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BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

BEA Main Comments

Subject: BEA main comments on the draft Final Report for the accident that occurred on 10th March 2019 to the Boeing 737-8 MAX registered ET-AVJ operated by Ethiopian Airlines.

Introduction

The BEA wishes to thank the EAIB for being consulted on the draft final report for the aforementioned accident.
From the very start of the investigation, the BEA has actively participated in the understanding and the analysis of the aircraft systems, in cooperation with the NTSB and their technical advisers, under the authority of the Ethiopian AIB. It became quickly obvious that the crew performance also had to be analysed. The BEA provided the EAIB with a contribution report dedicated to the crew performance analysis.
The BEA appreciates that many of his comments made on the previous version of the draft final report have been taken into account. The BEA globally agrees with the analysis of the crew performance for phases 4 and 5 of the accident scenario. However, the BEA considers that some aspects of the analysis of the crew performance in the first phases of the flight are insufficiently developed and could improve the understanding of what could have been done by the crew which could have modified the outcome of the flight.
Therefore, the following comments represent additional points that the BEA considers necessary for a comprehensive and balanced report.

In accordance with paragraph 6.3 of ICAO Annex 13, we request that this document be appended to the Final Report.

Sequence of events

BEA comment 1 : initial flight crew's response to failures

a) Shortly after take-off, as a result of the erroneous left AOA value, the left stick shaker activated.

Stick shaker activation requires application of the Approach to Stall or Stall recovery procedure, which is a memory item. As described in the FCOM/QRH, the first steps in the

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Approach to Stall or Stall Recovery procedure are to hold the control column firmly, disengage the autopilot and authrottle and then smoothly apply a nose down input.
Only the nose down input was performed by the flight crew.

b) A few seconds later, an IAS DISAGREE message appeared on both PFDs. It was followed one second later by an ALT DISAGREE message.
In the case of the IAS DISAGREE, the flight crew has to go to the Airspeed Unreliable checklist. This checklist states to first disengage the AP, the Autothrottle and put the F/D switches on OFF, before setting 10° pitch attitude and 80% N1 (when flaps are extended).
The captain insisted in engaging the AP. He didn't disconnect the autothrottle.

The BEA disagrees with the part of the proposed scenario (paragraph 2.1 of the report) which states that the crew was "waiting for a safe altitude to execute non normal procedures". This is not supported by any crew exchange on the CVR. The crew never referred either to IAS DISAGREE or ALT DISAGREE messages, which supports the conclusion that the IAS DISAGREE and ALT DISAGREE messages were most probably not seen by the crew throughout the flight. The captain's resources, already affected by the multiple and confusing alerts, were further distracted by his insistence on engaging the autopilot instead of flying manually the aircraft. This may have further prevented him from identifying the IAS DISAGREE and ALT DISAGREE messages, and from applying the associated procedures.

BEA comment 2 : flight crew's management of the autothrottle

As the flight crew failed to apply the Approach to Stall or Stall Recovery Maneuver and the Airspeed Unreliable Non-Normal Checklist, the autothrottle remained engaged. Due to the AOA vane separation, the autothrottle failed to transition to N1 mode and remained in ARM with takeoff thrust.

The expected crew reaction was to take manual control of the thrust. This was not done, most probably because the lack of transition of the autothrottle from ARM to N1 was not identified by the crew. The report states that "*the crew could have known their autothrottle was not working as expected was if it automatically disengaged or gave an alert or warning. The autothrottle did not automatically disengage after detecting the failure nor did it give any alert or warning until the end of the flight*". It should be noted that when the overspeed warning triggered, there was no attempt from the crew to reduce the thrust. The lack of actions from the flight crew members to reduce the thrust aggravated the difficulties encountered by the crew to control the aircraft throughout the reminder of the flight.

BEA comment 3 : crew training

The final report contains new information related to the crew training. The BEA notes that, in the months preceding the accident flight, the flight crew had performed recurrent training on events which actually occured during the accident flight : Stick shaker

activation, IAS DISAGREE, Runaway stabilizer, use of Trim wheel, reaction to multiple non normal, task prioritization.
However, during the accident flight, the flight crew did not make appropriate use of the associated applicable procedures on which he had received training in the preceeding months. Insufficient support from the F/O, and more generally a deficient crew resource management by both flight crew members, likely contributed to the crew failure to make an appropriate use of applicable procedures in the first phases of the flight. A more in-depth analysis of this aspect, and in particular of the training and history of performance of both crew members with regard to crew resource management, would have been desirable.

Findings (paragraph 3.1 of the report)

BEA comment 4 : additional findings

The BEA notes that the following points, although developed in the analysis section of the report, are not incorporated in the conclusions :

- The flight crew's failure to apply the Approach to Stall or Stall Recovery Maneuver or the Airspeed Unreliable Non-Normal Check-list allowed the autothrottles to remain in ARM mode, with TOGA thrust.

- The Captain's attempts to engage AP was in contradiction with the Approach to Stall or Stall Recovery maneuver check list, which was expected to be applied in reaction to the stick shaker activation.

- The IAS DISAGREE and ALT DISAGREE alerts were very probably not seen by the crew who thus did not apply the Airspeed Unreliable Non-Normal Check-list.

- The flight crew didn't fully apply the Runaway Stabilizer NNC when the MCAS triggered. Only step 5 of this NNC was applied (moving the stabilizer trim switches to CUTOUT).

- The captain used several times the electric trim to try to counteract the MCAS nose down orders. However he never applied trim inputs for a sufficient duration to relieve the high control column forces. This is contrary to the observations made during the ECAB simulator sessions where the pilots felt that it was instinctive to use the electric trim to counter the nose down situation..

- The reason why the captain did not apply longer electric trim inputs could not be understood.

- As no thrust reduction was performed by the flight crew, airspeed increased which, in combination with insufficient trim, caused an increase of the forces on both the control column and the manual trim wheel.

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Contributing factors (paragraph 3.2 of the report)

BEA comment 5 : degradation of the CRM

The following contributing factor, which emerges from the analysis is not precisely stated in the report :

- Degradation of the CRM which started immediately after the AOA vane failure and which didn't help the crew take the necessary actions to keep the plane under control although they had received an adequate recurrent training on situations that occurred in the accident flight.

BEA comment 6 : MCAS Information dissemination

The report identifies the following contributing factor: "*In the absence MCAS descriptive function and its effect, it would be more difficult for the flight crew to understand its function.*"

However the report also states that "*The ADs, Bulletins and MOMs were released through the Logipad system which the pilots are required to upload as a standard procedure before going for flight*" and that "*the company has a checking system who did and who didn't*" (paragraph 1.17.12.2). The report mentions that the accident flight crew did.

The report also mentions that the flight crew had received recurrent training on the BOEING Multi Operator Message (MOM) on 15 November 2018.The Boeing MOM, which can be found in appendix of the report, describes the characteristics of the MCAS.

The BEA notes that the process of information dissemination and training at the airline level appears to have been insufficient to make it sure that the flight crews had acquired the required knowledge on the MCAS described in the Boeing Multi Operator Message (MOM) issued by the manufacturer after the Lion Air accident in Indonesia.

Yours sincerely.

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