Simulated safety training - validity or fidelity?

By Professor Sidney Dekker

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

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

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

Professor Sidney Dekker

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

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

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

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

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

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

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

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

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

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

EDITORIAL COMMENT

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

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

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