Is 'value for money' always obtained in safety investment?

Captain Ed Pooley is an experienced airline pilot who for many years also held the post of Head of Safety for a large short haul airline operation. He now works with a wide range of clients as a Consultant and also acts as Chief Validation Adviser for SKYbrary.

How much? (cont'd)

being accountable for his/her own contribution to the achievement of the overall level of safety. In fact, any failure in the proper exercising of such responsibility may be harmful not only because it could directly produce unsafe conditions, but also in that it constitutes an unsuccessful result of an investment which the organisation made in the interests of safety.

The consequences of implementing a new operational procedure but not properly applying it are in the end not much different from those of buying a new piece of equipment and not getting it to work. Whatever effort lays behind them, however relatively big or small the quantity of intrinsically scarce resources involved, they are wasted twice, both because they did not yield the intended results and because they might have been used for something else. We should bear this in mind in our everyday working life. We can challenge the choices our organisation made and we should be prepared to, since that is the road to improvement. But we should also respect them and, as long as they are there, do our best to carry them through, because that is the direction defined for us and to go there we reasonably had to choose not to go somewhere else.

If, in the end, we share the conviction that the path we are taking is the right one, here's an extra good reason to be careful what we do as, needless to say, staying home is out of the question.

by Captain Ed Pooley

Safety is a great way to justify spending money. And a lot has been spent on all sorts of things in the name of safety over the years. I quite often hear things like "you can't have too much safety" and "in safety, you get what you pay for".

But my direct experience and my take on the bigger picture is that both are untrue, which is a particularly relevant observation in times where we want either the same benefit for less money or even perhaps 'more for less'!

Is 'value for money' always obtained in safety investment? (cont'd)

Sometimes, safety may genuinely be the primary driver for investment in new systems. I am sure we will all recognise examples such as TCAS (once it got past the 'experimental' stage and TCAS 2 appeared) and EGPWS (the first and still the predominant manifestation of Class 'A' TAWS). These two advances were such important 'final' safety nets against human performance deficiencies that it would be difficult not to have striven for them at (almost) any cost. The same can easily be said about the operational monitoring of aircraft flight data to validate that aircraft are being flown safely – a system unfortunately ignored in many parts of the world for so long because of domestic freedom of information problems which at first held up adoption of this obvious best practice in the US.

More often though, safety is always a good way to help justify the cost of investment which is usually primarily about efficiency. At the very least, it must be demonstrated that there will be no loss of safety. At best, a claim that safety improvement will result may be made.

However, staying for the moment with safety 'pure and simple' and with the realm of safety nets, the concept of MSAW is considerably older than EGPWS and the terrain database and accurate aircraft position that come with it. Nowadays, both serve as safety nets against the same threat – CFIT. But interestingly, despite its earlier origin, investment in MSAW did not really 'take off' until the direct alerting to pilots provided by GPWS and eventually EGPWS was available and being (understandably) mandated. You can probably agree that a direct alert to a pilot that CFIT may be imminent is likely to be a lot more effective (at least for most pilots) than a (delayed) instruction and / or alert from ATC. So has all the fairly recent safety investment in MSAW been worthwhile? Clearly it is not of primary relevance to aircraft which are mandated to carry Class 'A' TAWS.

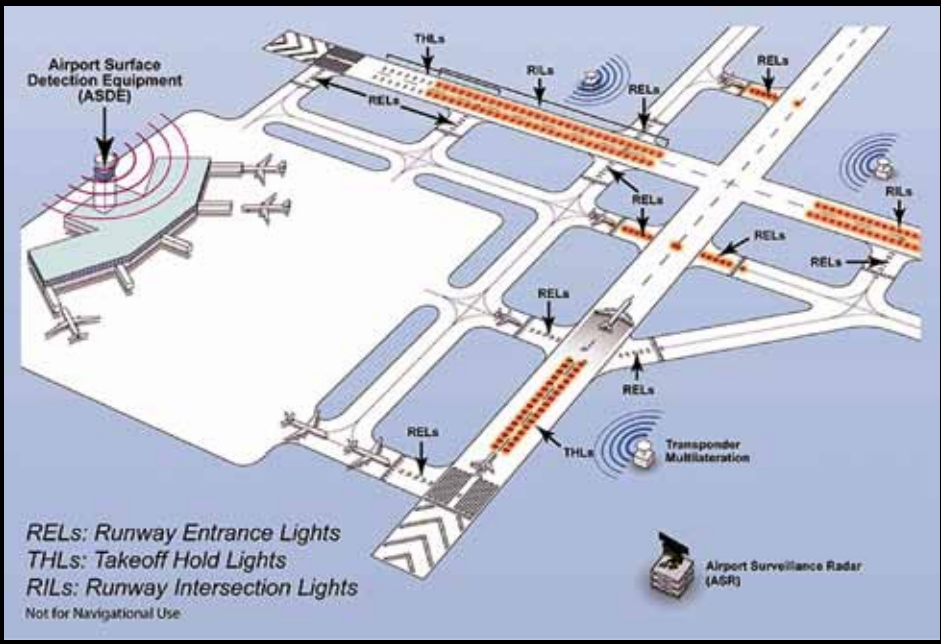
Anyway, whether the claim is that investment in new equipment will maintain or improve safety, and whether or not the investment is primarily justified by its safety case or otherwise, any extent to which the safety card is played invites very close scrutiny if we are to address the 'cost of safety' and ensure that the investment being made is actually likely to deliver the safety improvement claimed. Let me offer a couple of perspectives on this, the first one is strategic, the second one more practical.

A plausible proposition in respect of the operation of aeroplanes is that the commercial passenger flight accident rate is stable in the face of continuous growth in the number of flights because of automation rather than because of better pilot performance. The investment in increasingly reliable automation has reduced the size of the window of opportunity within which pilot error can precipitate an accident. However, when the now-normal high level of automation is suddenly reduced, 'basic skills' in both aircraft management and aircraft handling are not always available. Think of the 2009 loss of the Air France Airbus A330 'because' of the simultaneous disappearance, in stable cruise flight, of reliable displays of a single parameter – air speed – on all three indicators for less than a half a minute and on two out of these three displays (enough to be sure a reading is valid) for less than a complete minute. Awareness of airspeed is an important requirement for the normal operation of aircraft but transitory loss of just this alone is not critical.

The cost of the safety which is nowadays nearly always delivered by automation is user training in **both** the automation and the more 'traditional' way of operating aeroplanes. Unfortunately, this means that two sets of skills have to be trained **and retained** when only one is in use most of the time. There are often justifiable debates about 'training for change' but if the 'old' skills have to still be available, the real cost of safety-by-automation investment tends to be overlooked. There is a chance that the overall cost of recurrent training will increase because it must now address both the everyday use of automation and the (very) rarely used reversion to more basic methods. Of course it may be possible to reduce the time needed for recurrent training in the operation of the automation so much that the greater need to keep available the now rarely-used reversionary skills is facilitated without an increase in total training time. But those investing in automation are stuck with a regulated system of licence-holder training which has a history of following rather than leading as the aviation landscape changes. While this system catches up, the safety part of any business case for investment in automation would do well to be honest about the actual cost of maintaining or improving safety when the human task changes but the old methods of working must still be available 'just in case'.

That might all sound a bit esoteric. But perhaps my more front-line perspective on whether all investments in (or related to) safety are equally well justified in safety benefit terms will help.

I mentioned the case of the ground-based safety net MSAW earlier - and compared its 'safety improvement value' unfavourably to the direct warning provided by on-board EGPWS when this is fitted. I also characterised the direct alerting provided by TCAS II as



A typical deployment of a RWSL system (FAROS element not shown) diagram prepared by MIT Lincoln Laboratory

worth paying almost any price for as a means to avoid airborne collision. But when we move to high speed aircraft ground collisions, the cause of what is still the biggest-ever loss of life in any single aircraft accident at Tenerife in 1977, what about the huge sums of 'safety' money spent on attempts to develop meaningful controller alerting to such events? And by meaningful, I mean generating an alert which, at least at its final stage:

- Can't be missed (so it will need to be aural as well as visual)
- Is almost always a real conflict risk (both false and 'nuisance'[1] alerts are rare)
- Occurs with enough time for the controller to react, the 'solution' to be broadcast and the pilot(s) to respond accordingly

Of course the necessary leap forward is – you've guessed by now I'm sure – direct alerting delivered to the pilot(s). And it's available! After its ten years or so of development by the MIT Lincoln Laboratory in the US including five years of operational trials, the FAA have committed to a major installation program. It's called the Runway Status Lights (RWSL)[2] system. And it's being pioneered in Europe at Paris CDG where the inner runways in each parallel pair are being equipped with RELs and THLs – 09R/27L this year and 08L/26R next year.

In its final form, currently on operational trial in the USA, the three available RWSL components (see the representation above) are being linked with an add-on called the Final Approach Runway Occupancy Signal (FAROS)[3]. FAROS flashes the PAPIs at an approaching aircraft when a risk of runway occupancy by a vehicle or another aircraft is detected. Think of it all as rather like a TCAS TA-only system - although one which, despite also only providing risk awareness rather than risk resolution, leaves the pilot sufficiently informed in time to be able to avert a collision risk without undue stress.

Now that's what I call real safety improvement. Only this time the investor making the safety case is the same as the one with the chance to spend money on ever more sophisticated controller alerting systems driven by surface movement radar since both are ground based safety nets! As always, the leaders have to take a progressive path to the ultimate layer in the assembly of a family of safety nets in the familiar 'layered approach'. But in this case, do the eventual followers need to take the same incremental approach? Maybe if a choice between moving to the next stage of A-SMGCS as an improved controller-use tool or to a RWSL system utilising much the same technology is evaluated using comparative safety cases which are then input to a cost benefit analysis, a 'jump' to an RWSL system will be the winner. Of course, my examples of safety nets against both ground and airborne collision apply especially to relatively busy traffic environments – and if the budget is unlimited, don't choose, do both. But budgets are not usually like that….

So the lesson is that alternative safety investments, or indeed the safety consequences of alternative efficiency investments, especially but not only where more than one stakeholder is involved, can effect 'competing' safety improvements. This suggests than most safety spending really needs a somewhat more challenging examination than it often gets before we can allow ourselves to be convinced that it is worth it.

1- In the context of any safety net whether ground-based or on board aircraft, a nuisance alert should be understood as correctly functioning equipment generating an alert which has no actual safety value
2- see http://www.skybrary.aero/index.php/Runway_Status_Lights_(RWSL)
3- see http://www.skybrary.aero/index.php/Final_Approach_Runway_Occupancy_Signal_(FAROS)