Is automation of performance calculations reducing flight crew awareness of the reference performance values?

Runway safety - automation versus knowledge

by Captain Dirk De Winter

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has over 11,000 hours flying time over the last 22 years. He started as a cadet pilot with SABENA in 1987 flying Boeing and Airbus aircraft. Before starting his flying career Dirk obtained Masters degree in Electronic Engineering from the University of Brussels. Since January 2009 Dirk has been working part-time at EUROCONTROL.

Runway safety - automation versus knowledge cont'd)

After invading our daily lives tablets are emerging on the flight deck. While initially pilots were using smart phones and tablets on a personal basis, airlines have discovered their benefits and are introducing them rapidly on the flight deck as part of the aircraft operations.

The advantages of these tablets, more specifically electronic flight bags (EFB), are obvious and multiple. These little devices carry all the company and aircraft manuals making them great space and weight savers. The update function is also a great workload saver for the operations department and can even be automated through wireless technology.

Besides consultation of company documentation the EFB can offer loading and performance calculations. This puts the EFB in-between the paper loading forms and the FMC. The interaction between the paper loading form, the EFB and the FMC poses threats to flight safety and it requires robust standard operating procedures (SOP) to mitigate these threats. Recommendations and guidance material on this can be found in the European Action Plan for the Prevention of Runway Excursions (EAPPRE - REC 3.4.13).

REF	FLIGHT PHASE	RECOMMENDATION	OWNER	IMPLEMENTATION DATE	GUIDANCE
3.4.13	TAKEOFF	The aircraft operator should ensure their standard operating procedure (SOP) requires the flight crew to perform independent determination of takeoff data and crosscheck the results. The aircraft operator should ensure their Standard Operating Procedures include flight crew cross-checking the 'load and trim sheet' and 'performance' data input into the Flight Management Computer (FMC).	Aircraft Operator	31 May 2013	APPENDIX E

While the European regulator only makes a generic statement regarding the need to assess the in-flight landing performance most aircraft operators (AO) have SOP to clarify this assessment during the approach briefing (EAPPRE REC 3.4.15)

3.4.15	CRUISE	The aircraft operator should publish and provide training on the company policy regarding in-flight assessment of landing performance. Flight crew must be advised whether company landing distance data relates to unfactored or operational distances. In the case of unfactored distances the company should provide the safety margin to be used in normal and abnormal conditions.	Aircraft Operator	31 May 2013	APPENDIX [illegible]

Here the EFB shows its greatest benefit. To calculate the IFLD the flight crew selects the landing airport and runway and inserts relevant parameters such as: the latest weather information; the appropriate runway condition code; the landing flap position and the level of auto brake. Hit the compute button and the module calculates the Operational Landing distance (OLD) and factored operational landing distance (FOLD). If the FOLD is displayed in green it's smaller than the landing distance available and we're good to land. No need to use graphs to calculate the headwind component, no need to interpolate between multiple columns in complex tables.

More benefits are encountered in abnormal conditions. Any MEL[1] item affecting the aircraft performance; select the item from the list. An aircraft failure or an ECAM[2] message; just select the corresponding ECAM message from the list. A change in runway dimensions?

Make the correction in the runway tab and the performance module will calculate the approach speed and the FOLD instantly. This reduces the flight crew workload and reduces the possibility of an error especially compared to the manual calculation.

But are these all benefits? The airline I work for uses an alternative training and qualification program (ATQP) for recurrent training on their Airbus fleet. On the line orientated evaluation (LOE) day in the simulator, the flight crew is tasked to fly a normal line flight, but during it, the instructor generates abnormal events without the prior knowledge of the crew in order to observe the crew response.

Last summer season one of my favourite combinations was a reduced runway length followed by an engine failure on approach. When the flight crew requested the latest weather information to facilitate the approach briefing I passed the information the available runway length was reduced to 1600m due to urgent maintenance works. This triggered a landing performance calculation from the crew resulting in a FOLD of 1250m thus a 350m buffer to the available landing distance. All crew managed this event very well and elected to continue to the destination. The descent continued uneventful and the flight established on the ILS with the runway in sight. Just after descend on the glideslope had begun, I introduced a 'converging birds' visual effect combined with an engine failure to simulate an engine bird strike. At this stage the autopilot was still engaged and the initial actions to 'secure' the engine could be completed well before the 1000ft

1- MEL: Minimum Equipment List. Lists the conditions under which an aircraft can still be dispatched with inoperative equipment
2- ECAM: Electronic Centralised Aircraft Monitor system. Displays system diagrams and parameters; generates alerts and displays abnormal procedures.

Fly Smart with Airbus - A330 example of in-flight landing performance calculation

stabilisation 'gate' leaving sufficient time to decide on the safest course of action.

Only one crew continued to a landing – about a dozen others elected to commence an immediate single engine go-around followed by a 20-minute diversion through the busiest European TMA to another single runway airport. When asked to explain their decision making during the debrief, most crews said that there was not enough time to re-assess the landing distance so a go-around was made. When asked if a continued approach and landing was also a safe option, the answers were not so swift! What is the difference between the landing distance required for a 2-engine landing and one for a single engine landing? And what distance does this represent on a dry runway?

After various regulatory and safety initiatives, this aircraft manufacturer changed the presentation of the landing performance data. One of the improvements was the change from actual landing distance (ALD) data to realistically achievable operational landing distance (OLD). More importantly, the influence of the factors affecting the OLD were changed from relative (%) values to absolute values in meters. This was done to increase the flight crew awareness on the influence of these factors. Below is an in-flight landing distance table from the paper quick reference handbook (QRH) of an A320. It represents the OLD with full flaps on a dry runway with all the factors affecting the landing distance given in metres.

The table below indicates that the loss of an engine (and therefore the corresponding thrust reverser) represents only a 10 meter increase in landing distance on a dry runway. The knowledge that the effect of a thrust reverser on a dry runway is almost negligible could have avoided a diversion on one engine.

Calculating performance data using the EFB brings clear benefits for flight crew workload and reduces the possibility of calculation errors. The benefit is even more pronounced with complex or combined failures. Unfortunately though, this leaves the flight crew less and less involved in the calculation process and thus diminishes their insight in respect of the process and their knowledge of the effect of the correction factors on the landing distance.

Normal line operations never restrict the time needed to make landing performance calculations with the EFB. However in time-critical situations, knowledge of reference performance values increases flight crew awareness and delivers sound decision making in selecting the safest as well as the most cost effective course of action. S

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Corrections on Landing Distance (m)		WEIGHT		SPD	ALT	WIND	TEMP	SLOPE	REV
Braking Mode	REF DIST (m) for 63T	Per 1T BELOW 63T	Per 1T ABOVE 63T	Per 5kt	Per 1000ft above SL	Per 5kt TW	Per 10°C ABOVE ISA	Per 1% Down Slope	Per Thrust Reverser Operative
Maximum MANUAL	1 020	- 10	+ 40	+ 70	+ 30	+ 110	+ 40	+ 20	- 10
AUTOBRAKE MED	1 270	- 10	+ 30	+ 90	+ 40	+ 130	+ 40	+ 10	0
AUTOBRAKE LOW	1 800	- 20	+ 50	+ 130	+ 70	+ 200	+ 60	+ 30	- 10

A320 in-flight landing distance on dry runway