THE EFB & iPAD'S ENHANCE THE ELECTRONIC CHECKLIST (ECL)

A Major Victory in the War on Cockpit Error

by

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In the space of just 15 months, ending in April of 1990, there were three fatal accidents where misuse of the cockpit checklist was determined to be one of the probable causes by the National Transportation Safety Board (NTSB). In the first accident, an Air New Orleans BAE J-31 commuter airplane crashed immediately after takeoff due to flight-crew failure to apply maximum takeoff power (NTSB, 1988b). In the second accident, Northwest Airlines Flight 255, an MD-80, crashed shortly after takeoff from Detroit Metro Airport (Michigan) following a no-flap/no-slat takeoff (NTSB, 1988a). In the third accident, Delta Air Lines Flight 1141, a B-727, crashed shortly after lifting off from runway 18L at Dallas-Fort Worth International Airport (Texas), after a no-flap/no-slat takeoff (NTSB, 1989). Following on the heels of those terrible events, the investigation of USAir Flight 5050, a B-737-400, which ran off LaGuardia Airport Runway 31 and dropped into the East River, also focused on the crews' checklist performance.[i]


Delta Air Lines Flight 1141

We are now 20 years removed from those tragedies but the problem remains with us today. A quick search of the NTSB, ICAO and ASRS databases, scanning for information regarding checklist-related accidents and incidents, reveals that the use of the checklist remains one of the significant causal factors in any number of events that cross all categories of aircraft and types of operations. Whether the source is an air carrier, a charter organization, or a strictly private general aviation operator, the errors of omission continue to occur with damaging results. One would ask, "If the nature of the problems are so well-understood and the risks so great, why hasn't more progress been made to mitigate the threat?" The answer may lie with the fact that aircraft are operated by humans and humans remain constrained by the same psychological behavior patterns and are subjected to many of the same distractions as always.

In 1979, W.P. Monan[ii] conducted a study of distraction reports sent to the ASRS in order to determine the causes of distraction in the aviation system. He stated in his report that *"one of the frequently occurring causes of hazardous events in air carrier operation is the human susceptibility to distractions"*. He then went on to argue that due to distractions, one airman is removed from the operational loop and thereby a vital cross-checking function is eliminated. The operation becomes vulnerable to any error committed during "*the one-man show*." Distractions and interruptions can "*break*" the checklist process and may result in a checklist error or omission. Conversely, the checklist process itself can be a detractor for other cockpit tasks and duties. Of the 169 air carrier distraction reports analyzed in Monan's study, 22 were labeled as "distractions caused by checklist procedures".

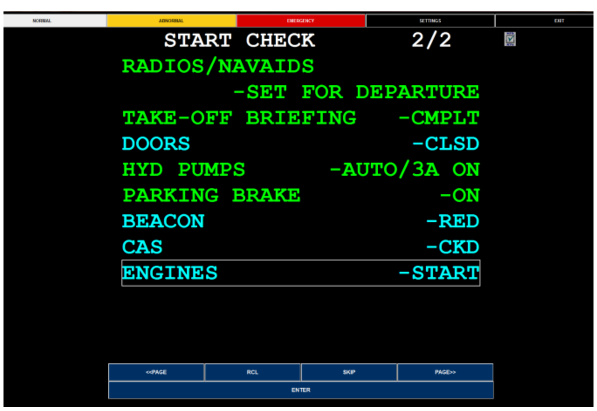
In 1980, Rouse and Rouse[iii] conducted experiments to evaluate the use of an on-board computer for checklist presentation. The computer retrieved the procedures from a database and provided a pointer by dimming the accomplished items on the screen. The results indicated that this computer-aided procedure is superior to a paper checklist in reduction of both error rate and execution time. In a second experiment, Rouse, Rouse, and Hammer (1982)[iv] compared a computer-aided checklist (which was part of the feedback loop) with a paper checklist. The use of normal and abnormal procedures was evaluated in a flight simulator. The computer-aided checklist was significantly lower in *error-rate*, while the paper checklist was significantly faster in execution time.

The advantages of a computer-aided checklist, regardless of whether or not it is integrated to the feedback loop, are then quite obvious. The device aids the pilot by providing a pointer, storing those skipped items for later retrieval, and eliminating the need to occupy one hand with holding a paper checklist card.

However, there were also some significant disadvantages that prevented widespread adoption:

- Display and font size was limited
- Non-adjustable distance of the CRT from the operator's eyes (this factor became more noticeable as the pilot's accommodation decreased with age)
- Inferior alphanumeric quality in early MFD CRT displays (compared to print on a card)
- The high cost of updating the normal checklist text, through the OEM
- A cumbersome interface through the Flight Guidance Panel (FGP)
- The checklist consumed valuable CRT display real estate

The advantages of the new On Board Data Systems (OBDS) Electronic Checklist ECL emulator ™ , employed, on an Electronic Flight Bag (EFB) or on an Apple iPad, and used in conjunction with a well-designed normal procedures checklist[v], offers significant advantages over similar variations employed on other cockpit displays. With dramatic improvements in display technology and the use of graphic fonts that are easily readable from anywhere within the typical cockpit by both crewmembers, OBDS has solved the first three objections found in previous studies. The Normal Procedures can be constructed using the guidance found in the wonderful work contained in the NASA Contractors Report, 177549, authored by Asaf Degani and Earl Wiener (1990) and easily updated using the OBDS Sync service for a nominal annual fee. This checklist no longer consumes the Primary Nav Display (PND) conflicting with other uses such as TCAS, Terrain, or Weather Display while retaining the OEM support for Abnormal and Emergency procedures straight from the Aircraft Flight Manual (AFM) which may not be edited or changed by the operator.



OBDS ECL - BD 700 Normal Procedures

Spanair Flight JK 5002

The Pilot Not Flying (PNF), executing the electronic checklist, will find navigation to be intuitive with the ability to quickly come into and out of a procedure, switching between whatever application has priority for that phase of flight, with no loss of orientation. OBDS has solved that problem with the use of open Tabs that immediately return the user to a previous location within the device.

"*Those who cannot learn from history are doomed to repeat it*."[vi] And repeat it they did with this unfortunate occurrence in Madrid involving the crash of Spanair Flight JK 5002, in 2008, which was almost a mirror of the checklist failure that led to the takeoff configuration accident with Northwest Airlines Flight 255 20 years earlier (the aircraft departed with no-flaps and no-slats selected for the takeoff).

Checklist failures claimed yet two more victims as evidenced by the final report on the GIV-SP Bedford, MA crash. 'NTSB investigators say the pilots of a Gulfstream IV that was destroyed after a rejected takeoff and runway excursion at Hanscom Field on May 31, 2014 did not perform a pre-takeoff control surface movement check.'1

Today's highly automated cockpits of the future from *Honeywell* and *Rockwell Collins* feature the ability to create and edit a customized Normal Procedures while the EFB ECL Emulator offers an affordable improvement, over previous technologies, and offers aviation a significant step forward as it continues to challenge the '*War on Cockpit Error*'!

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[i] *Aviation Week and Space Technology*, 1990, April 2
[ii] Monan, W. P. (1979). *Distraction - A human factor in air carrier hazard events* (NASA Technical memorandum 78608, p. 2-23). Moffett Field, CA: NASA Ames Research Center.
[iii] Rouse, S. H., and Rouse, W. B. (1980). Computer based manuals for procedural information. *IEEE Transactions on System, Man, and Cybernetics*, *10*(8), 506-510.
[iv] Rouse, S. H., Rouse, W. B., and Hammer, J. M. (1982). Design and evaluation of an on-board computer based information system for aircraft. *IEEE Transactions on System, Man, and Cybernetics*, *12*(4), 451-463.
[v] Degani, A., and Wiener, E. L. (1990). *The human factors of flight deck checklists*: The normal checklist (NASA Contractor Report 177549). Moffett Field, CA: NASA Ames Research Center. Degani, A. and Wiener E. L. (1991). Philosophy, Policies, and Procedures: *The Three P's of Flight-Deck Operations*. Proceedings of the Sixth International Symposium on Aviation Psychology (pp. 184-191). Columbus, OH: The Ohio State University
[vi] *George Santayana*

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[1]1 ERA14MA271 - National Transportation Safety Board