Preparing the Next Generation of Investigators – from a New Investigator's Perspective

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Abstract

This paper presents the uniqueness of the recruitment and development process of an aviation investigator and its challenges. In general, abundant industry experience in, for example, flight operations, maintenance, or avionics is preferred for an aviation personnel to be qualified for an investigator, as aviation occurrence investigations usually heavily rely on their comprehensive understanding in aircraft systems and operations; however, such ample experience does not guarantee that the mentioned professional will possess a manner of organized logic and personal characteristics that an investigator shall be required in order to perform his/her job functions, not mentioning the managing skills involved in major accident investigation. On the other hand, a new-hired graduate may own the required logical thinking and writing skills to present an aviation occurrence report in an organized manner, but he/she is in lack of the qualification of industry experience, which would constrain further growth if no appropriate on-the-job training is given to those young investigators. In this paper the author will look at the development process of investigators from different background in the following aspects: initialization training, accumulation of investigative experience, on-the-job training, and other related (nice to have) skills, in the hope of indicating the challenges that an investigation agency might be facing, and sorting out an feasible way in preparing our next generation of aviation investigators.

I. Introduction

With the advances in innovative technologies, travelers nowadays are able to fly in more efficient, more reliable, and the most importantly, safer airplanes. Such success is accomplished by not only the progression in aircraft technologies itself, but also by improvement in air traffic management and airport infrastructure. As demand in commercial air transport continues to see a growing trend, the more reliable aviation system makes global aviation safety record maintain an improvement over the last decade.

However, aircraft incidents even accidents still occur occasionally. To reveal the probable causes to an aircraft accident, it is air safety investigators' responsibility to carefully examine all collectable evidence related to the occurrence before coming to a conclusion and safety recommendations. In a major accident investigation which always draws attentions from the public and news media, image of investigators is viewed as highly professional and their announcements are being treated with respects. Such responsibilities make air safety investigators very influential and thus stand out the significance of training investigators to be qualified for

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unanticipated investigative tasks.

The continuous lowering fatal accident rate in civil aviation in modern world over last decades has to be partially credited to air safety investigators. As they might work strenuously at a hazardous crash site, over an intensive timeframe, much of the success in aviation safety has been due to the knowledge or lessons learned from prior aircraft accident investigation conducted with the aim of ensuring that accidents in similar circumstances will never recur[1,2]. However, an improving record of global aviation safety implies that air safety investigators would be foreseen to receive less opportunity exposing in a real investigative atmosphere to make use of their specializations. This is particularly true for young/junior investigators as they make their entrance into this industry during the unprecedented low era of aviation occurrence record in civil aviation. In consequence, on-the-job training and exercises to maintain their proficiencies become an important agenda for the new generation investigators.

Junior investigators, furthermore, may realize that in the aviation industry traditional, or reactive investigative practice may have approached to its limits; and proactive practices to identify safety hazards, assess the risks, and put controls in place to prevent accidents to occur have been gradually evolved[3, 4]. While it seems more difficult to throw in investment to prevent something that could never happen than spend money after an accident to prevent it from happening again, it is necessary to remind the next generation investigators to adopt new techniques for future investigations, and position themselves and their agencies well such that the investigative skills and agency operational process could follow the global trends.

This paper will be presented as follows: first a brief introduction of investigator recruitment will be given, following by the current guideline of international standard of air safety investigator training will be described, following by a comparison to author's training process when he joined the Aviation Safety Council Taiwan less than three years ago. As a fairly junior investigator, the author will provide his perspectives regarding the development process for next generation investigators on several aspects, from recruiting sources, investigator's attributes, and on-the-job training to maintain his competence. The aim is to illustrate the challenges from the evolving trends of future investigations and the significance of how young investigators shall position themselves to become qualified investigators for future occurrences.

II. Investigator Recruitment

While considerable practical experience in aviation is usually assumed as a prerequisite for prospective accident investigators to build on their investigation skills, it is still possible that new graduates are hired by an investigation agency as long as they possess the required background that fits into the specialized area that the agency assigns the new investigator to. In this case, graduates with aerospace/aeronautical engineering or mechanical engineering majors could benefit as they have better understanding on aviation fundamentals, hence are able to get on track to investigative duties quickly if proper training in specialized areas is given. As being an aircraft accident investigator usually requires long-term commitment, a new-hired graduate provides better potential to devote him/herself to an investigator career that lasts long if continuous on-the-job training is

offered. And such new investigator would become a valuable asset for the agency as he/she matures with investigation experience gradually obtained over time.

It has to be understood that even within aviation industry, few people could find their niches as an air safety investigators directly; therefore for an investigation agency, no matter an independent authority, or an accident investigation unit within a regulatory authority, recruits its new investigators with qualifications of experience acquired from civil or military aviation as a pilot, aircraft maintenance specialist, or air traffic controller. These personnel will make an immediate supply to investigative manpower after they receive orientation and basic training in aircraft accident investigation techniques, which is desired from an investigation agency's point of view. However, it has to be noted that for such new investigators, there is a trade-off between the amount of previous aviation experience and the length of time he/she could serve as an investigator.

A good understanding in English, usually referred to intermediate level even negotiable level for more senior positions, is absolutely essential for an aircraft accident investigator who is not an English native speaker. As most of aircraft manuals are written in English, it is necessary for investigators able to finish reading a manual within a reasonable timeframe, and with good understanding to the content. Oral communication in English is sometimes possible during an investigative meeting, while report writing in English will be required during an international investigation.

III. Training Guidelines

ICAO developed training guidelines for aircraft accident investigators in response to several state members' request for common standards for the training of investigators during the AIG meeting in 1999. The publication of Circular 298, titled "Training Guidelines for Aircraft Accident Investigators", outlines the experience and employment background required for training as an aircraft accident investigator, as well as appropriate training schedule in order to qualify a prospect investigator for various investigative roles[5]. This Circular 298 depicts several stages to train a new investigator:

- Phase 1: Initial training
- Phase 2: On-the-Job training
- Phase 3: Basic accident investigation courses
- Phase 4: Advanced accident investigation course and additional training

Phase 1 is to familiarize new investigators with the investigation legislation in his country, and with the standard operating procedures of the agency. Besides the legislations and rules, the initial training shall cover a range of topics from international standards (i.e. ICAO Annex 13 and Document 9756), equipments, initial response and on-call procedures, to organization of an investigative team and introduction to their duties. Once the initialization training is completed, an investigation agency will provide on-the-job training to a new investigator according to the duties that match into his/her qualifications. This is when the new investigator further familiarizes with the investigative tasks from factual information collection, analysis of the factual

information, determination of conclusion, and issuing safety recommendations (depending on the SOP of individual agency.) The new investigator also will gain experience in on-site investigation techniques. It is also believed that at least one senior investigator shall involve with the on-the-job training of a new investigator to expedite the learning effectiveness.

Attending a basic aircraft accident investigation course within the first year of service of a new investigator is recommended by ICAO in Circular 298. Such course could be found not only at an investigation agency affiliated training center, but offered at universities and industry partners (e.g. flight recorder manufacturers and aviation organizations). The curriculum shall cover a wide range of investigative topics so that the new investigator can have a comprehensive understanding on each of the investigation aspects, which is especially important for one conducting a general aviation investigation as he might be the sole one dispatched to the scene. A more advanced investigation related course can be called upon the investigator gains more experience after a few years of service. At the phase 4, he/she can select the topic of the course that best fits into the interest and would help conduct investigative duties at the agency.

A similar roadmap as the one described in Circular 298 for new investigators can be found at the Aviation Safety Council. As an example, the author, an aerospace engineering major, was recruited two and half years ago by the Aviation Safety Council. Before hired by ASC, the author only accumulated about one year of work experience as a post-doctoral researcher on aviation emission continued from his doctoral research. The initialization training took about one month to be completed, and covered a wide range of topics from organization SOP, domestic legislation, international standards, to introduction to technical groups in an investigation team such as flight operations, salvage, flight recorders, human factor, ATS, airport infrastructures, and aircraft structures etc. Since the author is a member of the investigation lab at ASC, specialization sessions on site survey with GPS tools (Fig. 1) and flight recorder readout and analysis were planned. With the completion of the initialization training, the author was able to join the investigation teams for three aviation occurrences since then, all as one of the members of flight recorder group, before attending NTSB training center's basic aircraft accident investigation training. The completion of phase 3 marked the ninth month of service since the author joined ASC. The phase 4 took place in the second year as the author felt the need to learn the full features of the flight data analysis software that the Aviation Safety Council has been using for years; therefore a training organized by the company that developed the software was arranged. In the near future, training to flight recorder manufacturer on recorder operations and data analysis is under consideration.

Fig. 1 On-the-job training includes occurrence site survey using GPS tools

The Aviation Safety Council also imposes an assessment system for new investigators. A freshman begins his career at ASC as OJT status until he completes on-the-job training (phase 2) for one investigation assignment in a technical group and the basic aircraft investigation courses (phase 3), and is capable of being promoted to an investigator. After completion of assignment in three investigations, he becomes eligible to apply for group chairman qualification. Currently, the author just received promotion to recorder group chairman qualification, and is in charge of the recorder group activity of one serious incident.

IV. Discussion

Neither a well organized training program nor abundant industrial experience guarantee qualified investigators. To become a competent aircraft accident investigator, certain personal attributes and capabilities are necessary in additional to a good basic training and practical experience. Therefore in developing a new air safety investigator, an investigation agency shall never forget to look into the following:

A. Personal Attributes

Air safety accident investigators require impartially and integrity in collecting factual information. With an unbiased mind an investigator is able to earn the trust from all parties within the investigation team; on the other hand, any presumption or a default position can cost an investigator to lose respects from his team and the public. It could be realized that aircraft accident investigation, from public's point of view, is extremely technically complicated such that people would regard safety investigators as highly professional. And this is also how an investigation agency can gradually build up its reputation as it relies on past investigation reports to educate the public what has been done to prevent an accident of similar circumstances from recurring, and which, as a result, contributes to the lowering of global accident rate in the past decade.

Investigators also need to possess the ability to analyze collected factual information in a logical manner, and to pursue the reason behind irregularities with perseverance. As the investigation process of an aircraft accident could be tedious and intensive in time, investigators must not be afraid of trying in errors, as long as a clear investigative roadmap is drawn, and remain focused with resilience[6, 7].

B. Technical Writing and Logical Thinking

The aviation occurrence report is the final product that summarizes the works done by investigators and a tool of communication with the public, in order to explain what happened to an aircraft accident and how the aviation industry shall do to prevent it from happening again. For most of the investigation agencies around the world, investigators are not assisted by technical writers to polish their investigation reports, thus it is significant that investigators not only have to conduct their investigation in a logical way, but need to compose their reports

in an organized and reasonable manner.

At the Aviation Safety Council, the targeted readers of ASC's aviation occurrence reports are general public that are no younger than undergraduate freshmen; however outstanding high school students shall be able to understand majority of the content in a report. That being said, it is investigators' responsibility to arrange their reports with sufficient information, a fluent history of flight, and logic, detailed but not overwhelming analysis to the factual information. The investigation process, including report writing, can be viewed as conducing academic research[1]. This approach believes that, to accomplish the objectives of an investigation which can be viewed as a research project, strategies to attack the problem and to help answer the questions that arose from the accident need to be well-planned. And the research efforts need to be periodically presented in writing as interim reports with final results presented as a full length research paper, which corresponds to the aviation occurrence report. Like any good research paper, an accident investigation cannot be regarded as successful without a final report with noteworthy findings.

There also exists a contradictory that while personnel with considerable aviation experience might be good candidates to become air safety investigators, he or she might not receive enough academic training on technical writing on presenting a report; on the other hand, new investigators recruited directly from academia with suitable background can be good in technical writing skills, but lack of industrial experience would be critical thus limits their future development. To resolve the former problem, short courses or training in technical writing could be useful; and for the latter, continuous on-the-job training and learning, which will be described in the following section, is the absolute solution to maintain the competence of new investigators.

C. Continuous Learning

People nowadays are living in a world with wealthy information benefitted from advances in blooming technologies, and safety investigators too, have no exception in their professional field. Take flight recorders for example, when looking back 30 years ago, no one could ever imagine that investigators in the 21st century are able to take advantage of using flight data recorders that can record over 3,000 parameters (and it will keep growing!). Modern aircraft accident investigators are therefore in cope with such wealth of data, and in order to maintain their competence, they can no longer rely on 20th century techniques to investigate 21st century accidents[8]. All available tools shall be used. This is particularly true for the next generation of investigators as otherwise the drastic augmentation of data available would make them knowledgably poor.

This highlights the significance of continuous learning for air safety investigators and this goal can be achieved in individual and from the support of agency. For new investigators, they shall regularly look into exploring new technologies as tools to assist their investigation works, for instance GIS platforms and use of UAV in site surveying. It is also helpful if they conduct literature survey, such as accident investigation reports from other AIBs, periodically. Wide literature survey not limited in aviation could stimulate some ideas that may fit well in aviation safety. For example, in civil aviation the trend "from reactive to proactive" hence the adoption of Safety Management System to ICAO Annex was partially inspired by the successful execution in

maritime mode.

From agency' side, systematic offers of on-the-job training to investigators would be appreciated if the investigators have a clear roadmap on their own to develop in accordance to their professional interests and assignments by the agency (Fig. 2, Fig. 3) . In addition, agency can encourage their investigators to conduct safety studies/research on topics to the agency's concerns. A safety study, dissimilar to an investigation analysis, contains broader coverage of information and data, and could produce a systematic findings and trends. In the Aviation Safety Council, a workgroup of runway excursion had been set up and run until recently, as improving runway safety has been on ASC's priority list for many years to come. Through continuous literature survey and use of data from actual aviation occurrences in Taiwan, the ASC investigators enriched their knowledge in factors that contributed to runway excursion events, and results were generously shared with domestic carriers during the annual safety symposiums.

Fig. 2 ASC investigator recurrent training on underwater recorder search

Fig. 3 ASC investigator annual high mountain training

V. Concluding Remarks

In this paper, challenges faced in preparation for the next generation of air safety investigators were presented. Qualification for aircraft accident investigators is so unique that it seems only personnel with ample practical experience in aviation can fulfill the recruitment requirements. However, to become a competitive air safety investigator it may require more than practical experience, an organized training program that follows

international standards is essential; and moreover, in this paper, three core values were added: personal attributes, ability of technical writing and logical thinking, and last but not least, willingness of continuous learning.

These core values, in author's opinion, could be put on top of the priority list when an accident investigation bureau makes its recruitment. Appropriate personal attributes and the ability of presenting (i.e. writing) investigation reports in a logical manner are definitely the basics for air safety investigators when performing their duties; in addition, a continuous learning attitude from the next generation investigators enables them to exploit available tools well to deal with growing information and booming amount of data that comes with advancing technologies nowadays, and to expand the knowledge database beyond what they already possess. Again, investigators cannot rely simply on past techniques to perform investigations on modern and future occurrences. To conquer future challenges a continuous learning attitude from the heart, along with the support from agency, would be definitely the best way to further refine themselves for qualified and competitive air safety investigators.

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