

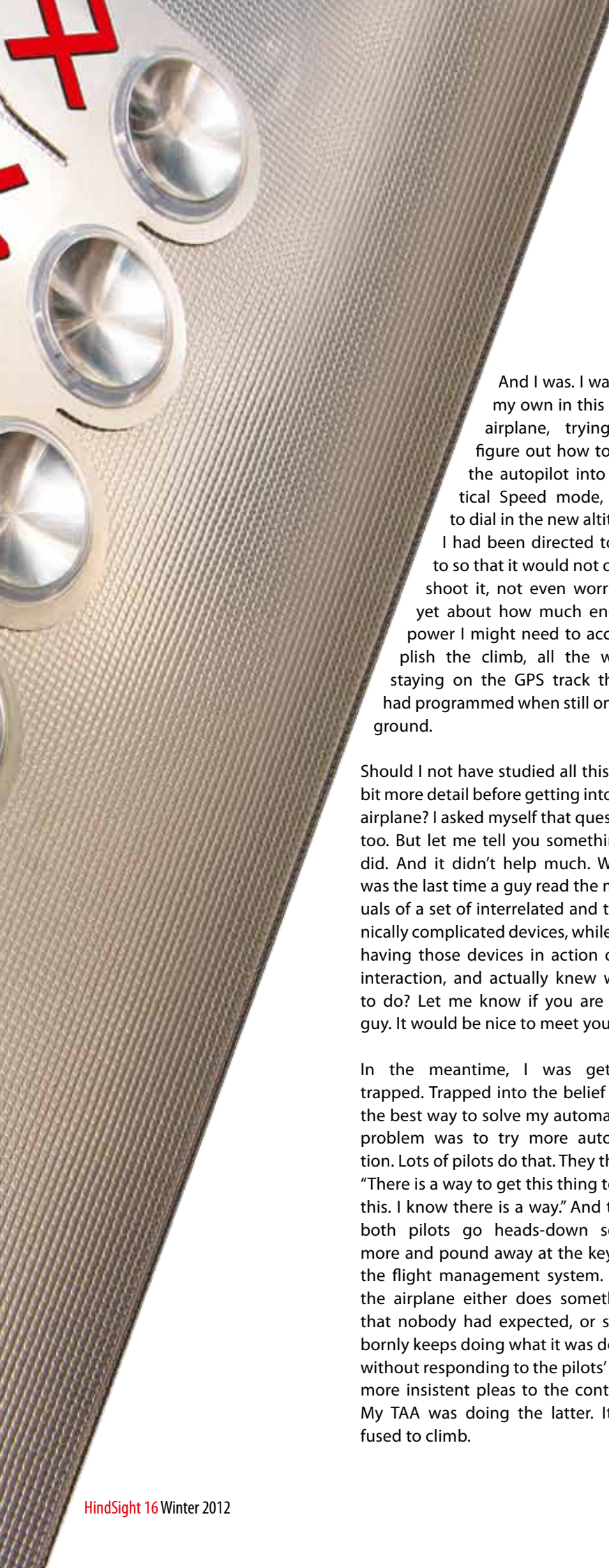
When the airplane is more **technically advanced** than you

by Sidney Dekker

"University 185, weren't you going to climb?"

I knew it. I knew the question was going to come. Here I was flying a small TAA, or Technologically Advanced Airplane, boring along at 2,500 feet and not climbing at all.

"Ah, Centre, University 185, I'm still figuring out the automation," is my limp reply.



And I was. I was on my own in this new airplane, trying to figure out how to get the autopilot into Vertical Speed mode, and to dial in the new altitude I had been directed to go to so that it would not overshoot it, not even worrying yet about how much engine power I might need to accomplish the climb, all the while staying on the GPS track that I had programmed when still on the ground.

Should I not have studied all this in a bit more detail before getting into the airplane? I asked myself that question too. But let me tell you something. I did. And it didn't help much. When was the last time a guy read the manuals of a set of interrelated and technically complicated devices, while not having those devices in action or in interaction, and actually knew what to do? Let me know if you are that guy. It would be nice to meet you.

In the meantime, I was getting trapped. Trapped into the belief that the best way to solve my automation problem was to try more automation. Lots of pilots do that. They think: "There is a way to get this thing to do this. I know there is a way." And then both pilots go heads-down some more and pound away at the keys of the flight management system. And the airplane either does something that nobody had expected, or stubbornly keeps doing what it was doing without responding to the pilots' ever more insistent pleas to the contrary. My TAA was doing the latter. It refused to climb.

Interestingly, there is an easy way to make any airplane climb. I had this explained to me on one of my first lessons ever. I must have been fourteen or so. "To climb, you pull the houses lever," the instructor said. "The houses lever?" "Yeah, the houses lever. You pull, and the houses get smaller. You push, and they get bigger." "Ah." I pulled the houses lever. And the houses got smaller.

But that was when I was fourteen, and the airplane I was flying was anything but technically advanced. In fact, it wasn't much of anything. Now I was thirty-something and half a decade into the twenty-first century and I was going to get the automation to do what I wanted. So I did not pull the houses lever. In fact, in this TAA, I was afraid of pulling the houses lever. What would happen to all the carefully programmed tracks and restrictions and waypoints and everything that I had so meticulously put into the machine before take-off? Would I ever find it again? I was motoring my way to a rather big international airport, granted still at 2,500 feet, and I found it very nice to know that I had all this automation watching my flight for me. I did not want to risk flushing it all away. And of course, I truly thought that there was a way to get this thing to do what I wanted. I'm that kind of guy, what can I say? Again, tell me if you're not. It would be nice to meet you.

Now the controller in this saga was actually very patient. And perhaps that is the right thing to be – you have that luxury of course. Pilots do not typically make their automation or their airplanes do funny things because they are deliberately bloody-minded. They themselves get surprised by the automation.



A decade before my hunt for the vertical speed mode in that TAA at 2,500 feet, I had been getting my doctorate at The Ohio State University. Researchers there were working hard on documenting and trying to understand automation surprises in the cockpit. Automation surprises, they concluded, happen when the automation does something on its own (or refuses to do something) without immediately preceding pilot input. It may refuse to comply with a limit on a level crossing, for example. Or it may refuse to climb. Or it may suddenly level off, with two pilots looking at it, and then each other, going, "Did you make it do that?" And, of course, neither did make it do that. It was an automation surprise.

One of the problems of technologically advanced airplanes (both big and small) is that indications about the future behaviour of the automation are typically weak. There is still no obvious vertical profile on display in most automated cockpits, for example. The vertical intentions of the automation need to be read from a map display, which shows the lateral, not the vertical. So the vertical gets conjured into this map with underspecified symbols like moving green bananas (I am not making that up) and dots and lines of various colours. It is like reading the runes to divine the future.



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If pilots are to avoid automation surprises, which surprise not only them but controllers too, then they have to have an accurate model of how the system works. They have to call to mind the portions of this knowledge, this model, that are relevant for the current situation. They have to recall past instructions to the automation, which may have occurred when they were still on the ground, or at least some time ago, and which may have been put in by somebody else. They have to be aware of the current and the projected state of those various inputs to the automation, and how they might all interact. They have to monitor automation activities and integrate all of this into a coherent assessment of the current and future behaviour of the automation.

Did you get all that? It is a tall order. A tall order indeed. And the way we train pilots for automated flight decks may still have some way to go before it really rises to the challenge. See a new pilot go into 737 training? He or she's all smiles walking into the classroom for the first time, because eventually, this is the first jet they are going to learn to drive. Four hours later, they come out of the classroom, not having seen a simulator or airplane yet, and they are lugging more books than they can carry. The smile is long gone. Their flight bag(s) are overflowing with

manuals that are chock-a-block with static, dead details of a machine not in action, and not in interaction. Go and study, see you tomorrow in computer-based training. And then, after that and after all those simulator sessions, you're outside, in the airplane, on the line, where you will learn the rest. Or learn how these things really operate.

As I said, we haven't risen to the challenge yet. And this is perhaps even more the case for the TAAs that get flown outside of airline supervision and training centres, by pilot-owner-operators who have nobody to tell them this or that, except perhaps their insurance company.

If you are the controller, maybe the best thing to do is try to be patient. If you can. Have patience with the guy who did not read the manual. Or did read it and found it to be rather useless. As we have seen in a recent accident, airplanes can pull off automation surprises that aren't even in the manual. So a pilot wouldn't know it – however diligently he or she studied the books.

Back in my TAA, I had finally been able to find the right mode and leave 2,500 feet. I announced as much on the frequency. And I did it without touching the houses lever! My pride and stubbornness were both confirmed. "University 185, I see you got it figured out now?" The controller sounded as relieved and proud as I did. Or perhaps that is what I wanted him to sound like. "Affirmative," I said. "I have. Thank you for your patience, Centre. University 185." "You're welcome," he answered. He told me to contact his colleague on the next frequency and wished me good luck with the automation on my journey northward. I wished it myself too. Because at some point, I was going to have to descend. **S**