



Challenges for organizational investigation

- learn from a flight training school plane crash investigation

Koji Fukuda, JTSB aircraft safety investigator

Mr. Koji Fukuda, is an Aircraft Safety Investigator of Japan Transport Safety Board from 2006. His background is a pilot of Japan Coast Guard and flew about 4,000 hours mainly rotor craft. He has been involved in 25 accidents and serious incidents investigations.

Introduction

This is a case study of an accident investigation of a flight school plane crash. This case is a fatal accident occurred in a flight school and a case described in organizational problem deeply. We experienced difficulty of an organizational investigation through this case. Structure of this paper is as follows. After summary the process of this investigation is separated in five phases along the time series, then following up, and then consideration of difficulty of organizational investigation, the conclusion is in the end of the paper.

Summary

On July 28, 2011, a Beechcraft A36 operated by a flight school took off for a training flight from based airport at 9:11 AM. During Basic Instrument Flight in near training and testing airspace, the plane crashed into a mountain slope at about 9:22. The accident site was north Japan, an east end mountain of a mountain range in the south of Hokkaido. On board the airplane were four persons: Instructor A who was captain in front right seat, two students, student A was front left seat, student B was rear right seat and an Instructor B in rear left seat for educational and research. Three of them: two Instructors and student B suffered fatal injuries, and student A sustained serious injury. The airplane was destroyed and a post-crash fire broke out. The site was about 40 degrees slope, about 10 m height trees in forest. In a "Basic instrument flight training", BIF, a trainee wears a hood to restrict his field of view from outside ground reference and control the airplane as direct by an instructor. It is a tragic accident three people died, but it would be just a small plane accident. I would like to introduce probable cause at first to be understood why this case related to the SMS.

In the first paragraph, the plane flew into clouds or close to clouds and crashed into the mountain slope. In the second paragraph, the captain's death denied us the clarification his intention. And in the third paragraph, *It is somewhat likely that the basic safety policy of the school was not instilled into the field instructors, and that there was a gap in safety awareness between management and field instructors. It is also somewhat likely that behind the accident was a problem that involved the entire organization of the school—a work environment/organizational culture that consequently allowed unsafe behaviors.*

I will continue to explain the events that led to such conclusion, organizational problem.

Fact finding

I explain along the time series, first phase is fact finding. After the accident, two investigators, I and another one were appointed for this accident investigation. An AR also participated in the investigation as the State of Design and Manufacture. On the day of the accident, we moved to Hokkaido and started initial investigation. Since wild brown bears inhabit in the region, we climbed the mountain with hunters. We found a wing caught in a tree, debris, a tree broke the tip on the flight path. We confirmed visibility aboard the same type of the aircraft. Though the sole surviving Student A injured large burn was a treatment in the intensive care unit, ICU, but we could see him very short time and get his testimony.

I determined the investigation possible in the field at this time was almost finished, return to Tokyo once and gave an initial report to the aviation sub-committee. In the September, we climbed to the mountain again and conducted investigation of the site and the aircraft while cutting down annoying trees. In the November, we could arrange for warehouse and a helicopter finally, carried the accident aircraft to the foot by helicopter and conducted detail investigation in the warehouse. It took three half month so far, but we could finish almost fact finding. I separate it here and name phase 1.

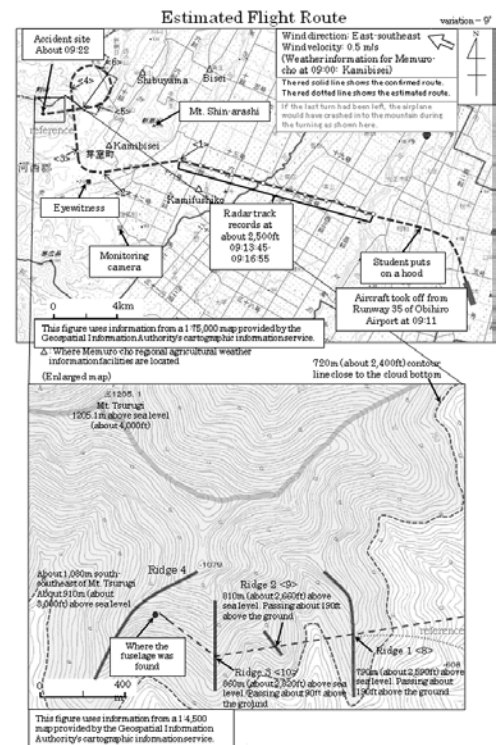
Analysis

We analyzed the information collected at phase 1, fact-finding, and reported as skeleton report in the December. I name this period phase 2. In here, I will explain the analyzed contents by using the description in the actual published investigation report.

The first is an analysis of the weather. We analyzed weather condition when the accident occurred from collected weather information, image of surveillance camera placed in an office and photograph of a climber. It is highly probable that the airplane could conduct training as planned without clouds over the mountainous area to the west of the Airport. It is also highly probable that the clouds that had existed near the mountain until 09:00 dissipated quickly by about 10:00. At around the time when the accident occurred, it is somewhat likely that the mountain and its vicinity were covered with clouds whose bottom was at an altitude of nearly 720 meters.

Next is analysis of estimated flight route. The accident plane didn't be installed recorder such as the GPS or DFDR that help us to identify the position. But we could estimate almost limited flight route from the airport and crash position, RADAR track of the ATC and testimony of the survived Student A and witness. It is somewhat likely that the airplane flew toward the accident site, heading 270°, while climbing, and that the accident occurred at about 09:22.

It is highly probable that Instructor A selected the training area in the vicinity of the cloud base where above ground distance was getting small at the edge of the mountainous area, not the airspace east of Mt. Shin-arashi, which was usually used. It is highly probable that above Ridge 3, the airplane came so close to obstacles on the ground that it almost touched them. It is somewhat likely that the reason Instructor A shouted "Ah!" and pulled the control wheel was that the Instructor A, who noticed the proximity to the obstacles, took the controls from Student A and attempted to evade Ridge 3. It is probable that Instructor A attempted to evade the mountain while changing the course of the airplane to the right to climb along the slope of the mountain. It is highly probable the last climb was attempted to get temporary altitude increase by raising its nose substantially. I explain the analyzed situation at the time of the collision. It is highly probable



that the airplane had flown normally until it collided with the trees. It is also highly probable that due to its collision with several trees, the wings were destroyed and its engine stopped; that its fuselage continued to move forward with inertial force while scattering fuel and violently crashed into the base of Tree 7 after colliding with Trees 5 and 6. It is highly probable that the fire broke out after crash.

It is highly probable the airplane intermittently flew into or close to clouds along the north-bound route and final leg to the accident site. It is also highly probable Instructor A uttered "Clear" without being able to confirm the safety of the area up ahead because; he could not see the mountain due to clouds; the airplane was about to be placed in an in-cloud condition or already in-cloud. There was no obstacle on its left-hand side, while mountains were approaching on its right-hand side and in front with the Ridge 4 blocking its course, and that despite these geographic features, it is highly probable that the airplane changed its course to the right and flew toward the steep slope of Ridge 4. A possible reason for this maneuver is the situation, where Instructor A could not see anything ahead and on his left-hand side due to clouds, forced him to resort to flying along the mountainside on the right overlooking trees, but his death denied clarifying the reason of this maneuver.

Needless to say, the airplane, which was conducting VFR training, was not allowed to fly into or close to clouds. In-cloud flight or close to clouds under VFR flight is extremely dangerous because the pilot cannot keep a safe distance from other airplanes or obstacles.

Why did he approach or enter clouds? It is somewhat likely that Instructor A flew close to or into the clouds with some intention such as to have students experience in-cloud conditions or to be able to continue training; however, his death denied us the clarification of his intention.

Why did the airplane crash into a mountain slope? It is highly probable that Instructor A became disoriented and unaware that he was closer to the mountains than he thought as the airplane became very close to or in-cloud and lost outside reference.

In addition to Instructor A and Student A in front seat, Instructor B and Student B had also boarded in the rear seat. Despite the airplane was flying close to or in the clouds in mountainous area, no advice was given from Instructor B or Student B. Why? Regard to Instructor B, it is somewhat likely that Instructor B refrained from objecting to the training presided over by Instructor A. Regard to Student B, it is highly probable that there was clearly an "authority gradient" between he and Instructor A.

I thought the mechanism of this accident had been almost clarified in what has been described so far. And I made a skeleton report to the aviation sub-committee in the December. It's a meeting to decide the direction of the investigation. In this flight school, several unsafe behaviors founded not only at the time of accident. In addition, the flight school had smaller accidents previous year and before previous year, subsequently the school had this fatal accident in the third year. Therefore, it was decided to carry out a detailed organizational investigation.

Organizational investigation

Phase 3, maybe you know ICAO document 9756 or AN965, the Manual of Aircraft Accident and Incident Investigation. We can see description of organizational investigation in chapter 3 of the manual part 3,

investigation. The importance of organizational investigation was described using the Reason model and the six M model of everyone familiar. Management problem, funding problem and potential problem are described. Each problem is important to conduct organizational investigation and should be kept in mind. It is mentioned as 3.5 methodology in the manual how to carry out the organizational investigation concretely. For example, 3.5.2.1 corporate goal. How we throw a question, they are concretely described. Similarly, *Organizational structure, Communications, Planning, Control and Monitoring, Design of systems and components, Corporate memory, Procedures, Resources, Regulation, Adaptation to new technology, Corporate culture and Safety management*. Each item is described in detail. We modified questions in these items to suit the circumstances of this flight school and created Inquiry list. Based on it, we conducted interview from General Safety manager by two board members in February 2012.

From here, using the quotation of the report, I explain the contents of analysis related to organizational problem and SMS. The number of accidents caused by the school grew sharply after it became an independent administrative agency, and the growth of fatal accidents was particularly outstanding. It is necessary for the Minister of Land, Infrastructure, Transport and Tourism and the School to focus on this fact and identify problems in the business administration system for the latter as an independent administrative institution and solve them appropriately. The school introduced a safety management system at its own initiative, and that its General Safety Manager has made the importance of safety management known to not only all employees but also all its students. If the head instructor or the deputy head instructor had known Instructor A's unsafe behaviors in advance, it is somewhat likely that the accident could have been precluded. Reporting system including the potential incident report did not work sufficiently and alternative reporting means were limited. They need to consider and implement effective methods that meet the actual situation of the school.

At the school, the investigation revealed at least five unsafe acts, and of which it is possible that at least four of them were intentional ones in which their performer underestimated the danger from the viewpoint of human factors. It is possible that the basic safety policy of the school was not instilled into the field instructors, and that there was a gap in safety awareness between management and field instructors. It is also possible that behind the accident was a problem that involved the entire organization of the school—a work environment/organizational culture that allowed unsafe behaviors. We pointed out the organizational problem of the school in this way.

Next, we have analyzed why such problems were not corrected. Audits of the safety management system of the school how it was. The school has its Main and Branch Schools conduct cross safety audits annually, and the CAB conducted extraordinary audits of the school after each of the accidents caused by the school, but there was no external audit aimed at examining the status of its daily operations. Judging from these, it is highly probable that the system of objectively checking mechanism for the safety management system at all levels of organization was not fully utilized.

The school was harshly evaluated for having caused accidents, but has received high ratings for all other items. Therefore, it is highly probable that this was because the school worked on its business

under the business administration system for independent administrative agencies. It is highly probable that the PDCA cycle was at work among the school, the Minister, and the Evaluation Committee under the business administration system for the school as an independent administrative agency. Judging from the fact that this accident occurred in the year following the period during which the school caused accidents for two consecutive years, it is highly probable that there was still room for improvements in the safety measures at the school.

We analyzed the safety measures under the Business Administration System for the school as an Independent Administrative Agency based on such situation. At first, in their evaluations for the medium-term-goal period, members of the Evaluation Committee pointed out the necessity of creating an organizational culture that urged all instructors and students to have an awareness of potential dangers at all times and eliminate danger factors before accidents occurred. An organizational climate cannot be built in a day but also it is brewed by daily ongoing activity. The Minister needs to consider how the College's medium-term goals should be. The Minister needs to periodically audits in the field.

Consideration of draft final report

I explain probable cause and recommendations as phase 4. Draft final report made by IIC was submitted to the aviation sub-committee through team meeting, mode meeting and secretariat meeting. Number of deliberation of this case was unusual number. Finally the probable cause is like this. As explained at the beginning, we pointed out the involvement of organizational problem. The school resumed the flight training after receiving an audit of Civil Aviation Bureau. In the actions to resume training and after resumption training, there are "Direct dialogues between the President and students", "Reviews of Video cameras and IC recorders", "using GPS logger". Recommendations for the Minister of MLIT are two, "Review of the medium-term plans" and "periodically audits". Recommendations for the flight school are three, "Review of the Training Procedures", "Strengthening of the SMS" and "Review of the medium-term plans".

Comments from relevant parties and state

Phase 5, we invited comments twice from a relevant party. Based on the comments, we continued to modify the draft report and to obtain the consent to a relevant party. We held five times aviation sub-committee meeting and took nine months, from the adoption to invite comments until the adoption of the final report. What I have described so far is the result. In order to make persuasive cause and feasible recommendation, much discussion was held. We published the final report in last December. We spent two years and six months from the accident. Why we took so long time? It can be said that the deep organizational investigation.

Follow up

We have followed up the response of the minister and the school for recommendations. CAB reviewed current medium-term plans and carry out field audits on a quarterly basis. In order to build of the open

educational environment, the school adopted "Assertion", a safety advice when necessary usually from subordinate. As measures that can be verified and understand real training situation objectively, the school adopted questionnaire for the students after each flight. And GPS logger and IC recorder were adopted. The school corrected concretely for two recommendations. New PDCA cycle by risk management was enhanced.

Though these are just self-evaluation of the flight school, as the result of efforts introduced so far, what effects were appeared to the students, instructors and the manager. The first are effects to the students. Their awareness and knowledge was increased, and attitude to tackle aggressively intensified. They came to speak actively comments about safety, and potential incident reports increased. Assertions came to be actively conducted. Opportunity to re-check the rules and restrictions between instructors and students together has increased. Next are effects to the instructors. Safety awareness of instructors has increased. And the atmosphere to create a safety actively spreads in instructors, and so on. The last are effects to the general safety manager. The manager came to check safety situation by himself and work actively to safety. The manager came to observe management staff, conduct hearings from students and guide instructors actively, and so on.

As described above, this accident investigation was very tough, but we are proud to have been able to contribute to safety.

Challenges

Based on the experience of this accident investigation, I tried to summarize the challenges of organizational investigation. In the ICAO manual, *"to be effective, investigations must consider the role of organizational factors, yet the investigation of such factors is likely to be heavily reliant on subjective judgment."* As might be obvious, we need to consider the degree of necessity of the organizational investigation depending on the form of the organization occurred accident or incident. In Japan, air transport services have SMS specified in the Civil Aeronautics Act. In aerial services, there is no provision of law or regulation, but most companies have SMS voluntarily. In flight school, SMS is a requirement for certification, and they have it. In private, there is no provision of law or regulation. But in some case, we should consider the role of the organization such as flying club. In the case of the A36 accident ; the flight school had SMS.

In the process of an investigation, organizational problems involved in the occurrence of the accident or incident will reveal. We should need to consider the necessity of organizational investigation depend on revealed organizational problem. In the case of structural defects of SMS were found, such as manual or number of staff, you need organizational investigation of course. Next, in spite of no problem in the manual or other structural, but the SMS is not functioning. It is suspected the functional defects, such as members understanding, lack of leadership or shortage of safety report, and so on. You should consider necessity of organizational investigation. At first glance, there is no problem in structure or function, but you find problem in the output. In such case, you should consider organizational investigation. If you find an existence of intentional unsafe act or gap of safety awareness

between management staff and field staff, and so on, you should check again defects of the SMS. In the case of the A36 accident ; on the surface, no problem in structure and function. But there were intentional unsafe acts and a gap between management staff and field staff.

I tried to summarize the points that we want to check on doing organizational investigation. By using as a checklist for each item in ICAO manual 3.5.2, we should be able to confirm no omissions in the organizational investigation. In the confirmation, it is important where they could stop the chain to the event. If we find them, we should carry out the investigation with an emphasis on this point. Disadvantageous point to the organization is likely to be concealed. I recommend some techniques. Interview from the lower interest members are helpful. Relationship built on trust is important. To this end, we should make them understand of the purpose of the investigation. In the case of the A36 accident ; the head instructor or the deputy head instructor could stop the accident. The students helped us by suggesting existence of intentional unsafe acts.

There is the limit of the organizational investigation in the ICAO manual. There is a description of *“A useful rule is that when the organizational investigator begins to arrive at circumstances which are beyond the control of managers, the investigation has exceeded reasonable bounds”*. In the case of the A36 accident ; We did not extend the investigation to the other incidents. We carried out to an interview from General Safety Manager, the top of the organization, by JTSB board members.

I tried to concern challenges for the future. I described before Relationship built on trust is important. There are difficult problem to be solved and good techniques to be considered. It is very difficult to correspondence in the case of no problem in the structural, such as they have perfect SMS structure. What is the Safety Culture? It is also difficult to fit interest point and components objectively to the real event.

Conclusion

I would like to summarize what I want to say.

- Organizational investigation is important to prevent recurrence.
- At first, consider the need of the organizational investigation.
- Build relationships on trust.
- Improvement of organizational investigation technique.

Organizational investigation is not always difficult. I want to introduce simple case. On the last New Year's Eve, a sightseeing flight helicopter dived to closer to sea surface at high speed, and crashed into sea since the wrong visual measurement. The copter destroyed, but no fatal injury. We carried out organizational investigation, because there are captain's intentional unsafe acts. We found problems in the manuals and the managements. We could publish the final report after a half year, June, 2014, because the company was very cooperative.