

Lessons Learned from SQ006 Accident

Investigation

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On October 31, 2000, approximately 2317 Taiwan time (1517 UTC), a Singapore Airlines Flight 006, with Singapore registration 9V-SPK, Boeing 747-400 airplane entered an incorrect runway at Chiang-Kai-Shek (CKS) Airport, Taiwan. The airplane was destroyed by its collision with the runway construction equipment and by post impact fire. There were a total of 179 people on board with 159 passengers, 3 flight crew and 17 cabin crew. A total of 83 people died (including 4 cabin crew), and 44 people injured. Heavy rain and strong wind from typhoon "Xiang Sane" prevailed at the time of the accident.

According to ICAO Annex 13 and Taiwan Civil Aviation Law Article 84, Aviation Safety Council (ASC), an independent government organization of Taiwan responsible for civil aviation accidents and serious incidents investigations, immediately launched a team to conduct investigation of this accident. National Transportation Safety Board (NTSB) of USA, the state of manufacturer and Ministry of Communication, Information, and Transportation (MCIT) of Singapore, the state of registry and the operator joined the investigation team as the Accredited Representatives (AR). At the request of IIC, the Australia Transportation Safety Bureau (ATSB) had also sent three investigators to Taiwan as advisors and later on designated as an Accredited Representative team in accordance with paragraph 5.23 of the ICAO Annex 13. ASC also acquired a local Research Organization, Chung-Shan Institute of Science and Technology, to assist the on-scene mapping and testing of the runway edge light pigtailed. Investigation commenced immediately after the accident. Basing on the nature of this accident, the investigation team was organized into nine groups: Flight Operations, Recorders, ATC, Weather, Ground Operations, Systems, Survival Factors, Aerodrome, and Human Factors. The Aerodrome and Human Factors groups were incorporated one

week after the accident. A total of 78 people participated in the investigation and the organization of the investigation team is shown in Figure 1. Major highlights of the investigation process are shown in Table 1.

During the course of both the on-scene investigation, and the activities that followed, numerous lessons were learned from the operation of this international team. It is therefore the opinion of the team members that those lessons should be shared to the aviation investigation community, such that the investigation process could be improved in the future.

I. Logistics

1. Better coordination with the local prosecutors and the law enforcement is definitely necessary to ensure efficiency of the entire investigation process. In earlier stages of the on-scene investigation, the local prosecutor denied participation of the Accredited Representative team due to the lack of knowledge of the international law and the Taiwan Civil Aviation Law.
2. Autopsies were conducted only on eight of the eighty-three fatalities due to the lack of awareness of its importance to the survivor factors investigation. Cultural issues also need to be considered, as families of the deceased were very anxious to bury their loved ones after the tragic accident. Due to chaos by the fire and rescue effort, and the poor weather condition, drug and alcohol test of the pilots were not conducted immediately after the accident.
3. All participants of the aircraft accident investigation should be housed in one hotel or hotels in close proximity to facilitate discussions between groups. As the CKS transit hotel was fully occupied by the deceased family and the family assistance effort, such practice was not possible.
4. There should be greater inter-group coordination and sharing of information to minimize duplication of work. To this end, each group should establish its own file with findings arranged in chronological order, for sharing with other groups.
5. The investigation protocol should be established & made known to all parties.
6. The country of origin should provide individual biohazard protective gear to all investigators to walk the accident site.
7. Due to the lack of better coordination effort and the absence of the IIC at the beginning of the investigation, command post was changed three

times before the commencement of the full scale on-scene investigation (the arrival of the international teams). This has created some confusion in the early stage of the on-scene activities.

II. Wreckage Identification / Mapping / Handling / On-Scene Data Collection

1. The wreckage identification/mapping team shall comprise one each structure, systems, avionics and engine specialist in addition to the GPS crew. This can speed up the documentation / parts identification process.
2. With the documentation completed, the tagged parts can be moved to a storage area. This is to be determined by the group chairman and after consultation with the IIC. Other groups with interest in the wreckage must consent to this move. This is particularly important to the Survival Group, as they need to look at the fuselage wreckage to understand the survivability of the accident. They have to ensure their work is completed before the wreckage could be removed.
3. Proper assessment of how to access the recorders is very important. That includes the risk and difficulty when accessing the wreckage, especially during the poor weather condition.

III. Photo taking and Marking, Video

1. Starting the picture taking from the start of the impact point and then work down the path of the aircraft. By this way, a sequence could be developed.
2. The first shot of every wreckage piece shall be taken from a position behind the wreckage piece in the direction of the aircraft path. This provides a view of the wreckage in the perspective of an investigator moving down the runway. It also provides the correct orientation to the runway heading. Subsequent shots of the piece can be taken from other directions to show the best angle and details of the damage. Picture taking at the accident site was haphazard and random.
3. The reference number of many of the photos taken by Chung Shan Institute could not be seen clearly. This was due to the use of green marker on a white reflective board. The writing shall be in black thick strokes and be written on white non-reflective background. The photo reference number and the GPS position shall be indicated.

4. A short description of the damage piece shall follow. This shall include name of the part, part number and serial number information as well as the approximate dimensions. This description shall be logged against the photograph reference number. Where the part cannot be identified at the time of picture taking, the part number or serial number shall be recorded. In case these are not available, then part number of any adjacent detail part shall be recorded. This would assist in the identification of the part by checking on the next higher assembly of the detail part from the manufacturer's drawings.
5. In addition to the 35-mm prints, a digital camera shall also be used to record the wreckage pieces. A video camera is also recommended. This will have voice over feature and would provide a panoramic view of the site.
6. Should have used measuring apparatus to measure the brightness of the questioned lights to prevent from disputing of qualitative description.

IV. Recorders' Activities

1. As transcribing of ATC radio communications is usually a lengthy process, it should have commenced early. Additionally, a dedicated group of people well versed in ATC communications should have been formed to solely handle the ATC transcription.
2. All draft CVR transcript must be properly destroyed.
3. The CVR transcript distribution control list should be ready for internal or external distribution.
4. Spare recorders for readout should be considered after knowing the Part number of the recorder.
5. CVR audio information must be strictly controlled. CVR Non-disclosure Agreement must be signed regardless who is intended to listen to the CVR.
6. Line pilots who recognize the voice of the pilots in the CVR Group are strongly recommended.
7. CVR Group members should consist of at least one from every accredited party.
8. To avoid interruption of CVR transcribing progress, separated listening environment for other groups who need to listen to the CVR is recommended.

V. Team Organization, Meetings and Daily Activities

1. Conflicts are almost inevitable for an international accident investigation, especially if the nature of the accident is in human factors. The best way to resolve such conflicts is to have closer communication during the entire course of the investigation. Frequent technical review meetings are encouraged. Different opinions should be expressed in writing in the earlier stages of the investigation. This includes the factual data verification process, the analysis, and even the derivation of the recommendations.
2. An important part of the investigation process is planning carefully the activities of the team and establishing a list of priority action items. A feature of this could be a daily team meeting where the allocation of tasks is discussed and the workload distributed between the respective team members.
3. Prior to joining the team, team members should be carefully briefed as to what is expected from their participation in the group. It is important for the team members to have the same understanding of the team's objectives and the role that they will play in achieving this task. Any potential conflict with other duties should be discussed at this time and a process adopted to ensure that this would not adversely impact on the effectiveness or efficiency of the team. The team's progress towards their objective needs to be monitored, to ensure that the investigation is kept on-track and that emerging issues can be incorporated in this process.
4. When planning activities, the team should discuss the time when a given task should be completed. This will assist in managing the workload and ensuring that the group can meet the deadline for presenting its group report. When summarizing activities, the team should bear in mind the style of report that is required from the group and milestones should be set to assist in maintaining the flow of the investigation process.
5. The group chairman should convene a meeting every morning to determine what needs to be done for the day and also to review what had been accomplished the previous day.
6. Duration of group presentations during the daily debriefs should have time limit. Each group should state findings and lessons learned during the day. This would have kept the daily debriefs reasonably concise and given each group sufficient time to meet and plan their own work for the following day.

7. Minutes of the daily debrief should have been kept and disseminated to all groups.
8. Roles of the investigation team members should have been established and defined early. This could have prevented some members from overstepping their limits.
9. Daily group meeting and progress meeting are proved very helpful in the development and control of the group activities and the direction of investigation.
10. [Those of members should have enough time to work with group.](#) More than 50% of working time absent is very bad for final verification.
11. Although most of the members are familiar with the aircraft involved, more aircraft information during the on scene phase of the investigation would definitely help the process.

VI. Interviews

1. Careful planning and coordination is required prior to conducting interviews to ensure the group identifies the issues, which are critical to progress the investigation. The team needs to agree upon a protocol for conducting the interview and recording the information supplied.
2. Key witnesses should be interviewed by the relevant investigators as soon as possible
3. Human Factors Group should be represented in the Flight Operations, ATC and Survival groups in the interviews. This is to ensure that HF aspects are covered in the interviews as well as to avoid additional interviews, particular on similar questions.
4. Formalities should not preclude organized interviews. From this, the following should hold:
 - All interviews organized by the state of occurrence and data subsequently collected should be submitted.
 - Interviews should not be conducted without a member of the investigation authority of the state of occurrence.

VII. Minutes, Reports and Documentation

1. All proceedings of the meeting shall be recorded.
2. The minutes shall be kept in a file and made available to all group members as well as members from other groups.

3. Group members shall discuss the documentation process like what needs to be documented and what bearing the documentation has on the investigation.
4. All records of data, including investigation reports should follow a standard format for consistency.
5. The format of the group report should have been made available at the onset of the investigation. This would have provided the necessary guidelines for all groups to follow. The ongoing amendment of ASC SOP should consider the provision of such format.
6. Participating parties should be told very clearly that there is only one authentic group factual report for the group. Data or opinions collected other than factual information such as observations and comments will only be used for reference during analysis, not to be incorporated in the final group data collection report.

CONCLUSION:

Aviation Safety Council was established on May 25, 1998 for the purpose of improving aviation safety via systematic accident investigation. To the time of this writing, ASC has investigated a total of 13 aviation accidents and serious incidents but SQ006 is the first major accident investigation that reaches the international level. We are still a very young organization in this field that has lot to learn from the international community. It is our sincere hope that those lessons may have some values added to the investigators internationally, especially to the young organizations and to those who are considering the establishment of an independent investigation organization. We all hope that major accidents will not occur, but if indeed it happens, we would be more ready than what we had encountered during the SQ006 investigation.

Fig.1. Organization Chart

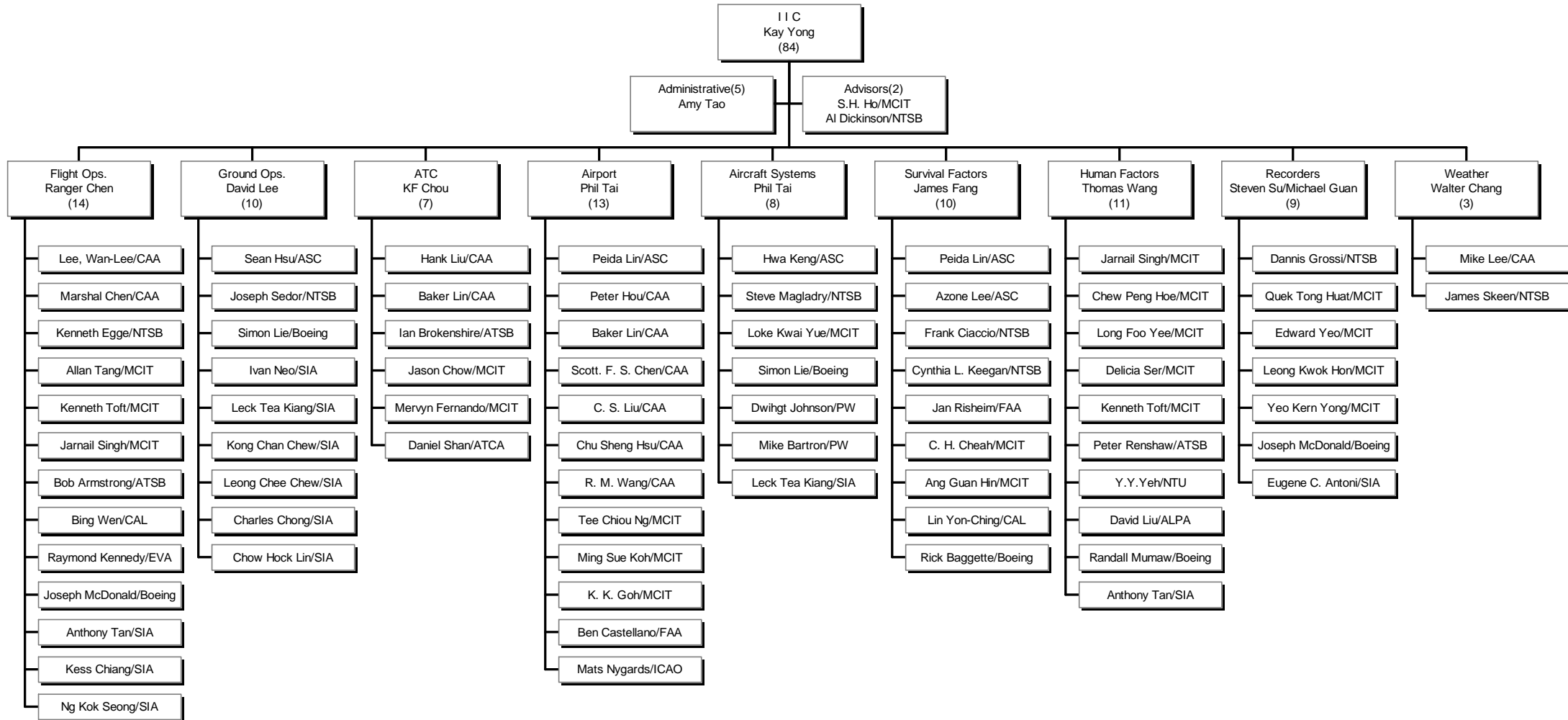


Table 1. Major Milestones

2000	10/31	Date of Accident
	11/04	Flight simulation of SQ006 completed
	11/08	Transcript of CVR completed
	11/13	On-scene investigation completed
	11/15	Wreckage removal
	11/15	On-scene report completed
	11/27	Interview SIA & CAAS
	12/04	Preliminary report published
2001	01/23	Factual data collection completed
	02/23	Factual Report on ASC Website
	03/01	Analysis process commenced
	07/05	Technical Review Meeting
	09/01	Draft report sent to NTSB & MCIT
	Late Nov.	Draft report submitted to ASC Board
	Early Dec.	Final report published