

# SAFETY MEASURES

AIMEE TURNER LONDON

Human factors in maintenance contribute significantly to accidents. Is there a way to manage the risks?

**D**r Mike Rejman is fond of quoting the fractured rhythms of a US secretary of defence when addressing themes common to human factors.

On 12 February, 2002, a perplexed press corps at a Department of Defense news briefing heard Donald Rumsfeld say: "As we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns; the ones we don't know we don't know."

To the ears of a human factors expert versed in safety critical domains spanning aviation, road and rail, however, Rumsfeld's words had the ring of truth. Rejman, as director of CIRAS, the confidential incident reporting and analysis system for the UK's railways, believes that while individual industries may have their own domain-specific problems, the goal of all human-factors systems should centre on the discovery of latent risk – the unknown unknown – and this achieved essentially within a benign, no-blame reporting environment.

These issues become all the more important with the International Civil Aviation Organisation requiring that all maintenance, repair and overhaul specialists, as well as operators and regulators, have their own safety management system in place by January 2009.

Most MRO businesses are expected to migrate seamlessly from meeting the current provisions contained in the European Aviation Safety Agency's Part 145 regulation controlling maintenance organisations' human factors programmes

Keven Baines of UK airworthiness and safety consultancy Baines Simmons doubts, however, that many have seized the opportunity afforded by the original EASA regulation, opting instead for what amounts to essentially a "tick box" approach to human factors training.

"The average aviation maintenance executive manager who has not received error-management-focused training is unlikely to be motivated to ensure anything other than regu-

latory compliance," he says, adding that those MROs that go down the one-size-fits-all path risk fail to deliver both the regulator's return on investment goal and the real potential business benefits that the more enlightened practitioner enjoys.

Simon Roberts from the UK Civil Aviation Authority says the challenge for the regulator in managing industry oversight is to support the effective implementation of human factors principles over and above simply minimal compliance with the safety management system requirement. The CAA is already gearing up with a series of roadshows to increase awareness of what ICAO requires. "By having a mandate, it forces industry to put these procedures into place," Roberts says.

But compliant implementation versus effective implementation – the difference between putting a summary tick in the box and going the extra mile – is something about which the regulator ultimately cannot do anything.

"We also have to ensure that as a regulator we are not overstepping the mark. We have to ensure we do not become a consultant, we have to get the balance right in terms of guidance and advice," says Roberts. "The differ-

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## **"Insurers are increasingly keen to assist and participate in the development of a safer risk"**

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**DAVID HITCHENS**

Former British Airways Engineering manager

ence between compliant implementation and effective implementation is not huge, although the potential payback from the perspective of reducing errors is."

Alan Simmons, a principal inspector for the UK Air Accidents Investigation Branch, rarely gets to assess near misses. But he supports proactive efforts to manage those events that reveal previously latent risk and massive potential rework costs.

"The risks incurred in maintenance are underestimated and sometimes uncontrolled. Underestimated because it is assumed that compliance with current regulations and best practice will also manage human error issues. And then some risks are uncontrolled because there is a gap between published procedures and day-to-day practice," says Simmons.

While most latent risks result in incidents, not accidents, they are expensive – 3% of accidents are directly MRO-related, says Boeing, although this could rise dramatically if maintenance is taken as a contributing factor. They are also widely suspected as being often driven by overreaching in an attempt to please the client. "So often we have a culture that rewards procedural malcompliance as we want to deliver to the customer on time," says Simmons.

### **CHANGING BEHAVIOURS**

The CAA's Roberts admits that changing behaviours and culture is one area that is receiving additional regulatory scrutiny. "Operators need to focus on the oversight of their maintenance providers and consider the human factor principles at work in this arena by avoiding setting both unrealistic targets and inappropriately ambitious performance targets that exceed scheduled tasks," he says.

"They should fix work packages and basically avoid overburdening the night shift. You could argue that maintenance providers should say no when it is appropriate, but here we see commercial and engineering realities essentially collide," Roberts adds.

Additionally, Roberts poses these questions: does the operator's paperwork hide incompatibilities that need adapting for the maintenance personnel in an effort to develop error tolerant processes? If EASA Part 145 easily transitions to an MRO's safety management system, does it bolt on as effectively to an operator's safety management system?

Fatigue is "an area where no-one has gone into much apart from the EU Working Time Directive provisions, but with the prospect of 12h shifts, what we would rather do is encourage a risk-based approach rather than prescriptive rules", says Roberts, who says further guidance is being prepared on this by the UK CAA and the Royal Aeronautical Society.

David Hitchens is a former British Airways Engineering manager responsible for line and minor maintenance of the flag carrier's London Heathrow-based short-haul fleet. Now an aviation loss surveyor, he has handled a wide variety of fixed- and rotary-wing claims, including several major losses.

He depicts an aircraft insurance landscape dominated by downward pressure on rates, with new market entrants from developing economies combining with a historically low number of hull losses balanced in part by increasing fleet values and global fleet growth.



Could appropriate safety management systems cut down maintenance-related accidents?

“From a risk management perspective, insurers are increasingly keen to assist and participate in the development of a safer risk – and not just through price, but through much more proactive means,” says Hitchens, who adds that an insurer now expects to see a mature safety management system as standard – and furthermore expects to understand it in terms of the issues reporting mechanisms have thrown up.

#### NO SURPRISES

“Leading underwriters meet often with senior directors of MRO businesses and one thing they don’t want is surprises that have not been built into the premium,” he says.

Hitchens cites a cautionary case study where one MRO business that had suffered a high number of claims over the previous two years

had been taken over by another company that wanted to include it in its policy. One of the major incidents had involved a Boeing 767 engine fire on take-off that a faulty on-board extinguisher failed to contain. The second claim involved an incorrectly latched thrust reverser that developed a crack before detaching.

Hitchens says that the business had originally been a traditional airline with its own engineering department, which had then evolved into an independent MRO, but without any safety management system or reporting culture. “It was a business where the insurers got more information than even their senior managers,” says Hitchens. Not surprisingly, new ownership has seen a more forward-thinking management established headed by a chief executive who understands the business and moral benefits of having a safety management

system. “Generally, looking at the whole operations side of the business, insurers understand that safety comes from the top,” he says.

Baines attempts to answer why executive management is so pivotal in making the human factors movement deliver: “Those maintenance organisations that have real value-adding human factors programmes are those whose management team understands what the potential return on investment prize is, and as such genuinely want a programme, not simply their staff to be trained, but a human factors programme. That prize is a window into the bottom of the ‘error iceberg.’”

Roberts agrees: “It is good to have senior management buy-in, otherwise it’s never going

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### “People on the shopfloor want to see senior managers walking the walk, not just talking the talk”

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**SIMON ROBERTS**

UK Civil Aviation Authority

to happen at the grass-roots level. People on the shopfloor want to see senior managers walking the walk, not just talking the talk.”

Another sign of a healthy system is having a high level of reporting, but the devil is often in the detail. What is contained in those reports? Are near-misses being reported? How do you determine what to investigate? Are the whys as well as the hows being asked? Are the difficult questions being asked?

Rejman recounts how, assuming the role of “honest broker” as head of the human factors unit for the UK Army Air Corps, people immediately started “unpacking” a lot of things, alerting him to unacknowledged, but known weaknesses in the operation. Rejman set up and ran its reporting system and opts for a confidential rather than anonymous system.

“You certainly don’t get the richness and complexity without going back to the people concerned, although anonymous reporting systems should not be discounted out of hand. They serve a purpose as a first-line effort to get to the main issues,” he says.

Once you have convinced your employees that the business actively encourages dialogue, do they receive effective feedback once concerns have been raised? As Roberts points out, “as soon as they see issues that they have raised disappearing into a black hole they will simply stop reporting problems”.

According to Baines, because near-miss events are more frequent than incidents or accidents, “non-output” failure reports lend themselves readily to statistical analysis in a way that accident reports do not.

“A reporting culture is a key measure of an efficient human-factors programme; if a main-

tenance organisation has 100 staff it should be getting a minimum of 200 reports a year, with more than 40 worthy of structured investigation, all of which should have been databased and analysed," Baines says.

It is only in this way that a value-added maintenance system improvement is achieved. "If not, your maintenance organisation is ticking boxes and missing an opportunity to gain competitive advantage," Baines adds.

Malcolm Rusby is European safety director and training manager at business aircraft operator TAG Aviation. He says that central to

the background, influences and consideration in the design and development of his business's safety management system was the need for people to own the process.

Safety officers are empowered with a direct link to the chief executive's office and an anonymous reporting system has been established. "This is so important, that the employee can air concerns without fear or reprisal," says Rusby, admitting that he suspects it is the only way he can guarantee the flow of reports. "We treat each incident on its own merit, there is no blame culture, but we still have to guarantee an

honest reporting system with the most important aspect of any investigation being to find the cause before any judgement," he says.

Rusby is responsible for detecting the build-up of trends across his organisation, with trend analysis contributing a vital element in safety management system improvements.

"The benefits of a smoothly working safety management system involves all sorts of costs, but there are substantial paybacks too. It's certainly not just a nice glossy document lying on the shopfloor. It's all about the staff and if they don't buy in, it's worthless," says Rusby. ■

### ANALYSIS

## HOW AND WHY MAINTAINERS CAUSE ACCIDENTS

Dr Bert Boquet heads the human factors and systems department at Daytona Beach, Florida-based Embry-Riddle Aeronautical University. He recently led a team which applied a human factors analysis and classification system to 1,935 maintenance-related commercial and general aviation accidents in the USA from 1990-2003.

While maintenance-related issues are understood to cause fewer accidents than those errors committed by aircrews, with up to 23% of accidents thought to be causally related to maintenance, an examination of the nature of those accidents in commercial and general aviation is interesting.

"What really stood out was the skill-based level where errors occur: low processing tasks. Errors here are consistent throughout all industries. They are the tasks we have to do, but the ones we don't have to think about, the things we do by second nature," says Boquet.

A further look at the level of violations by maintainers (30%) compared with pilots (10%) came as a shock to Boquet. "But then when you think about the different environment it makes sense, because violations are not so much about breaking regulations but deviating from procedures, and you have to acknowledge that figures may be inflated as the maintenance industry may tend to be harsher on itself."

What strikes Boquet in terms of maintainers operating within a future safety management system environment in the USA where initiatives are just ramping up, is that one issue that will loom large is

fatigue. "There has historically been a lot of protection for pilots in terms of crew rest, for example, but those things are still not in place for aircraft maintainers. In an industry where pay tends to be low, hours long and working conditions difficult, that speaks to their professionalism. If you look at aircraft maintenance as an aviation system that has not had any particular attention in terms of the development of a safety management system, it's done a pretty good job."

Embry-Riddle University will soon assess the real business effects of fatigue at a US maintenance provider with whose permission it will

be able to publish the study findings. "From interviews we know fatigue is a real issue. The big thing for the industry is the shortage of maintainers. You start to mention the need for rest and that's going to immediately affect workforce capacity which is already under pressure. It is a long overdue issue," says Boquet.

A natural consequence of labour shortage is more outsourcing by major airlines' engineering departments with independent maintenance providers more likely than to use increased contract labour.

"This all puts pressure on the already-overstretched Federal Aviation Administration inspection

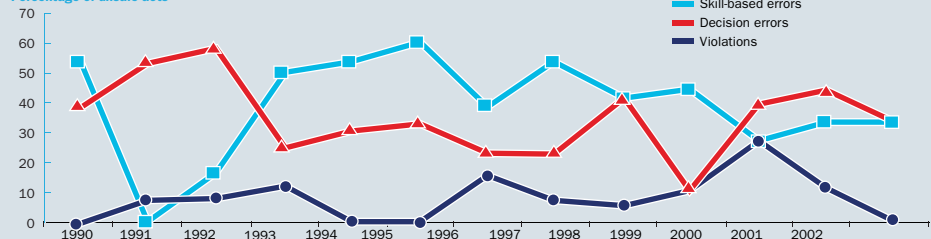
official. There are not enough of them out there to get the job done now and as more work is outsourced that puts even more pressure on that inspection system."

Ideally, Boquet says safety management system efforts should be linked to maintenance error levels rather than the much lower MRO-related accident tally. "For me, the real issue is that what is lacking in aviation is the lack of any standardised approach to how we collect that data," he says. "That is holding us back. Everyone, especially as we become more global, needs to be willing to share data, accident data and especially error data." ■

### AVIATION UNSAFE ACTS

Unsafe acts by year

Percentage of unsafe acts



Human-factors unsafe acts overall

Percentage of human-factors unsafe acts



SOURCE: Embry-Riddle Aeronautical University