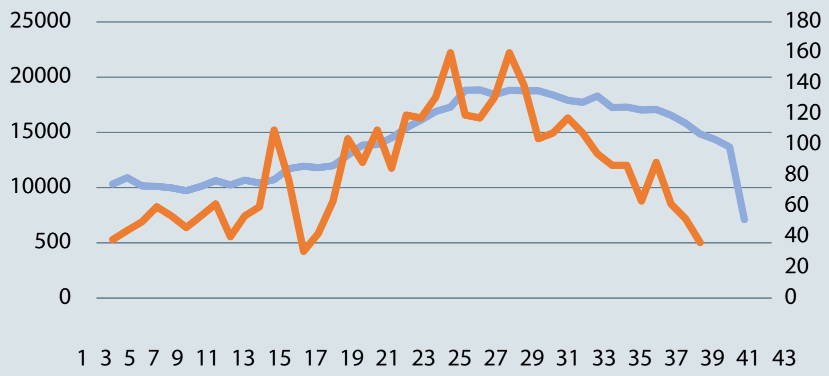
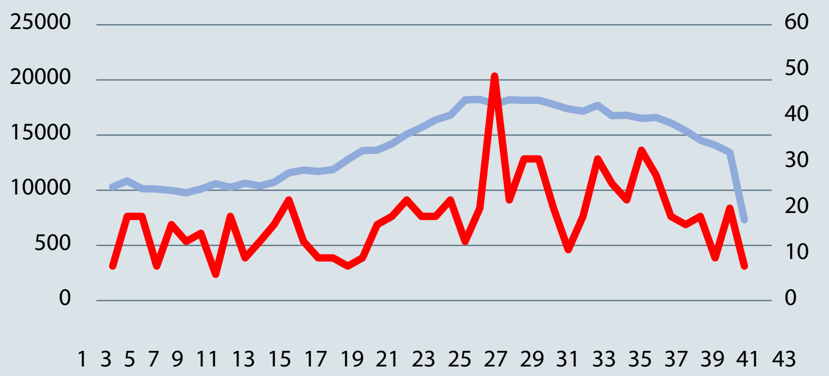


Figure 2: Number of movements and number of STCA (illustrative data)



This overload of capacity values caused the ATM system to trigger more pre-STCA warnings, which led to STCA warnings and in some cases to loss of separation minima.

During the audit interview, some ATCOs were complaining about workload and stress due to overload of the sectors, and some supervisors confirmed that demand for traffic was higher than set capacity values. Supervisors and ATCOs also confirmed that for some sectors, defined values were obsolete and needed to be updated as they were not reflecting operational good practices, procedures and needs.

Findings from the internal safety audit escalated into a tense discussion about a sensitive topic – sector capacity values. Naturally, managers want to have findings supported by facts and numbers, and not only based on the staff perceptions. So the safety unit decided to take out data from ASMT and tried to find the correlation between volume of traffic and numbers of triggered pre-STCA warnings, which continued into STCA warnings. Figures 1 and 2 show illustrative graphs, similar to those presented to management.

Each graph represents the volume of traffic per ACC and the number of generated pre-STCA and STCA warnings, covering a period one year. These numbers were also supported by safety analysis, which was an important input into the safety assessment of new capacity values and procedures for ACC. The change of capacity values was also supported by voluntary reports from operational personnel, and analysis of those reports. The investigation proved that in some cases the maximum capacity values per sector were exceeded by double. These inputs helped to improve the whole system used for flow management.

Based on these results, the top management opted for a new capacity study, conducted by EUROCONTROL. After discussions with supervisors and safety experts, it was found that procedures and capacity values defined in previous years were no longer relevant and couldn't meet traffic demand. It was found out that sectors had to be modified to distribute traffic in a more balanced way. A new approach to airspace design and sectorisation would help to prevent overload of certain complex sectors.

The capacity study showed that in some modified sectors the capacity value could be higher than had been set in the past. Sectors were redesigned and new procedures were developed, along with a new approach to traffic flow and sector management.

At the end of three years of discussions, analyses, assessments, and simulations, the company achieved a good result. We increased the volume of traffic managed within our airspace, and we also helped to ensure safety by the re-design of sectors, the introduction of new capacity values into CFMU, and new procedures for flow managers and supervisors.

The experience showed that safety and efficiency don't have to conflict. Safety professionals and tools can be used to help ensure overall system effectiveness.

Maria Kovacova is an aviation safety enthusiast actively contributing to safety areas such as just culture, safety management gap analysis and proposals for safety improvements. After her graduation in aviation engineering, she continued her mission to improve safety processes in air navigation services, supporting just culture within the Slovak Republic, providing training. She is currently at the University of Košice undertaking a doctorate in Just Culture.

SURVEILLANCE DATA PROCESSING TRADE-OFFS

Trade-offs are a defining feature of all forms of work, whether in operations or in system development and implementation. The trade-offs faced by others are not always clear to us. In this article, **Ceca Bunjevac** explains four trade-offs in support of air traffic controllers.

KEY POINTS

- **Optimising tracking systems involves a number of compromises and trade-offs in development.**
- **The size of the search space for aircraft position updates affect track accuracy.**
- **Multiple radars can increase the quality of position measurement, but only up to a limit.**
- **Different surveillance technologies bring many considerations and trade-offs for tracking.**
- **Nuisance alerts are invaluable diagnostic tool for tracker settings but they cause frustration for ATCOs.**

As a controller, having a short-term conflict alert (STCA) is invaluable. There is no need to see it in action to provide adequate separation between aircraft; just knowing that the safety net is there feels good. It is like an acrobat walking the rope in a circus, with a net stretched beneath the rope. The net is present, but the acrobat still needs to walk the rope. You are doing your job and if an unexpected problem arises, the system gives you a visual or an audio-visual alert.

Then at some point, you start noticing STCAs for aircraft that are not in conflict, and your frustration grows. Nuisance alarms start to affect trust, and loss of trust changes your practice (crying wolf syndrome). But the STCA reacts to the set of criteria given to it and it does this every single time the criteria are met. So the alarm is correct as per the system settings but it is 'false' as per the traffic situation – there is no need for the alert. Nuisance alerts are created between correct and false tracks and the word 'false' is appropriately used in this case.

Following around 15 years as an operational air traffic controller in Europe, along with operational supervisory and training roles, my first employment in EUROCONTROL was as a surveillance data processing and automated support tools specialist. I was part of a team working on the implementation of two automated operational systems. Bridging the worlds of operations and system implementation brings some of the trade-offs of tracking systems into focus, in a way that was never so clear to me as an operational controller. Here are four of those trade-offs.

The first trade-off: The search-space trade-off

An aircraft track is formed after a small number of consistent aircraft position indications (plots) have been registered. These can come from a single surveillance source or from various sources. A track is a calculation of a small space, which the tracker opens to search for the plot update.

If the space to search is too big, more than an original aircraft response could fall inside the search space. If the space is too small, the real-life position update could fall outside and slightly left, right, behind or in front of the search space.

Mathematically, it is very easy to enlarge the update search area or to calculate the future position of an aircraft as a

Figure 1: Position update search area

single dot in space. Both situations adversely affect the accuracy of the track and in both cases the above trade-offs have to be made.

The second trade-off: The multi-radar trade-off

Even if there are 10 radars covering the same specific portion of the airspace, the track quality will not increase in direct proportion to the number of measurements obtained. This is known as the law of diminishing returns.

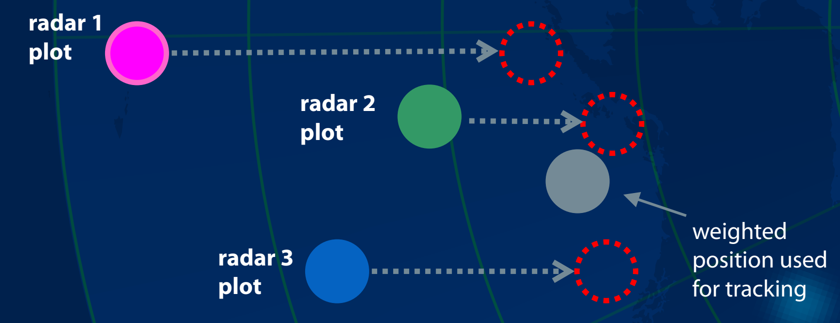
Using more than x number of radars to calculate a track costs a significant amount of processing power and time, without proportionally improving the track accuracy. The value of the x has to be carefully calculated and the trade-off must be made (processing time invested against accuracy improvement gained).

Trade-offs have to be made. The type of terrain to be covered (e.g., Switzerland, Malta or Italy, with corresponding topography), legacy systems, resources available, and the nature of surveillance required (civil, military, mixed, approach, etc.) must all be taken into the equation. We cannot create an environment free of nuisance-alarms. This is because we do not have tracking systems that are free of false tracks. Consider the following examples:

An aircraft that made a turn is shown to be in conflict with an aircraft on its previously registered path, which has not been updated to reflect the new path of this aircraft. This is a possible indication that the tracker response to military aircraft turn performance is delayed. This is a normal situation in civilian operations environment, but a possible problem in mixed-mode operations environment.

Bridging the worlds of operations and system implementation brings some of the trade-offs of tracking systems into focus, in a way that was never so clear to me as an operational controller.

Figure 2: Multi position update weighing



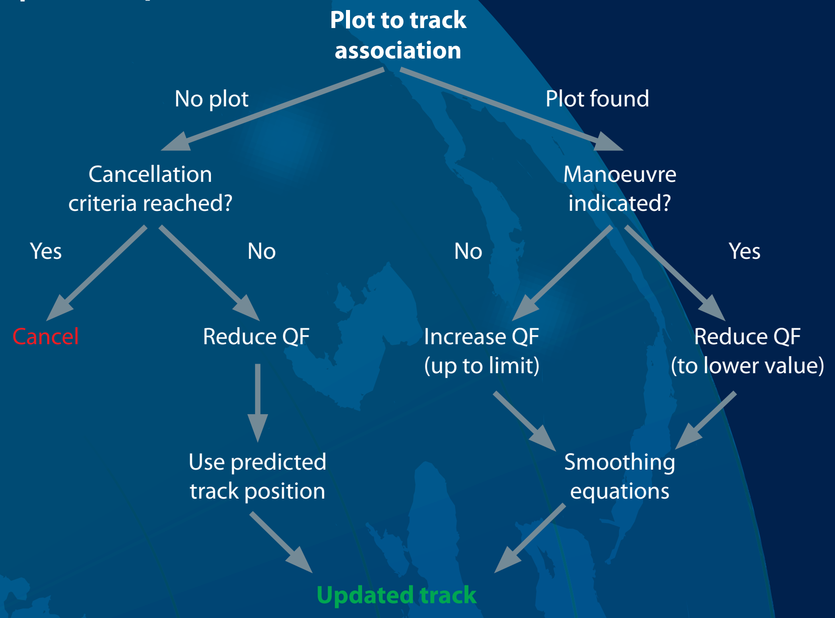
The third trade-off: The surveillance mix trade-off

We have ground-based radar surveillance (notably, primary and secondary), ground-based non-radar surveillance (multilateration), and air- or satellite-based surveillance (ADS-B). Only primary radars give us aircraft positions without the need for on-board cooperation. There is a significant difference in the purchase cost of different systems, and in the positioning requirements for the systems to work properly. Additionally, different surveillance systems contribute to different degrees of accuracy and with different amounts of processing needed to calculate a track.

Two aircraft that are 5 NM apart are in conflict even with 7000ft vertical distance. One (or both) aircraft is not transmitting Mode C information (vertical position). In this scenario, the system uses only horizontal proximity to indicate an alert, or does not alert at all. Alternatively, a system could alert and allow for manual inputs for vertical parameter alert triggers by the system user, or trigger no automatic alert but allow for manual inputs for vertical parameter alert triggers.

There is a conflict indicated between two different tracks, but you only have one aircraft. This is a possible result of reflections (e.g., the sea surrounding Malta or the snow covered surfaces in Switzerland). Adapting the tracker map of reflection prone areas where tracks should not be initialised might help.

Figure 3: QF – quality factor, trust in track forecast accuracy on previous cycle



How many nuisance alerts can be tolerated for the data processing system to be helpful, and at what number does it hinder operational staff?

The fourth trade-off: The nuisance alert trade-off

The three previous trade-offs are of a technical nature. They happen at every ATC unit with surveillance tracking systems. While nuisance alerts are a useful metric to improve tracking performance, how many nuisance alerts can be tolerated for the data processing system to be helpful, and at what number does it hinder operational staff?

If it was down to a numerical value, the equation would have been available by now, but the number does not exist in isolation. It depends on:

- the number of operations – in a sector with two aircraft, one nuisance alert is too many from the machine point of view but the controller might find it acceptable
- traffic complexity (including traffic mix and route layout)
- company operations (including sufficient staff and appropriately managed rostering), and individual stress and fatigue.

Conclusion

Surveillance data processing systems are not free of false tracks and the nuisance alerts are useful diagnostic metrics to keep improving system performance and reducing the number of false tracks. The issue remains though, that ATCOs already stressed by the traffic volume or the shift roster will be even more tested by possibly frequent nuisance alerts. Equally, given time to provide as details concerning nuisance alerts, ATCOs are a vital link to fine-tune the system parameters. This is only one example of how technology improvements are dependent on improving conditions for the people who use the technology.

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TO REGULATE, OR NOT TO REGULATE?

Regulating traffic is a trade-off decision that may involve a variety of complexities. **Anders Ellerstrand** recounts one such decision: to regulate, or not to regulate.

KEY POINTS

- **In a messy environment, goal conflicts are harder to understand and manage, and trade-offs often involve ambiguous alternatives.**
- **Getting extra resources is a good mitigation for many problems, but the request needs to be made in good time.**

Many years ago, one Saturday in October, I went to work to do an afternoon shift as a Watch Supervisor at the ATC Centre. I was to be the only supervisor there but expected a calm day at work. That day did not turn out as expected.

It is 14:20. I am in a bit early and, as the ATC centre supervisor, I send my colleague home from his morning shift. As I'm preparing for the afternoon briefing, one of the controllers points out that one colleague is on the roster, although he is sick. I am lucky to have an extra controller on the shift for the first few hours but after that, I will need to find a replacement. The missing colleague is also on the roster for Sunday morning, so I must find a replacement for tomorrow as well. Finding staff for a Saturday afternoon and a Sunday morning is never easy and to add to that, this is in a period where the union is in negotiations with our employer. I also must prepare for a dataset change coming the same night. That includes informing the Network Manager of a change of configuration and setting up traffic regulations, sending out information to surrounding flight information regions, and printing checklists.

Only 30 minutes after the briefing, sector 5 calls and tells me that the 'Probe' function is not working. There are no checklists or routines prepared for that kind of error, but my assessment is that it shouldn't affect the capacity of the sector. I get no system warning and assume it is a local problem, so I call the technical supervisor to discuss a restart of the MMI for the position that is handling sector 5.

Then I get a call from sector 8, saying that sector 9 needs to be opened. I do the arrangements but when sector 9 is open they also report that the probe function is not working. Soon after other sectors call in and I realise, the probe function is now out of service for all sectors. I also get a few other reports of strange system behaviour.

I am still trying to find a replacement for the missing controller and finally manage to find a controller who is now on his way. However, I still have a vacancy for the next day and keep on making my phone calls. I now get a call about the need to open sector 6.

I realise I am too busy and have not followed up on the 'occupancy' graphs presentation from CFMU. The controller says he had to handle too much traffic and decides to write an incident report. In the report is a complaint concerning the technical problems we're having: I should have regulated traffic to 50% of capacity. The controller is referring to another problem where we have a checklist, which includes a missing probe function, but also the medium-term conflict detection (MTCD). For that problem we regulate traffic to 50% of our capacity. My assessment is different, since the MTCD is working and I do not have any system alarm.

With traffic going down (it is a Saturday evening), and with my assessment that this is a minor system problem, I decide not to regulate traffic. One reason is that regulating traffic now will push traffic towards the night shift and produce new problems. I decide though to regulate traffic for the night, because of the coming new dataset to be implemented.

Still, I worry about the situation. The ATM system is not performing as normal and I'm still too busy. I need help and call a supervisor colleague. While waiting for him to arrive, I write an incident report on the failing probe function and I handle four other reports being filed; an error on technical transfer for a flight, the high load on sector 6, a missing conflict warning, and another one for conflicting call signs.

I realise I have to change my assessment of the situation and start preparing to regulate the traffic.

My colleague arrives. It is now two and a half hours since I started on the shift. Half an hour later there is an unexpected request to open sector W. The reason is high traffic volume in combination with the missing probe function, which according to the controllers is reducing their capacity. Now, all controllers of that rating group are in position. My newly arrived colleague has a valid rating in that group, so I let him work there instead of helping me out. I also file a report for having all controllers working with no-one in stand-by.

I realise I have to change my assessment of the situation and start preparing to regulate the traffic. The technical supervisor has been trying to solve the problem by rebooting one of the system servers in different ways. This must be timed to avoid reboots during traffic peaks. Another system expert has arrived and is saying we might get worse technical problems if we are not able to sort this out. Coordination is made with the neighbouring centre's Watch Supervisor and with other system experts. One of the issues is if the problems could affect the coming change of dataset on the same night.

Sectors are kept open and I ask one controller to stay on overtime while also having my supervisor colleague still working as a controller rather than supporting me. I finalise the change of configuration and regulations for the night shift.

Finally, the technical supervisor tries a reboot of our flight data processing system. This suddenly solves the problem! Five and a half hours after arriving to the shift we are back to normal operations.

A few incident reports were written during that shift and I was worried about being criticised for my decisions, which is why I made memory notes. This is what made it possible to write this story. Nothing too bad happened and I heard nothing about it afterwards. Still, I have looked back to that day many times and I also have my own hindsight bias, realising there could have been another outcome. I hope I learned something from it: don't wait to call for help when you need it. S

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No, we don't need flow control. The situation is normal.

CHANGING THE LANGUAGE OF SAFETY

Might the language of safety be holding us back? **Tom Lintner** explains why we need to shift from 'Safety is our Number 1 Priority', and instead talk more about risk.

Maybe we need to be honest among ourselves about our priorities and how we talk about safety.

Several years ago, at a major aviation safety conference in Europe, I made the statement, "Aviation is the safest way to travel". A hand from the audience immediately shot into the air. I was intrigued, especially since the hand belonged to a senior safety official from a European air navigation service provider. I asked if he had a comment. His answer was at first puzzling, but also insightful.

Paraphrasing his comments, he said, *"I disagree that air travel is safe. Just look at what we're doing. We take an aluminum tube, 5mm thick, stuff people inside, fill it with fuel, pressurise the contents, then light fires on the wings and take it five miles into the air where you need life support to live. And we call that safe? I think the only reason we're able to do this is we do a great job managing the risk of something that is dangerous."*

My initial reaction – fortunately left unspoken – was this was the nuttiest thing I ever heard, until I actually thought about it. While aviation is statistically the safest mode of travel for passengers, it is not risk-free, nor without costs when we lose control of risk. If you look at employee injuries, aviation ranks somewhere near mining as an industry. If you look at ground damage to aircraft (not associated with flight operations), there's reportedly something in the area of USD $6B in yearly costs industry wide.

And hyperbole aside, there may be something more to this, especially when we explore the human reaction to the word "safe" and how that might have limited how well we manage a risky operation.

If we examine the word, we see "safe" and "safety" is used in a way that limits discussion about an issue. "Safety is our Number 1 Priority!" "Safety was never jeopardized." Such declarations make it difficult to talk about safety in a sensible way, and perhaps make it difficult for people to say, "I think we're doing something unsafe here", without fear of how their feedback will be accepted.

So maybe we need to be honest among ourselves about our priorities and how we talk about safety. Perhaps we need to modify our language to better support our safety efforts by changing emphasis to something we can all see and understand better – hazards and risk.

I will occasionally ask an audience, "Is safety the most important thing within your organisation?" Nowadays, I can expect only about 50% of the group to say yes, while 10-years ago the percentage was much higher. I then ask, "If your organisation is not efficient and does not survive, do you think anyone will care how safe you used to be?" This is generally met with uncomfortable silence as we ponder a different perspective. That view may be one whereby an organisation needs to be as efficient (profitable) as possible while controlling risks and maintaining the highest level of safety to support the operation. Reaching and maintaining that level of safety is achieved by the proactive identification and management of hazards and threats before they become incidents and accidents.

There needs to be an acceptance that things can go wrong, and denial of that can be the greatest risk of all. But to reduce the likelihood of causing harm, an organisation must be able to identify, analyse, and discuss risks, and manage those risks so that they are as low as reasonably practicable. To do that, an organisation must first accept that:

1. What they are doing is, by its very nature, fraught with some risk of harm. Nothing we do is totally without risk and therefore nothing is totally safe.
2. Past success is no guarantee of future success. The statement, "It never happened here" may in fact mean you have just been incredibly lucky.
3. Humans represent both positive and negative contributions to the risk equation. We contribute to ensuring that things usually go well, and intervene when we detect that things may go wrong. But by our very nature, we make mistakes and we contribute to things occasionally going wrong. But very few people come to work planning on causing harm.
4. Identifying a 'single point of failure', whether it is human, mechanical, or procedural, may be a noble goal, but in today's world of complex systems, it's rarely a comprehensive or realistic solution to mitigating risk.
5. To manage risk, an organisation must know what the hazards are and accept that hazards, and the associated risks, can change on a short- and long-term basis. To identify and understand those changes requires open information exchange and reporting within the organisation.

A change in language may make us more open and less defensive when discussing conditions and events, and how to manage them openly and proactively.

A related challenge is how to get a clearer idea about the overall level of risk. I recall a meeting with an airline CEO who said, with some humour, "My Chief Financial Officer shows me one PowerPoint slide and I know exactly how we're performing. My Head of Safety gives me 80 slides and I'm still not sure what it means." S

Tom Lintner has over 47 years of experience in ATC, aircraft command and operations, airline dispatch, and flight and ATC training. He retired from the FAA with 30 years of high-level government experience at ATC facilities and Washington Headquarters; accident and incident investigations and litigation; ATC procedure development; air traffic management and flow control; aviation security, emergency operations, and military operations. He is President and CEO of The Aloft Group.

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There needs to be an acceptance that things can go wrong, and denial of that can be the greatest risk of all.

SAFETY MANAGEMENT Q&A

Francis Bezzina is Senior Head of Safety, Quality and Security at Malta Air Traffic Services.

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1. What is the most safety-significant change facing your organisation at the moment?

We are concluding the last phases of a new ATM system project – a project that took more than five years to conclude. The new ATM system has been in operation for almost two years. The final milestone is a standby backup system and a fallback system to assure continuation of service. The old ATM system served as a backup in case of a catastrophic system failure until the new contingency setup was installed. This is now decommissioned. This project presented big safety challenges because we performed the change without an additional full capability operations room. We had to deliver ATC services from a makeshift temporary operations room while the old system was dismantled and the new system installed. Naturally, this work had to be done without lowering the current safety levels of MATS ATCC operations.

2. Why is this change necessary? What is the opportunity or need?

The old system was rapidly approaching its end of life. Hardware was almost obsolete, and support from the manufacturer was barely available. From operational, efficiency and safety points of view, we were running out of options. The old system was also not able to handle the ICAO Fight Plan 2012, requiring a new flight data processing system. Short term conflict alert, area proximity warning (APW) and minimum safe altitude warning were already available in the old system, but we now also needed the approach path monitor (APM) safety net.

We also introduced the medium term conflict detection (MTCD) as a new ATCO tool. The intention of introducing the MTCD is to assist the ATCO in providing a more predictive ATC service. This would improve the tactical aspect of planning and provide early conflict detection with a lookahead time of 20 minutes, thus enhancing efficiency and at the same time reducing sector workload. For the new safety nets and the MTCD, we were supported by experts from EUROCONTROL. This was a necessary change and an opportunity to introduce new tools, including moving completely to a stripless system.

3. Briefly, how is safety assured for the change?

This was one of the biggest headaches of the project and assuring safety of this big project was the responsibility of the MATS Safety Section in collaboration with the Operational and Technical sections. One of the most important decisions taken at the safety planning stage related to a clause in the contract with the winning bidder for the ATM system. This required the manufacturer to provide the architecture safety case (hardware and software), in addition to all the standard regulatory requirements. ANSPs, especially small ones, lack the resources to do such complicated safety analysis from an engineering point of view.

The MATS safety process was extensive. It was initiated by a mind map covering the scope of the implementation, followed by an exercise supported by EUROCONTROL, to identify the most critical areas, complemented by a detailed safety plan. The six-year road map included more than 45 safety assessment meetings, process review meetings, surveys, audits, inspections, checklists and post mortems on the activities conducted, covering all elements of the system. We deployed working groups composed of experienced ATCOs and ATSEPs for all areas of the system. We started with the worst-case scenarios for the initial assessments to abide by regulatory requirements. We then tried to ensure the system was well protected before presenting the change for the safety assessment. We also conducted audits at the manufacturer against ISO 9000 requirements to ensure that what was promised was being delivered.

4. What are the main obstacles facing this change?

The main obstacle that we experienced was the control and management of contractors, especially where software updates and bug-fixing was involved. We controlled this activity with a set of procedures agreed and supported by the manufacturer. The other big obstacle was the new HMI incorporating new tools like MTCD and safety nets, e.g., APW. We expected some resistance due to the big technological change from users with different backgrounds and diverse age groups, even though working groups were involved all the way. The final obstacle was training on the high-fidelity simulator because issues cropped up when we moved to live traffic. Simulations are necessary and help a lot, but once you go live, what was good for the simulations sometimes presented difficulties with live traffic.

5. What is the role of front-line practitioners? How is their expertise incorporated into change management?

Involve those who tackle daily situations that crop up from an operational and engineering perspective; the people who work 24/7 with the system. Add to that safety specialists and good moderators/facilitators, and safety will be served with excellence. If the safety processes are done without appropriate frontline involvement, you end up with a paper exercise, maybe weak in important realities of the service delivery.

6. What do they think about the change?

This was the first experience of a change management process of such a magnitude and of such complexity. Our experience was limited to smaller projects, but thanks to all sections of the organisation, we made it work. Without leaving out anyone, I have to say that the whole safety process was conducted internally and supported by all sections. It was a big achievement because the entire team from all levels worked together diligently.

7. How can front-line practitioners get involved in safety management to best support operational safety?

We use front-line practitioners on a part-time basis in all safety management areas. They perform the roles of investigators, risk assessors, auditors, surveyors and other safety-related activities as necessary. They are all trained in their SMS roles in line with the safety section training and competence requirements. To sum it up, the engine of our safety management system is the practical set up, its documentation and the support from all levels of the organisation. Its lubrication comes from the front-line practitioners, who work for the safety of our organisation. The MATS SMS setup is based on the principle that things work best if they are kept simple rather than complex. For us at least, this setup is delivering.

TO GO, OR NOT TO GO?

Trade-off decisions are subject to pressures, including commercial considerations. And not everyone may agree with your decision, either at the time or with the benefit of hindsight. In this experience report, **Captain Paul Reuter** describes one such decision: to depart, or cancel a flight.

London City Airport, December 23rd

All over Europe, weather disruptions due to snow have made a mess of the days' schedules for many airlines. Snow had closed, at any one point, one or several runways of most major airports. In London, meanwhile, the weather has been quite good, with no precipitation and just a little wind.

While we had to deal with quite some disruptions on the previous rotation, the general mood in the crew is good. The co-pilot, while a very competent person, was known for being quite rigid and inflexible in situations that upset the planned order of things.

We managed to operate to LCY with a couple of hours of delay, but with many flights cancelled and passengers stranded, things were quite a mess.

Having arrived late, we might leave dangerously close to the airport's curfew, with an outbound slot that gives us only 10 minutes to spare.

As some of our airline's flights have been cancelled throughout the day, we are hopelessly overbooked.

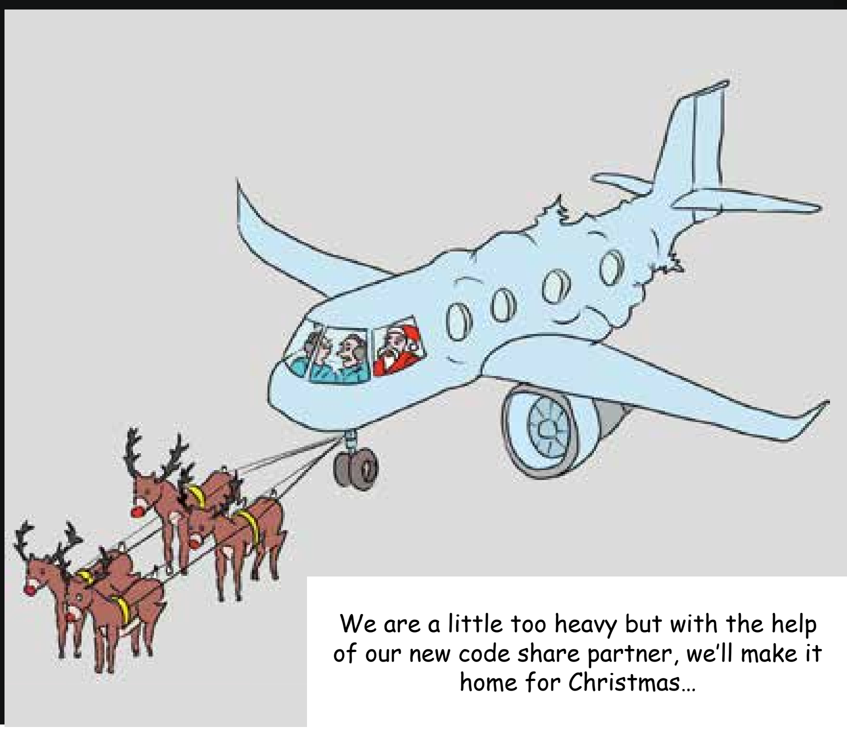
While the wind would favour a westerly departure, coming roughly from the north-west, this would limit our passenger load quite dramatically due to obstacles in that departure sector. So we opt for a departure to the east, albeit with a limiting tailwind, at full take-off power, in order to take the maximum of passengers back home, on this day before Christmas Eve.

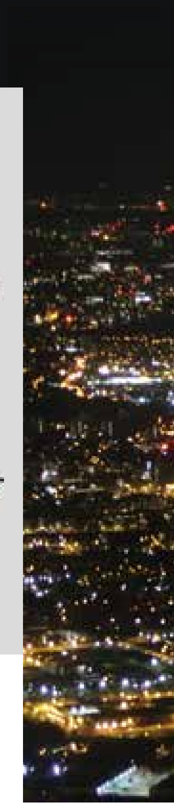
With our departure time approaching (and with it the curfew that would potentially strand the passengers, ourselves and the aircraft), we are constantly updating our performance calculations as the wind shifted in our favour, in order to take a maximum number of passengers.

Finally starting the engines with fewer than 10 minutes to spare on the curfew, we taxi out, all the while keeping an eye on the shifting winds. At the holding point, we do a last performance calculation on the EFB, using the wind given to the previous departing aircraft: we are just at the maximum tailwind limit for our weight.

I am acutely aware that, while we are next to depart, the wind is picking up and shifting unfavourably. I also know that my crew mate might not look favourably on accepting a take-off clearance if the wind is even a little out of limits. We line up, get take-off clearance, along with a wind reading that is at least a knot or two over our tailwind limit. Without further ado, I call, "Take off, your controls" and set take-off power.

> These are the normal trade-offs of our profession and we need embrace the fact that they are neither black nor white, and are 'left to the judgement of the Commander', but perhaps as long as the outcome is positive.





I sense my co-pilot is not happy, but now is not the time for an argument. Take-off roll and climb-out is uneventful as is the climb to cruising level, though the atmosphere has chilled somewhat in the cockpit. I broach the subject during cruise and indeed, my crew mate is not happy at all, firmly stating his belief that we were out of limits to start the take-off roll.

My line of thought was quite straight forward: Yes, reported tailwinds might have been a knot or two out of limits but, with the buffers built into performance calculations, we were safe.

Not taking off, recalculating and asking for a runway change, close to curfew, would have meant that the flight would have been cancelled as we would have had to disembark quite a number of passengers in order to be able to use the opposite runway. All 70+ occupants of our aircraft would have had to arrange for hotels. The aircraft would have stayed in LCY, disrupting the next day's (Christmas Eve) schedule.

I knew that no matter what my decision, my company would not have questioned me cancelling the flight at that moment, and no pressure would have come my way. My decision and the pressure I felt, I put on myself, because as captain, as long as I believe my actions to be safe, I will do my utmost to complete my mission and bring the aircraft and passengers home. Also, this being the day before Christmas Eve and having many people on board visiting family, grandchildren and friends for the holidays played a role in my decision to go. Having assured myself that there was no safety risk involved, I was absolutely willing to shoulder that decision and I debriefed the flight with the safety office the next day.

This event illustrates, I believe, the many decisions that pilots – and probably also controllers – need to take routinely. Such decisions fall into a grey area where the implications may well be questioned later.

These are the normal trade-offs of our profession and we need embrace the fact that they are neither black nor white, and are 'left to the judgement of the Commander', but perhaps as long as the outcome is positive.

I know that my decision that day is open to being questioned by some. In the same position, some might have done the same thing, while others might have simply cancelled the flight. In hindsight, while I still stand behind my decision to go, I would do a number of things differently, chief among those being more proactive in discussing our options and stating my intent and the reason for it earlier.

Paul Reuter is a Captain Boeing 737NG for Luxair, and President of the European Pilot Peer Support Initiative. He is a former president of Luxembourg's Airline Pilot Association, former Technical Director of the European Cockpit Association, and former Chairman of ECA's Safety Strategy Task Force. Paul is an IFALPA Accredited Accident Investigator.

SAFETY FIRST! OR NOT?

We often hear the slogan, 'safety first'. But what does this mean in practice? **Captain Wolfgang Starke** considers the question from a pilot's perspective, finding that time and cost pressure make trade-offs riskier.

KEY POINTS

- **Pressures of time and costs can lead to a shift in priorities and greater acceptance of risk.**
- **Significant reductions in safety may not be apparent from single assessments of operational risk, but a reduction of flight safety may be more obvious from a combination of changes to practice.**
- **There is an urgent need to resist and address production pressures, and focus more on safety.**

It is a long-standing term in aviation. Most airlines promulgate "safety first". But does this really still reflect reality? With increasing costs, high compensation fees in case of delays, tightened rosters, staff shortage, and everlasting slots all around Europe it somehow seems that the race for number one priority is up.

Landing with tailwind

During a routine day, a crew of a domestic flight was approaching their destination. Weather was quite welcoming, but some variable winds were prevailing. Despite a significant tailwind, the crew elected to continue the approach into their destination airport. Following a runway excursion during landing, the final report listed, despite others, time pressure as one of the causal factors.

Nowadays, we still see numerous runway excursions during landing, often overruns as a result of tailwind landings on wet runways. Pilots and controllers know this risk quite well. Still, controllers offer these options to pilots – intending to do the pilots a favour – and pilots request these riskier approaches and landings.

So we should ask ourselves, why? Often, pressures of time and costs influence these runway excursions. The airlines, of course, never educate their pilots to take unnecessary risks. However, pilots understand the results of delays, cancellations and high fuel costs. This

knowledge of economic considerations can, especially in a situation of tough competition between airlines, lead to a shift in priorities.

The safest way to land and take-off is into the wind. ICAO has stated conditions for selection of the runway in use in document 4444 PANS-ATM. With regard to tailwind, it is written that environmental factors like noise abatement should not be the determining factor if the tailwind exceeds five knots.

Let's look at reality. Despite the known risks of operation in tailwind conditions, an increasing number of airports are operating with noise preferential runway configurations. As the 5 knots maximum tailwind is a limiting factor, there have been numerous discussions within ICAO panels to increase the maximum allowed tailwind component for these operations up to 7 or even 10 knots.

This does not mean necessarily that aircraft will overrun the runway. Still, 10 knots of tailwind compared to 10 knots of headwind – using the other direction of the runway – means a total of 20 knots increase in ground speed upon landing. Also, the likelihood of a longer flare will increase with increasing tailwinds. All of this increases the chances of overrunning the end of the runway. Noise restrictions, like forbidding the use of reverse thrust, add further complications.

Irrespective of the winds, there is another step that is taken at many airports to reduce noise. The glide path of the ILS is in some places increased from 3 degrees to 3.2 degrees. Aircraft are now approaching a little steeper, which theoretically reduces noise by a couple of decibels.

Every single step seems manageable, and so it is in many cases.

But how might these add up? A steeper and faster approach that increases the chances of unstable approaches. A tailwind on the ground of 10 knots, which means the tailwind at 3000 feet above ground will be around 20 knots. Perhaps the runway is a little wet and reverse thrust is forbidden for noise reduction reasons. Are we still looking at a safe approach?

Each step, each assessment, will not show a significant reduction in safety. But if you combine all the small steps, all the different assessments, and make a large-scale safety assessment, the reduction of flight safety, the trade-off between safety and other goals will manifest quite clearly.

▸▸

Despite the known risks of operation in tailwind conditions, an increasing number of airports are operating with noise preferential runway configurations.

The brake fault

I was once approaching a small regional airport with an Embraer 190 jet. During gear extension my Embraer came up with a 'brake fault' indication. We went around and worked through the related checklists. From the checklists, the landing seemed uneventful and so it was later on.

My first thought was to stay at that airport and see maintenance. Still after consultation with our maintenance office we did some ground checks and decided to return to our hub.

> Pilots understand the results of delays, cancellations and high fuel costs. This knowledge of economic considerations can, especially in a situation of tough competition between airlines, lead to a shift in priorities.

During approach to our hub, the fault came up again. Upon landing the efficiency of our brake was heavily reduced making the landing very interesting. Luckily, nothing happened and we ended up safely at the stand. But why did we return to the hub instead of calling maintenance staff at the airport?

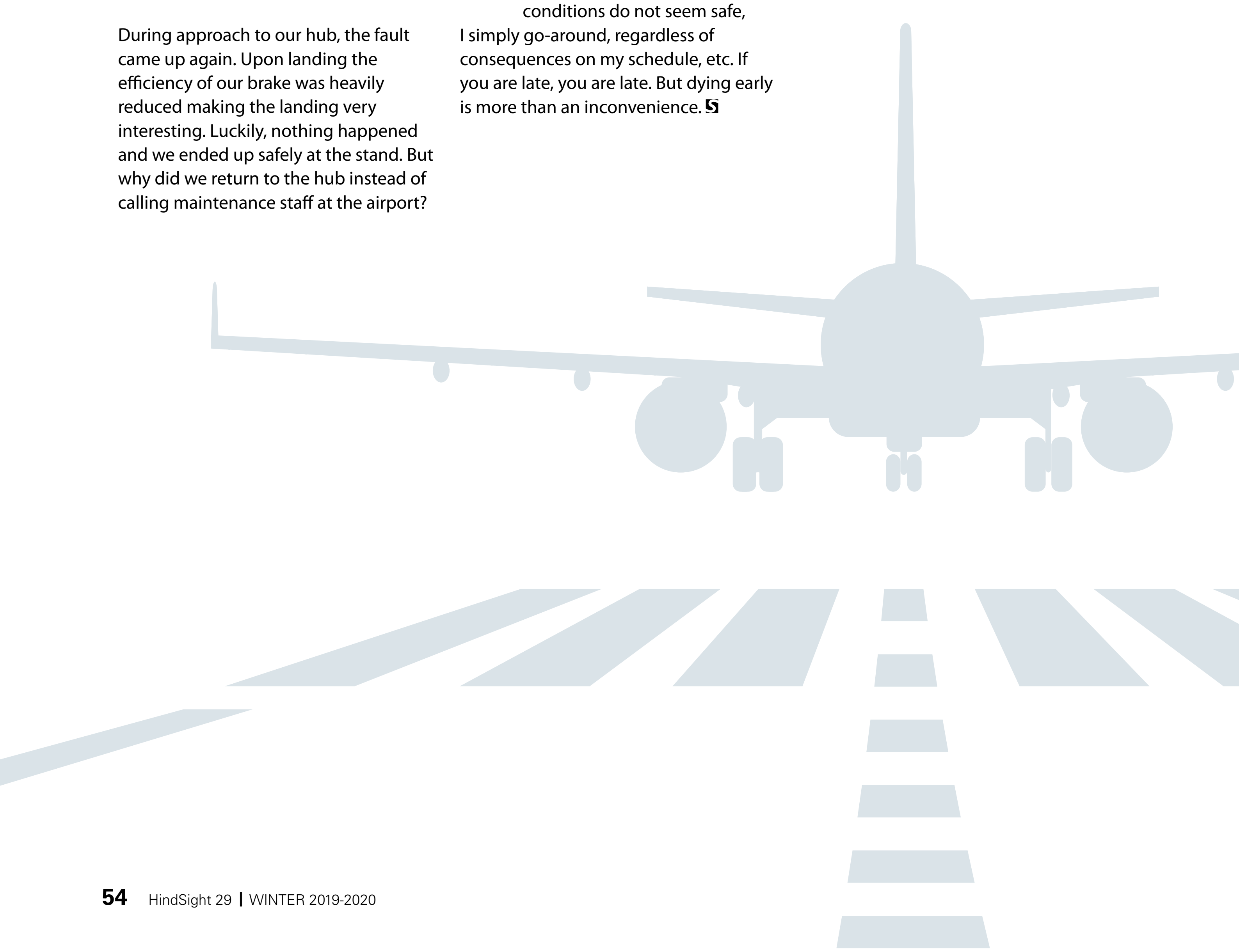
Calling maintenance to the small regional airport would have probably taken a day. The return flight and two other flights would have needed to be cancelled. This, as a consequence of a 'manageable' problem, seemed a little too drastic to my colleague and me.

If the primary goal had been 'safety first', then, of course, we should have accepted all the inconvenience and operational consequences for the airline. We always shift priorities in aviation, which is part of our job. These priorities are cost-effectiveness, on-time performance, safety, passenger comfort, and environmental footprint.

In times of increasing competition between airlines and less favourable market conditions, there is an urgent need to focus more on safety.

I have become more cautious when in flight deck. If the conditions do not seem safe, I simply go-around, regardless of consequences on my schedule, etc. If you are late, you are late. But dying early is more than an inconvenience.

Wolfgang Starke is a Bombardier Dash8-Q400 type-rating examiner. He has recent experience on Boeing 737 and Embraer 190 flying with a regional German airline. He serves various technical committees within German Pilots' Association (Vereinigung Cockpit) and the International Federation of Pilots' Associations (IFALPA). He is a pilot representative to ICAO in the ICAO surveillance panel.



UNDER PRESSURE: THE SELF-INDUCED STRESS OF A HEMS PILOT

Helicopter emergency medical service pilots face unique risks and trade-offs, balancing goals concerning crew safety with the safety of those being rescued. In this article, **Captain Owen McTeggart** describes some of the pressures and dilemmas that affect him and his colleagues.

I've been a helicopter emergency medical service (HEMS) pilot based in Cumbria, UK, for the past seven years, and each day comes with its own set of challenges. Contrary to what you might think, we experience a quieter time during the winter, as most of the 15 million annual visitors to the English Lake District come during the summer months. Throughout this period, we're dealing with novice walkers, climbers, paragliders and others who sometimes find themselves in remote locations needing urgent medical help.

While our general work is slightly different to that of a commercial airline pilot, our training is equally as intensive and diverse. For example, all our pilots are trained and tested IFR, as per commercial pilots, but most HEMS pilots will have previous mountain flying experience of how to navigate and land in such terrain. But, being charity funded, we don't get as much training in this environment as we would like.

We also experience some issues in common with those in commercial aviation, such as fatigue. However, one specific issue that crops up is the self-induced pressure we can put ourselves under. Knowing that the choices we make can be the difference between life and death brings with it an enormous weight of responsibility. The general awareness of this pressure within our community is very good. There is no point rushing to the aircraft without taking into account our own safety, the weather, the best route, how close we can get and how serious the injury is.

> Knowing that the choices we make can be the difference between life and death brings with it an enormous weight of responsibility.

We discuss this as a crew and make a plan. If there is a serious injury in a difficult location, we may accept increased risk while maintaining the safety of the crew, aircraft and other users of the hills and mountains. However, if the injury is not an immediate threat to life, we will offload some risk by landing further away, with the doctor and paramedic walking to the patient.

Risk factors

We are also aware of how certain factors can play a part in our involvement in the job. We have a good crew resource management (CRM) programme in place, which means should any crew member believe that the task doesn't justify the risk, the task will be discontinued. For example, the doctor has a greater understanding of the medical reasons for the task and is best placed to advise whether or not the sortie is worth the increased risk of a low-flying HEMS mission in strong winds.

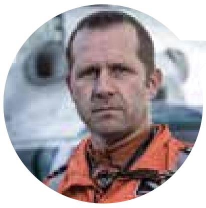
Self-induced pressure can come from all the crew, but for different reasons. For example, if a crew member has a young family and the task is to a child, the perception of risk versus need can be skewed by the thought of "what if it were my child?". This is where UK CAA/EASA regulations come in, to protect us from ourselves.

Commercial aviation comes with commercial pressures to complete the sortie, HEMS comes with emotional pressures to get the job done.

Commercial aviation comes with commercial pressures to complete the sortie, HEMS comes with emotional pressures to get the job done. Good CRM training and self/crew discipline stops us taking undue risk for those heart-string pulling tasks. There are countless anecdotal tails of HEMS crews busting a gut to get to that life or death task, only for the patient to walk to the aircraft with an overnight bag packed. Being part of a HEMS operation brings other stresses as well, such as the fact that we're charity-based and, therefore, there isn't always operational joined up thinking between neighbouring charities, or National Health Service (NHS) Trusts and the local air ambulance charity. But this is constantly being worked on, so the most appropriate aircraft is sent to the task, even if it is in the neighbouring charity's or NHS Trust's area.

We share some other dangers with the commercial aviation sector, too – drones and lasers have become an increasing risk. The last thing we need is a laser attack on the way to the hospital. Add this to the long-standing mid-air collision risks with general aviation aircraft, and some days can bring with them a lot of different stressful factors. I have a growing concern over the lengthy and difficult process of reporting, and wonder if AIRPROX safety report figures are lower than we see in reality, as a result.

However, being a HEMS pilot can be incredibly rewarding. The self-induced stress does reduce with time and experience, but it's important we maintain good CRM and continue to evaluate each situation as it arises.



Captain Owen McTeggart is a HEMS pilot and British Airline Pilots Association member. He has been a helicopter pilot since 1996.

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MANAGING GOAL CONFLICTS IN FLIGHT OPERATIONS

Not only do we each have to balance multiple goals, our goals can be in conflict with others' goals. **Captain Brian Legge** explains how we might not always realise how our goals diverge, nor the risks involved, but that we need to take time to understand each others' perspectives.

KEY POINTS

- **Goal conflicts are not limited to an internal pursuit of multiple goals simultaneously. Different people operating within the same system can view conflicts differently from inside their own operational reality.**
- **If not managed successfully, goal conflicts between actors can create a tug-of-war as different groups work to satisfy their own demands.**
- **To solve problems effectively, we need information, expertise that includes a systematic way of making decisions, and time to complete the process.**
- **It is impossible to maximise efficiency and thoroughness at the same time. However, we operate on a continuum that allows us to shift from one end of the spectrum to the other. Our movement from efficiency to thoroughness should not be driven by time or available resources alone, but also our assessment of risk.**

Nothing that a bit of oil or duct tape can't fix!

"*Is that fuel pouring out the bottom of our airplane?!*", the First Officer asked. I remember my heart sinking as I rounded the corner and saw fluid flooding out from nearly every vent and opening in the bottom of our shiny new jet.

Airline pilots, like air traffic controllers, make thousands of decisions in the course of their workday. Most of these are mundane or easy to resolve because they require previously acquired knowledge and expertise, recall of common experiences, or else the trade-offs are inconsequential. Nevertheless, to make these and many of the more challenging decisions we are faced with, people need the same thing: data. Data not only provides the contextual cues we need to interpret situations but also contains the technical knowledge, policies, procedures, and other resources needed to resolve conflicts. The work of airline pilots has changed significantly over the last 30 years. Whereas our biggest challenge was once the limited access to accurate, reliable data (such as weather, NOTAMs, aircraft status information, and company policies) the most frequent shortcoming now is the time we have available to make sense of it all.

For long-haul pilots and cabin crews, the efficiency-thoroughness trade-off (ETTO), as characterized by Erik Hollnagel, is particularly problematic. Aircrews are expected to be efficient processors of information; after all, on-time performance is a metric that drives passenger satisfaction, a key goal of airline management performance.

▸▸

However, we are also expected to be thorough, as the safety of our system often depends on our ability to proactively detect and mitigate problems either within the data or our operating environment. As a result, there will always be pressure, either experienced directly, or as a byproduct of contradictory messages received from managers who oversee the system. The message is to be efficient, but if something goes wrong that message can shift to one that blames crews for not being thorough enough. Psychologist Dietrich Dörner remarked, "Contradictory goals are the rule, not the exception, in complex situations."

Whereas our biggest challenge was once the limited access to accurate, reliable data, the most frequent shortcoming now is the time we have available to make sense of it all.

To illustrate the ETTO concept, consider a flight from Toronto to Hong Kong. On the flight today, pilots must review a 17-page flight plan, eight pages of weather information, and 104 pages of NOTAMs! In his investigation of an Air Canada flight that nearly landed on a taxiway in San Francisco, NTSB Chairman Robert Sumalt expressed his frustration with the process, referring to NOTAMs as "just a pile of garbage that nobody pays attention to." But pilots are expected to pay attention to, and make meaning of, these data, as there might be an important piece of information buried deep within.

The amount of time allocated to this task varies but averages only 10-15 minutes before crews need to move on to the flight preparation phase. In addition to this, the flight duty clock starts once the crew arrives at dispatch or the aircraft. On a long-haul flight that approaches 16 hours, there is typically less than one hour of 'fat' available for contingencies. There is an opportunity to extend the crew duty period, known as Commander's Discretion, but the risks of increased fatigue and future demands of the flight must be considered. These are the constraints of a 'normal flight', before any mechanical or passenger management problems surface.

Returning to our leaky aircraft, we were scheduled to operate the flight from Toronto to Hong Kong in the evening. The aircraft had arrived less than two hours prior to the start of our duty. The mechanic approached us straight away and told us what happened. Here is how the conversation unfolded:

Mechanic: "*Prior to landing in Toronto, a pipe connecting the potable water tank to the aircraft galleys and lavatories burst. But you don't have to worry. We've already repaired it, so you won't be delayed.*"

Me: "*What about the water?*"

Mechanic: "*The water tank has already been refilled and confirmed to be free of leaks.*"

Me: "*Not that water, I'm referring to the water that was pouring out the bottom of our aircraft.*"

Mechanic: "*Oh, I can't fix that, I'm afraid. Once you get back to Hong Kong they will deal with the mess.*"

As a crew, we were conflicted. The mechanic said the aircraft was safe to fly yet his response did not instill confidence and we still had many unanswered questions! How much water was still pooled at the bottom of the aircraft? We were already near maximum takeoff weight, would the extra weight from any additional water invalidate our takeoff performance? Where did the water go and what damage could it have done? Did it reach the Main Equipment Center (MEC), which houses the 'brains' of the aircraft where most of the electronic components are supported? What impact would the pooled water have if it were pooling up against the outermost layer or skin of the aircraft?

The most valuable lesson I learned from this experience was the need to take the time to understand and empathise with the challenges faced by other stakeholders in the same system.

It was at this moment I realised that our goals had diverged. It's not that the mechanic was unconcerned with our safety. Rather, he didn't appreciate the risks that his decision, which favoured efficiency, exposed us to. We didn't realise it at the time, but the mechanic had other conflicting goals as well. There was another aircraft arriving in less than an hour that needed his services and our parking bay. Moreover, he had only one apprentice to assist him and limited resources to complete the task, which should have included pumps, fans, dehumidifiers, and a large supply of towels. The design of the aircraft also made it difficult to determine the extent of the damage as the metal walls of the cargo area have a thick insulation lining to assist the heating system to regulate temperatures, as we operate in temperatures in below -50° Celsius at altitude.

Water did not reach any electrical components but a squishy walkthrough of the cargo area told us the insulation and areas around the metal skin were saturated. Water had pooled up against the outer skin layer under the insulation meaning it would be exposed to very cold temperatures as we transit through the polar region to reach our destination; as water freezes it expands and can damage surrounding structures. Unfortunately, the risk was lost on our engineer, so I turned to an analogy. "*Have you ever put an aluminum can of soda in the freezer to get cold quickly and forgotten about it? We are the can!*", I exclaimed.

Now that the mechanic understood our dilemma, the final task was to secure the resources necessary to do the job effectively. This required a frank discussion with operations that included the phrase, "*We aren't going anywhere until this is fixed properly.*" Faced with the alternative of securing 300 hotel rooms, the company agreed to remove some of the insulation, which came at a cost of payload as cargo had to be offloaded. In addition, our ground staff was able to obtain the necessary tools, including a large supply of towels and blankets, and recruit several extra hands from around the airport to assist in getting the job done and the plane back in the air without too much delay.

We did what was necessary to ensure a safe outcome and the flight was completed without exceeding our flight time limitations. The most valuable lesson I learned from this experience was the need to take the time to understand and empathise with the challenges faced by other stakeholders in the same system. Only by communicating our needs and challenges effectively, and actively listening to understand those of our mechanic, could we find a resolution. In this case, the resolution involved the getting extra resources to satisfy both of our goals.

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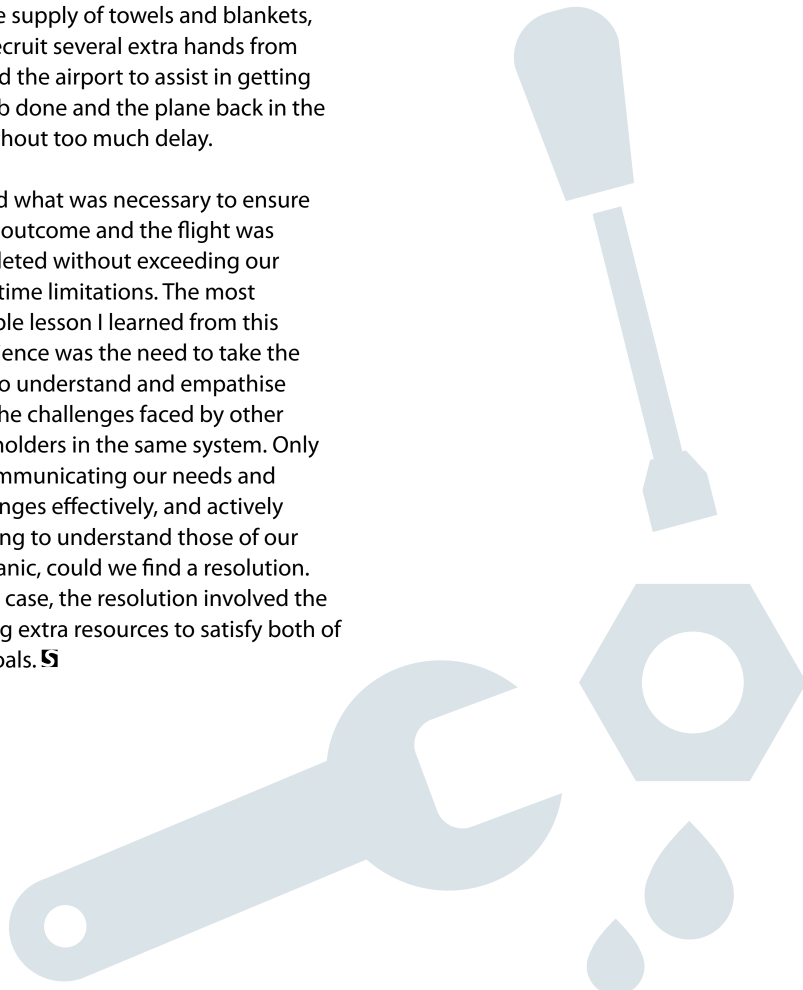

GOAL CONFLICTS AND TRADE-OFFS BEFORE TAKE OFF

Before take-off, pilots and other aviation front-line staff have to make trade-off decisions in response to goal conflicts. **Guy Malpas** gives two examples – turnarounds and refuelling.

Turnarounds

On time performance (OTP), is critical for both passenger appeal and slot and aircraft utilisation. The turnaround is a critical phase in aircraft operation where time can be recovered or lost, affecting OTP. A turnaround utilises several different work teams: refuellers, baggage handlers, cleaners, caterers, engineers, etc. Each team has set tasks, often complicated by unknowns. It is not uncommon for each team to work as silos, happy when their task is completed, with little or no consideration for the aircraft operation as a whole. Occasionally, there have been missions to optimise OTP performance, whereby staff are placed to monitor work teams during a turn-around to assess their performance. This can affect the silo performance mentality as each team tries to complete their task quickly, so as not to have any OTP delay apportioned to them.

Pilots can be a central coordinator during this busy phase and, to some extent, will keep track of activities like refuelling, baggage handling, and engineering, to gauge progress of the turnaround for subsequent OTP. This can interfere with cockpit pre-flight preparation, in the form of interruptions such as noise from caterers in the galley behind the flight deck, engineers coming in and out of the flight deck, or demanding a signature for aircraft acceptance when 'they' are ready, sometimes with no awareness of, or consideration for, the pilots' activities. This is similar with refuellers.

Pilots must have the ability to deal with many interruptions during the set-up and have measures in place to prevent lapses or errors occurring. This includes chunking tasks together in a logical fashion, whereby one can handle interruptions in between 'chunks'. Sometimes, if demanding situations require, one can 'eject' these teams (engineers, refuellers, traffic staff, etc) from the flight deck, shut the door, and concentrate on the flying task, until the crew have the capacity to deal with each team one at a time. This is another trade-off: it can create friction between cockpit and external teams, but controls stress, allows the crew to focus and get on top of their planning, and ultimately leads to a smooth and controlled turnaround.

Another way of saving time during a turnaround would be to limit the amount of FM programming, i.e., not inserting forecast wind or destination arrival information. This can be done airborne, but can affect aircraft top of climb performance predictions (an issue if there are climb restrictions) or complexity in descent preparation on short sectors where the cruise portion is minimal.

Fuelling

There is pressure on pilots for tighter fuel ordering limits to control unnecessary uplift. Any extra fuel over the flight planned fuel at a given weight will naturally incur a burn-off that directly equates to cost. This has been achieved through several means, including:

- tighter ZFW weight margins that require modifications to fuel uplift and burn
- monthly publishing of a crew's cost to the company of the extra fuel burnt to carry any extra fuel ordered or reductions in fuel burnt when fuel is off-loaded, and
- charts showing historical data of fuel planned, extra fuel ordered by crew, and the subsequent actual fuel burnt in the real operating environment (these have been very useful in giving confidence to crew that the planned fuel load is sufficient for the sector concerned, given the real operating environment).

While these measures are useful to understand cost, they may have a psychological effect on some crew as they feel they are being personally monitored.

Crew can suffer stress over the fuel to be ordered. For instance, if there is a slight drop in aircraft zero fuel weight or the sector short- or mid-range (thus a minor change in fuel load required), and they are running late, common sense may be to keep the original fuel load for simplicity and depart on time. Because of individual crew fuel load monitoring, crew will often report on administrative reports the supposed over-fuelling by refuellers of 100-300kg, losing sight of the fact that refuellers will often over-fuel by 1-200kg due to roll-back of the truck gauges, etc., and other operational factors, such as long taxi times, or sitting on a taxiway with idling engines. This stress and or time taken to calculate fuel to small values can detract from the operational big picture.

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CONFLICTS WITHIN AND WITHOUT: LEARNING FROM COSTA CONCORDIA

When Costa Concordia sank, the Captain's actions came under the spotlight. But what was the context of his decision to sail past Giglio island? Former Master Mariner **Nippin Anand** interviewed Captain Francesco Schettino and uncovered goal conflicts that are woven into the industry, and were not unique to that tragic day.

KEY POINTS

- **'Revenue-earning' units of businesses, such as hotel departments of cruise vessels, have particular power and autonomy, which influences decision-making.**
- **Financial risks dominate large scale corporations and their strategic choices, and how organisational priorities are communicated and perceived throughout the organisation.**
- **Decision-making is not characterised by individual rational choices between safety and efficiency goals. People do things that make sense to them at the time, given the context of work, including the conflicting goals and pressures.**
- **Messages about 'safety first' are often contradicted by pressures in the operational environment.**
- **The messy reality of front-line work (and workers) needs to be better understood, with a view to creating a safer future.**

"Have a look to see what speed we need to get out of here and approach Giglio. We've got to sail past this f####ing Giglio right, let's chart the route then."

"Is half a mile OK Captain?" There's [enough] depth of water [there]."

Court of Grosseto (2012). Captain's Interrogation Report – 17/01/2012

This was an exchange of words between Captain Francesco Schettino and the second mate onboard the Costa Concordia at 18:27 on 13 January 2012. Following this conversation, the passage plan was amended to perform a sail past at a distance of 0.5 nautical miles from the shore. The same night at about 21:45 on her passage from Civitavecchia to Savona, the vessel ran aground and capsized off the Giglio Island resulting in a loss of 32 lives.

A week before this accident, the maître d'hôtel (hotel manager) made a special request to the Captain: "*Now that I am due to sign off I would be grateful if you could pass by Giglio for a sail past.*" Due to unfavourable weather conditions, Francesco rejected the request on the first occasion but when the maître reminded him in the next voyage, the Captain felt that he should perform the manoeuvre.

Financial risks dominate large scale corporations and often dictate strategic choices.

With a mammoth cruise liner lying submerged resulting in human suffering in the European waters, it is morally difficult for an investigation agency to ignore public outrage. Someone must have wronged or else the ship would have never been in this situation. Going by the outcome alone, the decision of the Captain to please a hotel manager whilst ignoring the safety of over four thousand passengers and crew members seems utterly stupid and unforgivable. But if hindsight is kept aside, a sensible question to ask would be what motivated Schettino to perform the sail past manoeuvre.

Duty of care

During our three days of interviews with him, Francesco used the term 'deontology' (meaning duty of care) on several occasions. Unpacking this term would be an appropriate starting point for the analysis.

The captain has a duty of care. Safety of the vessel, crew and passengers take priority. The decisions made by the Captain should not put anyone in imminent danger. In that sense, when the maître d'hôtel first approached Schettino and requested a sail past, Francesco made it clear that the manoeuvre will not be performed due to bad weather.

In the following week, once the weather conditions had improved, Francesco felt under pressure to perform the manoeuvre when he was approached by the maître again. In the wake of an accident, organisations often point fingers at practitioners for not carrying out their duties in a professional manner. However straightforward it may appear on the surface, professionals are always faced with conflicting and competing goals. Whilst the duty of care means keeping the ship safe, it also means taking good care of crew and passengers. Let's explore the conflict between 'good care' and safety for the Captain of a cruise vessel.

The economics rule the roost

Me: *What was the motivation to go past the Giglio Island?*

Francesco: *The maître was asking me to perform the manoeuvre so I said OK I will come to the bridge. It was kind of reward as this man was good and also there was a former captain at Giglio so I thought I will make happy both of them.*

While it may be simple to pin down the survival of an organisation to one single metric of profitability, to achieve this is not always straightforward given the multiple and conflicting goals within any organisation. The problem is even more pronounced in large organisations that consist of business units, sub-units and so on. It is here that the divide between 'revenue-earning' and 'resource exhausting' units within the organisation becomes worthy of investigation. While technical and safety units are generally considered a burden on resources, operations and chartering divisions are considered a source of revenue-earning. No company would admit this out and loud, but in general the resource exhausting units often struggle with power and autonomy compared to revenue-earning departments. In deep-sea drilling, the production teams enjoy more privilege than the marine department as is the case with crane technicians on heavy lift vessels and subsea engineers on specialised offshore vessels. It is a hard truth of life that the economics rule the roost; that is what guarantees survival in the face of intense market competition.

The hotel department on luxurious cruise vessels shares a similar privilege in terms of departmental supremacies.

Sifting through some of the cruise line company websites, it is not difficult to understand this. Some of the world's most famous chefs are appointed on cruise ships to showcase their culinary skills. A job advert seeking to fill in the role of a maître d'hôtel on a cruise ship job reads:

"I am a Department Head and so responsible for reporting to on-board management and the main office, scheduling of all my personnel, disciplinary action within my Department, public relations with guests and taking care of any special needs, such as specific dietary requirements."

"*Public relations with guests*" explains the vital importance of this role. After all, it is the core business of cruise services. It is understandable that the request from the maître was not simply overruled by the Captain. During a follow-up correspondence two weeks after our meeting in Italy, I probed Francesco why he felt the need to deviate the ship on request from maître d'hôtel, to which he replied:

"Fleet wide was induce a sort of mentality to reward the hotel managers on board by paying attention to them. His request was not exceptional one since the island

was on the route, and passing close to any island is a normal practice for a cruise ship."

Safety is a top priority

We will leave the topic of 'normal practice' for another discussion. For now, let's ask why, despite a clear commitment to safety as a top priority in every board meeting, it becomes so difficult to achieve it in practice?

Measure what you must to manage your business. This is the philosophy of running a profitable business, but in doing so what exactly is being measured? Often, organisational priorities drift away from focus into ancillary or secondary areas that do not quite make sense to those at the front end. Of course, what is 'ancillary' to a ship master may not be the same for the management, but it shows the detachment between onboard and onshore staff. This was neatly summarised to me some time ago by a senior manager in the cruise sector who had also served as a master on cruise vessels in his past career at sea. "*When I joined the boardroom, I looked at the corporate risk register and there were at least thirty risks, mostly financial. Within that long list there was one operational risk and every emergency you can think of was thrown into that risk – fire, grounding, collision, spill – you name it*", he said. It is apparent that financial risks dominate large scale corporations and often dictate strategic choices. All this plays an important role in how organisational priorities are communicated and perceived down the line.

While technical and safety units are generally considered a burden on resources, operations and chartering divisions are considered a source of revenue-earning.

"I thought I will make happy both of them"

That human actions are influenced by the competing goals of safety and efficiency is a somewhat oversimplified statement. Why did he choose to go 'so close' to the island? Why did he not consider maintaining 'safe distance'? The framing of the questions is characterised by certain assumptions and biases. It is as if decision-making is about individual rational choices between safety and efficiency goals – in this case maximising pleasure for the passengers whilst keeping the ship at a safe distance from the coast. But when I asked Francesco about his motivation to manoeuvre the vessel close to the Giglio Islands, his response reflected a strong sense of giving back to his community. In his own words, he said, "*I thought I will make happy both of them*" (i.e., the hotel de maître and a former captain who was his friend and lived on the island).

If taken honestly and accurately, this simple phrase provides a deeper insight into individual values and beliefs that make a profound impact on decision-making. The idea of making a crew member or a close friend happy by putting the ship in danger may go against the professional conduct of a ship captain who, at least in the modern Western world, is expected to conform to a set of rules and standards, and exercise judgement in his vocation. But this may not be true of other societies where skills, finesse, charisma, artistry, heroism, and courtesy are valued more than meticulous conformity to a code of practice (Elias, 1939).

In 2008, a senior pilot from the Cathay Pacific was sacked for flying a passenger jet just 28 ft off the ground as a stunt

There is little value in preaching one thing when market competition and the operational environment demands quite the opposite.

to entertain a group of VIPs on the plane's maiden voyage at the Boeing's headquarters in Seattle. Later it was found that such stunts were a common practice on maiden flights intended as a 'bit of a jolly' for executives. More recently, Pakistan International Airlines came under attack on at least two occasions where 'unauthorised' guests were allowed into the cockpit by the pilot while the aircraft was airborne and during landing (Siddiqui, 2017). Such examples show a direct conflict between modern ethics of professionalism and the alternative forms of professional conduct that beg for a deeper understanding of human motivation.

Conclusion

The economic struggle to maintain competitiveness whilst constantly pushing the boundaries of safety and efficiency in pursuit of profit often puts organisations and their staff in a vulnerable situation. One response to this problem is to deny reality and proclaim infallibility (i.e., zero accident vision, accident-free future, foolproof designs, 'unsinkable' ships, and so on). Often it means preaching safety as a top priority, warning employees against taking 'undue risks', reminding them of their families and winning hearts and minds through behavioural based programmes and safety culture assessments. But there is little value in preaching one thing when market competition and the operational environment demands quite the opposite.

One possible alternative could be to understand the conflict between safety, efficiency, and professional values, and acknowledge human fallibility as an essential and ongoing challenge for any business. This could help us to work towards designing technologies, governance tools (audits, inspections, surveys, etc.), recruitment campaigns, and training programmes that would reflect the messy reality of front line work (and workers), with a view to creating a safer future.

Nippin Anand PhD is the Founder of Novellus Solutions Limited, a specialist in human factors and safety and a former Master Mariner with a PhD in Social Sciences. His research interests include applied sciences, storytelling, cultural anthropology and safety management.

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References

Elias, N. (2000) [1939]. The Civilizing Process (revised ed.). (Translated by Edmund Jephcott). Oxford: Blackwell.

Siddiqui, I. (2017). PIA pilot endangers lives, invites unauthorised woman into cockpit. Geo Television Network. Retrieved from https://www.geo.tv/latest/141100-PIA-pilot-endangers-lives-invites-unauthorised-woman-into-cockpit

DILEMMAS IN HEALTHCARE

Healthcare is an environment with puzzling paradoxes and dilemmas. While the system can seem to be set up to make it hard to do the right thing, shared conversations are the first step to achieving shared goals, says **Suzette Woodward**.

KEY POINTS

- **A dilemma is a situation in which a difficult choice has to be made between two or more alternatives, especially ones that are equally undesirable.**
- **Healthcare is full of dilemmas as a result of the huge number of stakeholders with conflicting goals, multifaceted interactions and constraints, and multiple perspectives, which change daily.**
- **Dilemmas are created when safety conflicts with productivity, cost-efficiency, and flow. A focus on one patent's safety may conflict with a focus on all patients' safety.**
- **It is vital that the different stakeholders talk to expose dilemmas and reveal the hidden trade-offs or adjustments that are kept secret because people are fearful of the consequences.**
- **Articulating dilemmas helps us to find a way to bring people with different interests and incentives into a conversation that meets everyone's needs.**

There are many different words people use for a dilemma – a choice between two or more alternatives that are almost equally undesirable: difficult decision, catch-22, quandary, predicament, puzzle, conundrum or awkward situation. Whatever word you prefer, healthcare is full of them. Dilemmas are created when there are completing goals and trade-offs, for instance between safety and other goals such as productivity, cost-efficiency, and flow.

Like all high-risk industries, work in healthcare is rarely about certainty and predictability. There are a huge number of stakeholders with conflicting goals, complex interactions and constraints, and multiple perspectives which change daily.

A dilemma can be as a result of the divergent needs of policy-makers, managers, clinicians and others. There can be opposing forces and strong views on either side of the dilemma. This results in clinical staff and managerial staff being faced with having to choose between adhering to one policy or another, with conflicting requirements. Ultimately there is pressure to choose between unfavourable alternatives, often with no right or wrong answer. Let us consider two examples; one local the other global.

A local dilemma

In the UK National Health Service (NHS), governments have set performance targets over the years, such as guaranteeing maximum waiting times for non-emergency surgery or guaranteeing a maximum four hour wait in the emergency department. These targets have been blamed for distorting clinical priorities. With limited resources, trade-off decisions can cause conflicts, especially when one target is challenged by another. For example, ambulances have been forced to queue up outside busy emergency departments. The ambulances might not be able to meet their targets to respond to emergency calls, but the hospital can meet its four-hour emergency department target.

A dilemma can be as a result of the divergent needs of policy-makers, managers, clinicians and others. There can be opposing forces and strong views on either side of the dilemma.

The four-hour target is the need to assess patients, and either admit them from the emergency department within four hours, or send them home. This target can mean that a clinician has to make a difficult choice. For example, if there were no target, the emergency department staff may just keep a patient who has a suspected heart problem for a few hours to monitor them. However, because of the target they have to move them somewhere – admit them to the hospital or send them home. This is the first dilemma – the pressure to discharge or admit patients that would otherwise be monitored in situ. The second dilemma in this example comes when the choice of bed is limited. For example, there may be no beds on the cardiac ward. The choice is to breach the four-hour target while waiting for a bed on the cardiac ward, or send patients home, or place them on another ward that does not specialise in their particular problem.

The senior nurse on a cardiac ward knows that to keep patients safe, they should be sent from the emergency department to the cardiac ward. The senior nurse also knows that her hospital is judged by its compliance with the four-hour wait in the emergency department. She knows that patients tend to be safer out of the emergency department, and the individual patient admitted to a different ward, such as an orthopaedic ward, may be at greater risk because staff are unfamiliar with their condition.

There are no beds on the cardiac ward but there is space in the tropical and infectious diseases unit...

A global dilemma

Antimicrobial resistance is the ability of a microbe to resist the effects of medication (antibiotics) that once could successfully treat the microbe. Resistant bacteria are more difficult to treat, requiring alternative medications or higher doses. Microbes resistant to multiple antimicrobials are called multi-drug resistant. Antimicrobial resistance is increasing globally because of greater access to, and prescription of, antibiotic drugs. Preventive measures include only using antibiotics when needed, thereby reducing misuse of antibiotics or antimicrobials. This dilemma has led to the development of programmes for antibiotic stewardship aimed at persuading doctors to refrain from prescribing antibiotics in marginal cases.

A particular dilemma in relation to antibiotic use is that of patients with sepsis. Sepsis is a life-threatening condition that arises when the body's response to infection causes injury to its own tissues and organs. Sepsis is usually treated via intravenous fluids and antibiotics as soon as possible, usually within one hour of potential diagnosis. However, some severe infections such as sepsis are often deceptively trivial. The dilemma is this: does the clinician wait or prescribe antibiotics 'just in case'. If sepsis is missed, this could result in significant harm or even the death of a patient, if they do not receive their antibiotics quickly. So this is a very real pressure. Additionally, there have been a number of cases of patients dying as a result of untreated sepsis in the UK, which have led to staff being judged as making the wrong decision and being punished or castigated for not prescribing or administering antibiotics. The pressure not to give and the pressure to give antibiotics is an especially difficult dilemma in healthcare today. It can have the knock-on effect of treating patients inappropriately or not treating them enough.

Let's talk about it

The first step in addressing dilemmas is to talk about dilemmas. It is vital that the different stakeholders talk together about the conflicting propositions that people face. If we talk about dilemmas and the challenges that arise for leadership and frontline staff, we may find a way to expose them and reveal the hidden trade-offs or adjustments that are kept secret because people are fearful of the consequences.

Talking about dilemmas could help us to get closer to what is being ignored, and how this is woven into organisational culture.

For example, in the case of the four-hour target, the different stakeholders actually have similar goals of efficiency, effectiveness, and safety. The government set a target of four hours wait in the emergency department because they don't want the public to be waiting unnecessarily before they get treatment, they think this will incentivise organisations to make their departments more efficient. Clinicians want their patients to be safe and also don't want their patients to wait longer than necessary. The managers within the organisation are measured on this target and are therefore keen for no patient to wait longer than four hours. Managers also feel it is the right thing to do; they too want the patients to be safe. Everyone wants the best for patients, but they have different incentives and pressures. These differences cause tension and conflict. So one way to address the dilemmas is to identify shared goals are and how each of these goals can be met in some way. It is never down to one person or one team. Therefore, the senior nurse is helped by exposing what is actually going on (work-as-done) and by a shared responsibility for the dilemma.

Articulating dilemmas helps to make explicit how people are expected to manage them. It helps us to find a way forward that is not simply about giving more weight to one side of the dilemma than the other. Talking about dilemmas could help us to get closer to what is being ignored, and how this is woven into organisational culture. We know we need to find a way of creating a shared conversation between people with competing interests and incentives; one that sees 'keeping people safer' as means of doing the right thing, saving money and achieving goals.

Dr Suzette Woodward is a paediatric intensive care nurse who has worked for 40 years in the UK National Health Service. With a doctorate in patient safety, she has worked for over twenty years leading national patient safety programmes. Until recently, she was the National Campaign Director for 'Sign up to Safety'. She is the author of the books Rethinking Patient Safety and Implementing Patient Safety.

EUROCONTROL SAFETY NEWS

Helping CANSO leaders to support human performance

EUROCONTROL was invited to facilitate an interactive session on human performance with aviation industry leaders at CANSO's annual Global Summit and AGM. With around 90% of world air traffic handled by CANSO ANSP members, CANSO's annual Global Summit and AGM is a major event, bringing under one roof over 200 C-suite leaders of airlines, airports and ATM.

In June 2019, EUROCONTROL's Dr Steven Shorrock, from the Network Manager's Safety Unit, was invited to facilitate a 75-minute interactive session on human performance with aviation industry leaders in Geneva. He started the session with the origins of Human Factors Engineering in the 1940s, before going on to talk about the role of human performance in flight QF32 (see this Issue of HindSight), and applications of Human Factors and human performance management to healthcare. Neil May, Head of Human Factors at NATS, went further into human performance and the CANSO Standard of Excellence, developed initially by EUROCONTROL/FAA AP15 (https://www.canso.org/canso-standard-excellence-human-performance-management).

Steven then moved on to a panel session with four ANSP leaders from four CANSO Regions: Alex Bristol (skyguide), Graeme Sumner (Airways New Zealand), Thomas Kgokolo (ATNS, South Africa), and Major Brigadier Walcyr Josué de Castilho Araujo (DECEA, Brazil). Steven interviewed the panel about support for human performance in their ANSPs.

Questions included:

- In your role as CEO, how do you get to understand the concerns and dilemmas of staff when it comes to support for human performance?
- What kinds of things are done in your organisation to make it easy for front line staff to do the right thing, and hard to do the wrong thing?
- If you had to explain to a neighbour about why your organisation was safe, and the role of human performance in keeping the organisation safe, what would you say?

Interspersed were questions to the industry leaders in the room via smartphones, on support for human performance in their organisations. The questions concerned listening to staff, the availability of HF practitioner support, refresher training, and current challenges for human performance management.

Overall, CANSO members and leaders greatly appreciated the session, with Simon Hocquard, Director General, underlining that the main message has been "to help CANSO Members better understand that Human Performance Management is about making it easy for people to do the right thing and hard for them to do the wrong thing, which really resonated with the audience."

Simon added, "Additionally, I very much appreciate the support EUROCONTROL continues to provide in the CANSO safety arena. The CANSO/EUROCONTROL partnership is an important aspect of how we collectively push the boundaries into new safety performance areas, and is mutually beneficial to both organisations."

2019 Safety Forum – bringing the global aviation safety family together to keep the skies safe

This year's Safety Forum looked in detail at 'safety and procedures' –bringing more than 250 aviation operations and safety specialists together over two days at an event hosted by EUROCONTROL.

EUROCONTROL and event co-sponsors the Flight Safety Foundation, and the European Regions Airline Association partners are justly proud of their 'outcome-based', highly hands-on Safety Forum, which sees participants split over two days into different tracks to exchange ideas and experiences on the development of new procedures, to hear about real-life cases when adherence to, or even a deviation from, established procedures saved the day, or how pilots and controllers acted when encountering a situation not covered by any procedures.

Intense discussions help experts learn from industry best practice and look for ways that current safety procedures could be improved, or new ones be designed, helping decision-makers improve safety in aviation at both a general and a system level.

The 2019 Forum, which has now been running for seven years, saw 250+ participants examine via a series of interactive presentations and discussion with three main themes: how procedures develop from the drawing board to become published regulations; issues arising from procedural shortcomings; and the increasing influence of technological evolution on procedures.

Celebrating the industry's shared commitment to safety is also an important component of the Safety Forum, which saw three practitioners honoured this year for their contributions to ensuring a safe industry. Joe Sultana, Director Network Management at EUROCONTROL, was congratulated by Hassan Shahidi, FSF CEO, for "advancing international aviation safety and outstanding service to the aviation industry".

The prestigious Guest of Honour award for personal contribution to aviation safety was presented by Tzvetomir Blajev, EUROCONTROL operational safety manager and Chair of the FSF's European Advisory Committee, to Captain Harry Nelson, Operational Advisor to Product Safety at Airbus, for breaking barriers, connecting people and walking the talk in saving lives in aviation. "Collectively, we fight for safety improvements", noted Captain Nelson in a short acceptance speech in which he stressed the vital role that all Forum attendees play in trying collectively to raise the bar for aviation safety higher and higher.

The third award of the event was the SKYbrary Aviation Safety Award for outstanding personal contribution and commitment to aviation safety. This went to Karen Bolton, Manager Future Safety at NATS, who stressed how for her, "being part of the safety family is an amazing journey, and a tremendous honour to keep aviation safe".

The videos, presentations and recommendations from the 2019 Safety Forum, and previous events, are freely available on SKYbrary, EUROCONTROL's pioneering safety hub at https://www.skybrary.aero/index.php/Category:Safety_Forum.

Low level go around operational safety study published

In 2017, EUROCONTROL conducted an analysis of a sample of A and B severity incidents that occurred in the Terminal Control Areas (TMAs) and Control Zones (CTRs) around airports in EUROCONTROL member states in the period 2014 - 2016. Based on this analysis, EUROCONTROL Safety Improvement Sub-Group (reporting to the EUROCONTROL Safety Team) concluded that two new issues be examined with a view to NM Operational Safety Studies. One of them is conflict on or following low level go-around. The study on this issue has just been released and provides an analysis of the risks of different go-around scenarios and potential mitigation and preventive barriers. Recommendations are made for both airport authorities, aircraft operators and ANSP's to reduce the risk. The report can be found at https://www.skybrary.aero/bookshelf/books/4627.pdf on SKYbrary.

EUROCONTROL Voluntary ATM Incident Reporting (EVAIR)

Between 2013 and 2017, aircraft operators and ANSPs have provided EUROCONTROL's Voluntary ATM Incident Reporting system (EVAIR) with some 13,000 ATM reports, many sent on a daily basis. In addition, for the purposes of monitoring the call sign similarity de-confliction tool, 21 ANSPs provided 28,000 call sign similarity/confusion reports.

The feedback process facilitated by EVAIR allows connections between aircraft operators and ANSP safety managers, and the exchange of ATM occurrence information.

When collecting and processing data, EVAIR follows strict security and confidentiality arrangements. The safety data provided are properly safeguarded and de-identified, and the information used only for the promotion and enhancement of aviation safety.

Some of the problems analysed by EVAIR are:

- RPAS/drones – final approach is the most affected, although there were reports of drones at higher levels. About 10% of the drone reports were categorised by airlines as AIRPROXES.
- GPS outages – areas most affected were Middle East-Europe, South-East Mediterranean-Europe, and Middle East-North America/Canada via the North Pole. Unfortunately, the majority of States affected by GPS outages failed to issue NOTAMs.
- ACAS RA data collection – the number of ACAS RAs has stabilised at 0.5-0.6 occurrences per 10,000 flights, with most reports recorded in the en-route phase.
- Laser interference – this is still creating problems for pilots and controllers across Europe, although the trend is falling, probably due to States prohibiting the sale of powerful laser devices and also criminalising laser interference.
- Call sign confusion – the main contributors remain 'hear back omitted' and 'handling of radio communication failure/unusual situations'. In 2017, there was a decrease in the number of cases of call sign confusion reported by pilots. There was also a downward trend in cases of call sign similarity/confusion identified by ANSPs. The data clearly show that airlines using the EUROCONTROL Call Sign Similarity De-Confliction Tool (CSST) on average have 2-7 times fewer problems with call sign similarity and confusion, which is a clear message to airlines to use the tool for similarity de-confliction in-house.
- Contributors to incidents – 'Air-ground communication' continues to show the highest trends. For the second year in a row, EVAIR recorded an increase in the number of 'air-ground communication' problems. In 2017, the contributor regarding the provision of 'traffic information' by air traffic controllers showed a significant increase, as did lack of or problems with 'ATC clearance/instructions'.

EVAIR is constantly looking for ways to improve its services and products. Suggestions and proposals are more than welcome. Please forward any thoughts, ideas or comments to Ms Dragica Stankovic, EVAIR Function Manager at dragica.stankovic@eurocontrol.int, or to the EVAIR general address: evair@eurocontrol.int:

Bi-annual safety conference brings ANSP CEOs and senior leaders together *Good Safety, Security, Capacity and Regulation = Good Business*

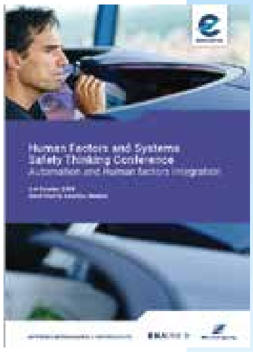
Every two years, EUROCONTROL as the Network Manager, with the support of one of the leading ANSPs, organises the Safety Conference for CEOs within the framework of the Experience Sharing to Enhance Safety Programme (ES2). A conference in Copenhagen, from 15-16 May 2019, provided an opportunity to meet and discuss safety challenges and outcomes as well as to set operational safety priorities for the Network Manager.

This year, EUROCONTROL and NAVIAR teamed up with EASA to allow greater industry insight as well as bringing top speakers on two sensitive topics: safety data in the public domain and cybersecurity. More widely, we covered in the proceedings:

- the level to which safety should be disclosed to public – is it a threat or an opportunity, and
- to which level of security should we protect our service.

The CEO Conference topics are in line with the recently published output of the Wise Persons Group established by the European Commission to produce recommendations for the direction that European ATM should take in the years ahead, to meet current and future challenges.

Conference explores automation and human factors integration



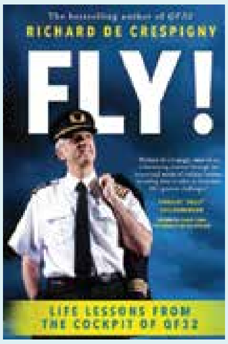
Following previous conferences on aspects of human factors and system safety in Dublin (2013), Lisbon (2014), Barcelona (2015), and Brussels (2017) this year's biennial conference was held with the support of ENAIRE, from 02-04 October 2019 in Madrid under the headline 'Automation and Human Factors Integration'.We all would probably agree that air traffic management will remain a human-centred industry for some years to come. People at the sharp end remain in control and are making safety and business-critical decisions. Technology can support these decisions and in the near future will progress from information delivery towards decision support. In order to achieve the desired positive effects of the technology, close interaction with the future user and the usage concepts is required. One-sided optimisations are not effective. User-centred engineering has proven its worth in achieving the goals.

However, the gap between the disciplines of human factors and systems engineering with new technology is widening because of rapid technological development and progress. This gap needs to be closed in order to form a team comprised of people and technology, where working methods are better coordinated and interconnected. For this, it is necessary to deal with the technical development as well as with models of cognition.

This conference explored the issues of human-machine interaction in complex safety-critical technology from different perspectives and experiences. During the event; EUROCONTROL also launched the White paper Human Factors Integration in ATM System Design.

EUROCONTROL expressed its deepest appreciation to the ENAIRE senior leadership and Safety and Human Factors Team, without whom this event would have been be possible as well as DFS, co-chair of Safety and Human Performance Sub-Group, for a most exciting agenda.

If you want to read more about some of the topics raised in this Issue of HindSight, then these books might be of interest.

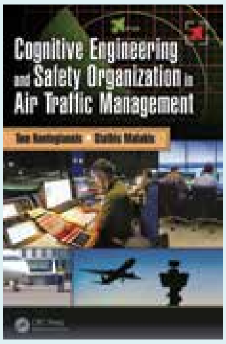


Fly!: Life Lessons from the Cockpit of QF32,

by Richard de Crespigny (2018)

From the publisher: "In Fly!, Richard de Crespigny shares the insights and techniques he built up over decades in the high-pressure world of military and civilian aviation. Covering leadership, teamwork, risk-assessment, decision-making, crisis management, lifelong resilience and more, it's a book whose wisdom can be applied to challenges and opportunities in the workplace as well as to life. Including exclusive insights from fellow hero pilot Sully Sullenberger, astronaut Neil Armstrong, NASA's Gene Kranz and others who have, like Richard de Crespigny, succeeded under intense pressure, Fly! will enable everybody to perform at their best and to succeed in any situation."

"Richard de Crespigny takes us on a fascinating journey through the hearts and minds of resilient leaders, revealing what it takes to overcome life's greatest challenges." (Chesley 'Sully' Sullenberger, Captain of Flight 1549, the Miracle on the Hudson)

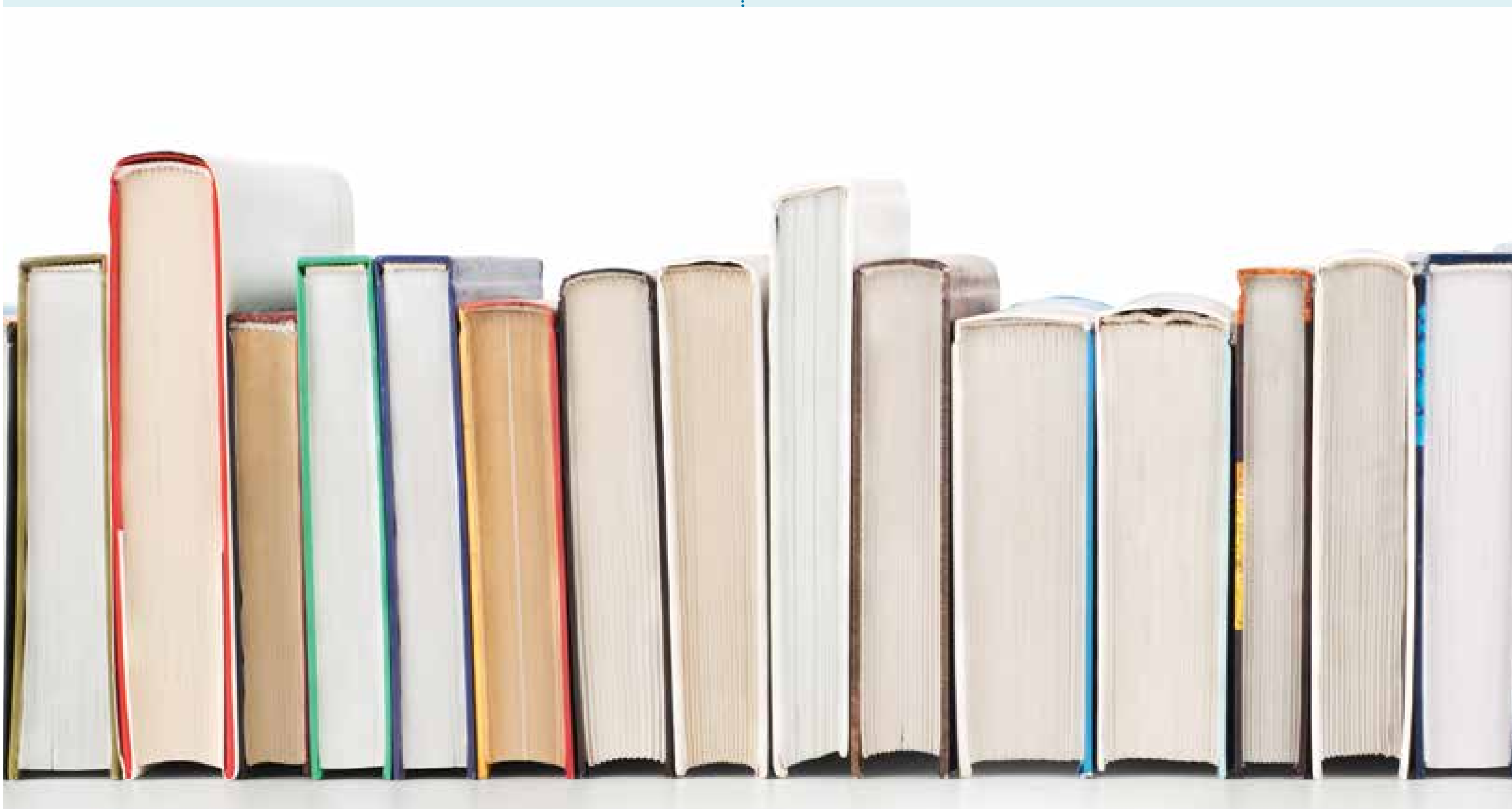


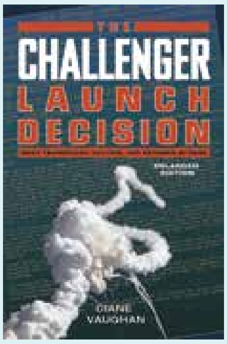
Cognitive Engineering and Safety Organization in Air Traffic Management,

by Stathis Malakis and Tom Kontogiannis

This book covers the Air Traffic Management (ATM) environment and the controller-crew interactions. The International Civil Aviation Organization (ICAO) regulations and organizational procedures are also presented in a succinct manner so that novel and experienced aviation practitioners appreciate how safety organization affects their cognitive performance. The book distills theoretical knowledge about human cognition and presents real examples and case studies to help readers understand how air traffic controllers make sense of difficult situations, make decisions under time pressure, detect and correct their errors, and adapt their performance to complex situations.

"The authors have deep knowledge of air traffic management and a heritage of safety and cognitive ergonomics, both from inside and outside perspectives. This shines through in the examples and contextual descriptions throughout the book." (Dr Steven Shorrock, University of the Sunshine Coast, Australia)

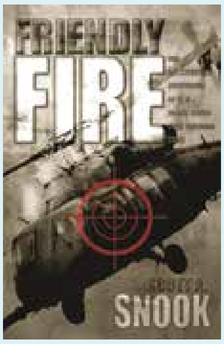




The Challenger Launch Decision: Risky Technology, Culture, and Deviance at NASA (2nd Ed),
by Diane Vaughan (2016)

From the publisher: "When the Space Shuttle Challenger exploded on January 28, 1986, millions of Americans became bound together in a single, historic moment. Many still vividly remember exactly where they were and what they were doing when they heard about the tragedy. Diane Vaughan recreates the steps leading up to that fateful decision, contradicting conventional interpretations to prove that what occurred at NASA was not skullduggery or misconduct but a disastrous mistake. Why did NASA managers, who not only had all the information prior to the launch but also were warned against it, decide to proceed? In retelling how the decision unfolded through the eyes of the managers and the engineers, Vaughan uncovers an incremental descent into poor judgment, supported by a culture of high-risk technology. She reveals how and why NASA insiders, when repeatedly faced with evidence that something was wrong, normalized the deviance so that it became acceptable to them. In a new preface, Vaughan reveals the ramifications for this book and for her when a similar decision-making process brought down NASA's Space Shuttle Columbia in 2003."

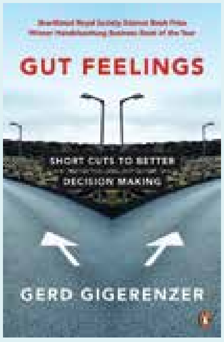
"A landmark study." (Atlantic)



Friendly Fire: The Accidental Shootdown of U.S. Black Hawks over Northern Iraq Paperback,
by Scott A. Snook (2002)

From the publisher: "On April 14, 1994, two U.S. Air Force F-15 fighters accidentally shot down two U.S. Army Black Hawk Helicopters over Northern Iraq, killing all twenty-six peacekeepers onboard. In response to this disaster the complete array of military and civilian investigative and judicial procedures ran their course. After almost two years of investigation with virtually unlimited resources, no culprit emerged, no bad guy showed himself, no smoking gun was found. This book attempts to make sense of this tragedy--a tragedy that on its surface makes no sense at all. With almost twenty years in uniform and a Ph.D. in organizational behavior, Lieutenant Colonel Snook writes from a unique perspective. A victim of friendly fire himself, he develops individual, group, organizational, and cross-level accounts of the accident and applies a rigorous analysis based on behavioral science theory to account for critical links in the causal chain of events. By explaining separate pieces of the puzzle, and analyzing each at a different level, the author removes much of the mystery surrounding the shootdown."

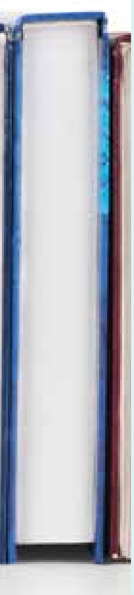
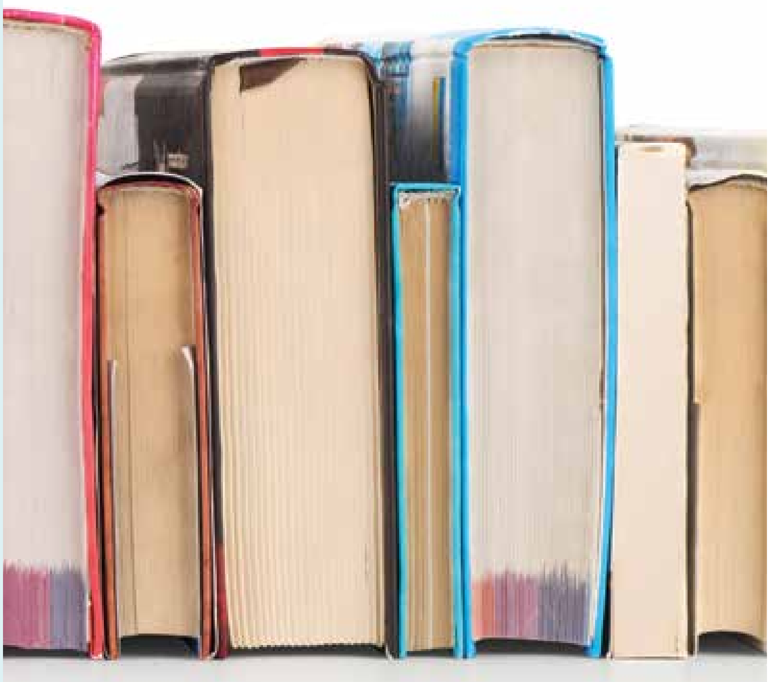
"The reader will be fascinated ... The conclusion is eye-opening and the 'lessons learned' are insightful … A lucid and well-argued book that is a must-read for anyone seeking to comprehend the complexity of fratricide." (John Davis, Air Power History)



Gut Feelings: Short Cuts to Better Decision Making,
by Gerd Gigerenzer (2008)

From the publisher: "In Gut Feelings: Short Cuts to Better Decision Making, psychologist and behavioural expert Gerd Gigerenzer reveals the secrets of fast and effective decision-making. A sportsman can catch a ball without calculating its speed or distance. A group of amateurs beat the experts at playing the stock market. A man falls for the right woman even though she's 'wrong' on paper. All these people succeeded by trusting their instincts – but how does it work? As Gerd Gigerenzer explains, in an uncertain world, sometimes we have to ignore too much information and rely on our brain's 'short cut', or heuristic. By explaining how intuition works and analyzing the techniques that people use to make good decisions – whether it's in personnel selection or heart surgery - Gigerenzer will show you the hidden intelligence of the unconscious mind."

"Gigerenzer's writing is catchily optimistic and slyly funny … devilish." (Steven Poole, Guardian)

Would you like to write for HindSight magazine?

HindSight is a magazine aimed primarily at air traffic controllers and professional pilots, on the safety of air traffic management.

As such, we especially welcome articles from air traffic controllers and professional pilots, as well as others involved in supporting them.

Here are some tips on writing articles that readers appreciate.

1. Articles can be around 1500 words (maximum), around 1000 words, or around 500 words in length. You can also share your local good practice on what works well for you and your colleagues, on the theme of each Issue, in up to 200 words.

2. Practical articles that are widely applicable work well. Writing from experience often helps to create articles that others can relate to.

3. Readers appreciate simple and straightforward language, short sentences, and concepts that are familiar or can be explained easily.

4. Use a clear structure. This could be a story of something that you have experienced. It helps to write the 'key points' before writing the article.

5. Consider both positive and negative influences on safety, concerning day-to-day work and unusual circumstances, sharp-end and blunt-end.

If you have an idea for an article that might be of benefit to others, we would like to hear from you.
Please write to **steven.shorrock@eurocontrol.int**

HindSight

The ability or opportunity to understand and judge an event or experience after it has occurred

The theme for HindSight 30 will be

WELLBEING

HindSight is an aviation safety magazine for air traffic controllers and professional pilots on the safety of air traffic management.

We welcome articles and short contributions, including good practice examples, **by Friday 24 January 2020.**

We especially welcome articles written by or with operational air traffic controllers and professional pilots. Some suggested subject areas include:

- Stress, including chronic stress and burnout, critical incidents and traumatic stress, and stress management approaches.
- Social and family aspects of work, including work-life balance, relationships at work, and influence on wellbeing and performance.
- Shift work, sleep, fatigue, rest, and rest facilities.
- Growth and development, motivation, recognition, and involvement.
- Behaviour change and wellbeing programmes.
- Medical issues, nutrition, and performance.

Draft articles (1500 words maximum, but may be around 1000 or 500 words) and short examples of experiences or good practice (that may be helpful to other readers) (200 words maximum) should:

- be relevant to the safety of air traffic management
- be presented in 'light language' keeping in mind that most readers are air traffic controllers and professional pilots
- be useful and practical.

Please contact
steven.shorrock@eurocontrol.int
if you intend to submit an article,
to facilitate the process.

If you are interested in downloading back issues of the **HindSight collection**
http://www.skybrary.aero/index.php/HindSight_-_EUROCONTROL

In the next issue of HindSight:
"WELLBEING"

EUROCONTROL

This edition is printed in 8000 copies

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