

3. Conclusions

3.1 Findings

- 1) The captain did not adhere to a number of SOPs, particularly during the approach and final phases of flight:
 - (a) During the descent and the first approach, flight GF-072 had significantly higher speed than standard.
 - (b) During the first approach, standard 'approach configurations' were not achieved, and the approach was not stabilised on the correct approach path by 500 ft.
 - (c) When the captain perceived the he was 'not going to make it' on the first approach, standard go-around and missed approach procedures were not initiated.
 - (d) Instead, the captain executed a 360-degree orbit, a non-standard manoeuvre close to the runway at low altitude, with a considerable variation in altitude, bank angle and 'g' force.
 - (e) A 'rotation to 15 degree pitch-up' was not carried out during the go-around after the orbit.
 - (f) Neither the captain nor the first officer responded to hard GPWS warnings.
 - (g) In the approach and final phases of flight, there were a number of deviations of the aircraft from the standard flight parameters.
- 2) During the approach and final phases of flight, in spite of a number of deviations from the standard flight parameters and profile, the first officer (PNF) did not call them out, or draw the attention of the captain to them, as required by SOP's.
- 3) During the go-around after the orbit, it appears that the flight crew experienced spatial disorientation:
 - (a) During the go-around the aircraft was accelerating rapidly, as the captain was dealing with the flap over-speed situation, he applied a nose-down side-stick input that was held for about 11 seconds, resulting in a nose-down pitch of 15 degrees.
 - (b) A perceptual study conducted using FDR recordings of the accident flight indicated that while the aircraft was accelerating with TOGA power in total darkness, the somatogravic illusion could have caused the captain to perceive (falsely) that the aircraft was 'pitching up'. He would have responded by making a

'nose down' input. As a result the aircraft descended and thereafter flew into the shallow sea.

- 4) Controlled Flight Into Terrain:
 - (a) The GPWS 'sink rate' alert sounded, followed by the ground proximity warning 'whoop, whoop, pull up' which sounded every second for nine seconds until the impact.
 - (b) The analysis of FDR and CVR recordings indicated that neither the captain nor the first officer perceived, or effectively responded to, the threat of the aircraft's increasing proximity to the ground in spite of repeated hard GPWS warnings, and continued addressing the comparatively low priority flap over-speed situation.
 - (c) The captain did not fully utilise critical information provided by the aircraft instruments during the final phases of the flight, where he was also experiencing 'information overload'.
- 5) During the approach and final phases of the flight, the captain did not consult the first officer in the decision making process, and did not effectively use this (the first officer) valuable human resource available to him. A lack of training in CRM contributed in the flight crew not performing as an effective team conducting the operation of an aircraft.
- 6) Gulf Air's Organisational Factors:
 - (a) Inadequacy was identified in Gulf Air's A320 training programmes such as adherence to SOPs, CFIT, and GPWS responses.
 - (b) At the time of accident, Gulf Air's flight data analysis system was not functioning satisfactorily, and the flight safety department had a number of deficiencies, which restricted the airline's awareness in many critical safety areas.
- 7) Safety Oversight Factors:

A review of about three years preceding the accident indicated the following:

 - (a) The regulatory authority (DGCAM) had identified cases of non-compliance, and inadequate or slow responses in taking corrective actions to rectify them, on the part of Gulf Air in some critical regulatory requirements.
 - (b) Although the DGCAM was attempting to ensure regulatory compliance by Gulf Air, it could not accomplish it in some critical regulatory areas, due to inadequate response by the operator.

- (c) The regulatory authority and the airline are expected to fulfil complementary roles in maintaining safety of aircraft operations. The evidence indicated inadequacies in the fulfilment of the above, and highlighted the systemic factors in the airline's mechanisms to respond to the regulatory requirements.
- 8) As described in sections 1.17.11.1, 2.8.1 and 2.9.2, and thereafter, the airline has taken a number of post-accident safety initiatives in the areas such as: go-around procedures, ab-initio training, CRM training, command upgrade training, A320 fleet instructions, recurrent training and checking, instructor selection and training, pilot selection, modification to the A320 automatic flight system, and the flight safety department. Gulf Air has further reported that it is in the process of enhancing its flight crew training, particularly that of A320 aircraft, and introducing more safety initiatives.

3.2 Contributory Factors

The factors contributing to the above accident were identified as a combination of the individual and systemic issues. Any one of these factors, by itself, was insufficient to cause a breakdown of the safety system. Such factors may often remain undetected within a system for a considerable period of time. When these latent conditions combine with local events and environmental circumstances, such as individual factors contributed by “front-line” operators (e.g.: pilots or air traffic controllers) or environmental factors (e.g.: extreme weather conditions), a system failure, such as an accident, may occur.

The investigation showed that no single factor was responsible for the accident to GF-072. The accident was the result of a fatal combination of many contributory factors, both at the individual and systemic levels. All of these factors must be addressed to prevent such an accident happening again.

- (1) The individual factors particularly during the approach and final phases of the flight were:
 - (a) The captain did not adhere to a number of SOPs; such as: significantly higher than standard aircraft speeds during the descent and the first approach; not stabilising the approach on the correct approach path; performing an orbit, a non-standard manoeuvre, close to the runway at low altitude; not performing the correct go-around procedure; etc.
 - (b) In spite of a number of deviations from the standard flight parameters and profile, the first officer (PNF) did not call them out, or draw the attention of the captain to them, as required by SOP's.
 - (c) A perceptual study indicated that during the go-around after the orbit, it appears that the flight crew experienced spatial disorientation, which

could have caused the captain to perceive (falsely) that the aircraft was 'pitching up'. He responded by making a 'nose-down' input, and as a result, the aircraft descended and flew into the shallow sea.

- (d) Neither the captain nor the first officer perceived, or effectively responded to, the threat of increasing proximity to the ground, in spite of repeated hard GPWS warnings.
- (2) The systemic factors, identified at the time of the above accident, which could have led to the above individual factors, were:
- (a) Organisational factors (Gulf Air):
 - (i) A lack of training in CRM contributing to the flight crew not performing as an effective team in operating the aircraft.
 - (ii) Inadequacy in the airline's A320 training programmes, such as: adherence to SOPs, CFIT, and GPWS responses.
 - (iii) The airline's flight data analysis system was not functioning satisfactorily, and the flight safety department had a number of deficiencies.
 - (iv) Cases of non-compliance, and inadequate or slow responses in taking corrective actions to rectify them, on the part of the airline in some critical regulatory areas, were identified during three years preceding the accident.

(b) Safety oversight factors:

A review of about three years preceding the accident indicated that despite intensive efforts, the DGCAM as a regulatory authority could not make the operator comply with some critical regulatory requirements.
