Setting verification: the PL 603 case study

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The PL 603 case study

Aeroperú Flight 603 was a scheduled passenger flight from Miami, Florida, to Santiago, Chile, with stopovers in Quito, Ecuador, and Lima, Peru. On October 2, 1996, the Boeing 757-23A aircraft flying the final leg of the flight crashed, killing all 70 people aboard.

Flying over water, at night, with no visual references, the pilots were unaware of their true altitude, and struggled to control and navigate the aircraft. The investigation determined that the air data computers were unable to show correct airspeed and altitude on cockpit displays because a maintenance worker had failed to remove tape covering the pitot-static system ports on the aircraft exterior.

Setting verification

SEBoK does not define the concept of setting. In engineering, setting verification is the testing of the system operation following a change in the system setting. Sebok does not require special testing following the setting.

This case study indicates the need to verify the setting after each time the setting is changed. In this case, it is after changing the scenario from maintenance to operative

A simple method proposed recently for detecting unexpected risks is based on risk indicators. These are continuous system variables, accompanied by a range of values with high likelihood. These indicators are used to notify the operators when reaching a value that does not fall in this range (Harel, 2020).

Apparently, the altitude measurements are continuous system variables, and as such, they may be used for setup verification. Apparently, in the PL603 case, the developers did not conduct any setup testing: the setup error was detected only later, following the takeoff.

Learning from other industries

In engineering, there are plenty of opportunities to learn from accidents in other industries. One such opportunity may be based on the MX981 accident reported elsewhere (Harel, 2024). Currently there are no standards for enforcing setup testing.

Controllability requirements

To enable the setting verification, the operational requirements should specify a range of measurement values that should be acceptable, and the verification program should provide an indication when a measurement does not comply with this range.

Setting verification relies on a tiny addon to the sensor driver. This addon may enable setting the control parameters, verify that the measurements comply with the control requirements, and activate a procedure for notifying about crossing the limits.

The control requirements are that the readings are within the range of acceptable values. The control parameters may include:

- Safety limits for the measurements
- Initial limits for notifications
- The acceptable rate of false alarms.

In the case of altimeter of commercial airplane, such as in the case study, the safety and initial notification limits may be few meters, depending on typical readings when the particular airplane is on the ground, performing the checklist verification.

During the operation, the driver should update the statistics and verify the likelihood of the measurements, namely, that the readings are within the limits. In case of crossing the safety limits, the system should alert and disable subsequent operation. Otherwise, when crossing the notification limits, the system should just notify on the exceptional readings.

Apparently, the Boeing used in the PL603 accident did not incorporate this feature.

Conclusions

The PL603 accident demonstrates a need for early detection of setup errors, and a method based on capturing exceptional values of the sensor measurements. This simple method may be applied to many sensors of continuous variables and contribute to the productivity and safety of many systems, in many industries.

It is proposed here that system engineering standards may include a chapter on when and how to apply this method.

References

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