Reorganizing the Evaluation System of Transportation Accident Investigators in the TTSB

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Abstract: Transportation accident investigation is a professional task which should only be undertaken by qualified investigators. With the goal to raise investigation quality and promote international recognition for accident investigation, the Taiwan Transportation Safety Board (TTSB) is reorganizing a pre-existed evaluation system for accident investigators. This evaluation system inherits the features to evaluate investigator's performance and attributes from subjective and objective perspectives. The enforcement of this evaluation system ensures quality improvement of accident investigators and increase the investigation creditability in the foreseeable future.

Keywords: Taiwan Transportation Safety Board, transportation accident investigation, qualification and evaluation

1. INTRODUCTION

On February 16, 1998, a China Airlines Airbus A300 aircraft crashed into a road and impacted a residential area during an attempted go around at Chiang Kai-shek International Airport. The crash totally caused 203 fatalities which was the deadliest aviation accident at that time. The accident not only caused damage to numerous properties and lives but also struck national aviation developments severely. To improve flight safety and to avoid accidents from reoccurring, the Aviation Safety Council (ASC) was established on May 25, 1998 to independently investigate aviation accident on national aircraft. Since the establishment of the ASC to 2018, the 10 years moving average hull loss accident rates of national turbojet airplane was reduced from 3.18 per million departures to zero. As a result, the ASC received recognition and reputation for its professional and performance from domestic and international aviation accident investigation communities. (Taiwan Transportation Safety Board, 2019)

Serious transportation accident usually draws worldwide attentions from either news

media or the public. On October 21, 2018, a Taiwan Railway Puyuma Express Train No. 6432 derailed from the main line outside Sinma Train Station in Yilan County resulting in 18 fatalities and more than 200 injuries. To response to the expectation of national civilian and recover people's trust in transportation safety, Taiwan government quickly decided to establish an agency on the basis of the ASC to independently investigate the catastrophic railway accident. The Congress (Legislative Yuan) later passed a bill in April, 2019 to establish a new government agency in charge of investigating major aviation, marine, railway and highway transportation accident. The TTSB was then officially established on August 1, 2019. Duties of the TTSB include: 1. conduct major aviation, marine, railway and highway accident investigations to determine its causes; 2. make recommendations to prevent the recurrence of similar accidents ; and 3. Conduct research to fulfill the afore mentioned duty. (Taiwan Transportation Safety Board, 2019)

This paper first introduces how the TTSB was established, following by a brief introduction of the organizational structure and capabilities of the TTSB. In order to effectively investigate transportation accident and find the real cause of the accident, investigative quality of investigators are definitely the key factor in the investigation. Therefore, trainings of newly recruited investigators and how their qualification are evaluated in the TTSB will be presented and discussed in this paper.

2. ORGANIZATION and DUTIES

In accordance with "The Organization Act of the Taiwan Transportation Safety Board" (Taiwan Transportation Safety Board, 2019) and "Transportation Occurrences Investigation Act" (Taiwan Transportation Safety Board, 2019), the TTSB is established to investigate major transportation accident independently on aviation, marine, railway, and highway. Board members are appointed by the Premier to carry out the TTSB's mandate. The Board itself consists of nine to eleven Board Members. Five full-time Board Members, one of them is Chairperson and another as Vice Chairperson to assist the Chairperson with the operations of TTSB; the rest four to six are part-time Board Members. All of them will serve a four-year term and are allowed to be re-appointed. The organizational structure of the TTSB is shown as in Figure 1.

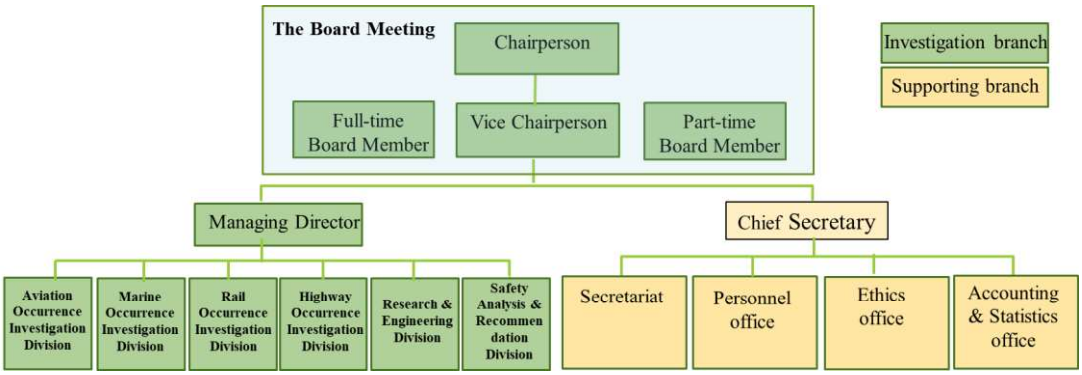

Figure 1. TTSB organizational structure

As shown in the organizational chart, two branches of staff, one investigation branch and the other one supporting branch, support the Board. The supporting branch with a staff depth of 17 led by the Chief Secretary maintaining daily administrative business of the TTSB. The investigation branch includes about 53 investigators which led by the Managing Director responsible for accident investigation on aviation, marine, railway and highway. All investigators are based in Taipei.

Since its establishment, TTSB's primary duty has been to determine the probable cause of transportation accidents and to issue safety recommendations to improve transportation safety. Transport activity grows as the economy grows. In order to face with the progress of transportation vehicles and to facilitate transportation accident investigation, the TTSB continuously do preventive research that investigators can acquire knowledge and develop new investigative skills. Engineering capabilities such as accident site survey, vehicle data recorder readout, performance analysis, structure failure analysis etc., are summarized in Figure 2. Developed investigation tools and systems include SMS investigation tools, fatigue analysis tools, investigation analysis system, safety recommendation tracking system and voluntary safety reporting system, are summarized in Figure 3.

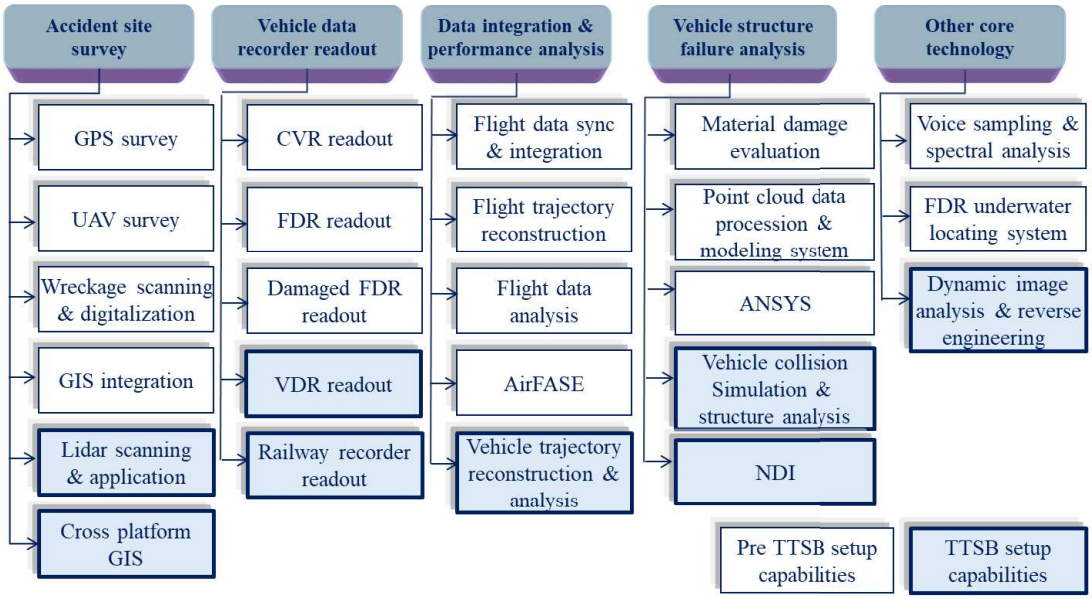

Figure 2. TTSB Engineering capabilities

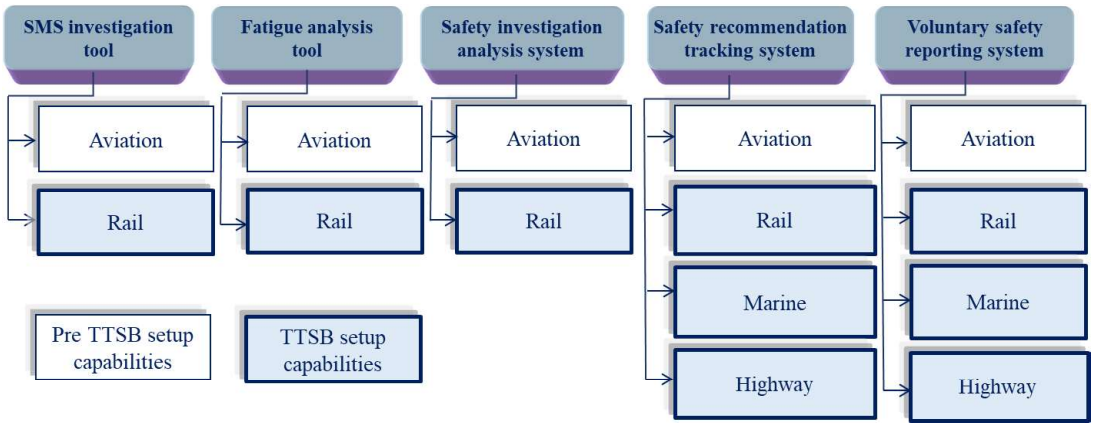

Figure 3. TTSB investigation tools and systems

As an independent agency, the TTSB is entirely separate from all transport regulatory authorities such as Civil Aeronautics Administration, Maritime Port Bureau, Railway Bureau and Directorate General of Highways. This separation avoids external influence and ensures the independence of TTSB investigations. However, pursuant to the Transportation Occurrence Investigation Act, the TTSB shall invite representatives from the authorities and organizations concerned to participate in the investigation. The TTSB will investigate military ship accident only when a civilian ship is involved in the same accident. When requested, TTSB will assist the military aircraft accident investigation.

Although the TTSB is not a member of either the International Civil Aviation Organization (ICAO) or the International Maritime Organization (IMO), the TTSB has frequently communicated and coordinated with transportation safety related organizations worldwide. (Norihiro G., 2010) In the interests of making global transportation safety, the

TTSB will continuously collaborate and assist with international transportation accident investigations.

3. INVESTIGATOR TRAINING

In order to respond to any unexpected transportation accident and to launch investigation team immediately, investigator should well prepared and equipped. The TTSB recruits experienced experts from the fields of aviation, marine, railway and highway together with experienced investigators from formal ASC to form a comprehensive investigation team to investigate all types of major transportation accidents. To effectively investigate transport accident and find real causes of the accident, investigators should possess multi-folded knowledge and have expertise in accident investigation. Areas of expertise should at least include evidences collection, personnel interviewing, analysis based on collected evidences and capability of investigation report writing. (International Civil Aviation Organization, 2003, International Maritime Organization, 2014) In addition, a qualified investigator should also possess logical reasoning ability and balanced personal attributes in conducting accident investigations. (International Maritime Organization, 2014) All investigators attending an accident site should also have sufficient knowledge to identify accident site hazards and prepare effective countermeasures to eliminate or mitigate potential hazards exposure. (International Civil Aviation Organization, 2008)

Investigator's techniques and experience on accident investigation can be gradually accumulated through progressive course trainings, on job trainings and the involvement of accident investigations. The possession of these techniques and attributes were evaluated from personal training records and documented observations from an experienced investigators being involved in the same investigation. (Aviation Safety Council, 2010) As a result, the TTSB developed a series of training programs for its investigators. Newly recruited transportation accident investigators came from various fields and they may have different specialties. Newly recruited investigators need to take general investigation training initially. The general investigation training includes familiarization training and initial training which is undertaken in the TTSB. After completion of the general investigation training, an investigator should be familiar with administrative arrangements in an accident investigation, communication with parties, on-call procedures and formal investigation procedures, such as national and international regulations.

A newly recruited investigator may concurrently join an accident investigation supervised by an experienced investigator for the required on job training. During the on job training, he/she needs to learn how to collect evidences under the supervision of experienced investigator and follow the standard operation procedures during the investigation. Upon fulfillment of the

required general trainings, each investigator will be sent to domestic or foreign training organization or training academy for basic training. After that, the investigator needs to arrange by himself/herself an advanced training. The scheduled advanced training should be beneficial for oneself to conduct transportation accident investigation in the future. Most of the time, advanced training course is chosen to cope with the specialty of investigator. The training requirements of each investigative mode are summarized in Figure 4. (Taiwan Transportation Safety Board, 2020.)

	Initial Training	On Job Training	Basic Training	Advanced Training
Aviation	25 course subjects 50 hours	join 2 investigations	34 course subjects 50 hours	Join 2 investigations or 30 hours course
Marine	10 course subjects 15 hours	join at least 1 investigation	domestic/foreign training organization	domestic/foreign training organization
Railway	10 course subjects 25 hours	join at least 2 investigations	domestic/foreign training organization	domestic/foreign training organization
Highway	23 course subjects 25 hours	join at least 1 investigation	23 course subjects 42 hours domestic/foreign training organization	9 course subjects domestic/foreign training organization

Figure 4. Training requirements of each mode

4. INVESTIGATOR'S QUALIFICATION and EVALUATION

On December 2010, the ASC commenced a personnel qualification process to qualify its aviation accident investigators. As far as we are concerned at that time, no such process had been applied to evaluate investigator's qualification either in ASC or abroad. The reason was that there were no objective standards to identify personality and capabilities of an aviation accident investigator, typical mentor - apprentice system and subjective judgment to qualify investigative competence is still favorable for agencies with limited staff depth. Based on the guideline of ICAO Circular 298, with the incorporation of investigative performance and personal attributes, the ASC established a system to evaluate investigator's qualification. The implementation of this evaluation system was proved to have the capability to identify qualified investigators commensurate with their investigative grades in the ASC. The increase of aviation accident investigation quality can be proved from the trending of aircraft accident rates. Figure 5 shows the latest 10 years average hull loss rate of domestic turbojet aircraft. The calculation

of average hull loss rate was based on a 10 years moving average. After the establishment of the ASC, the rate was as high as 1.75 per million departures in the early stages. Eventually, the average hull loss rate of domestic turbojet aircraft was decreased slowly but steadily from this high rate to a perfect zero. During this period of time, ASC investigators' quality and performance improvement in the conduction of aviation accident investigation was absolutely the key point.

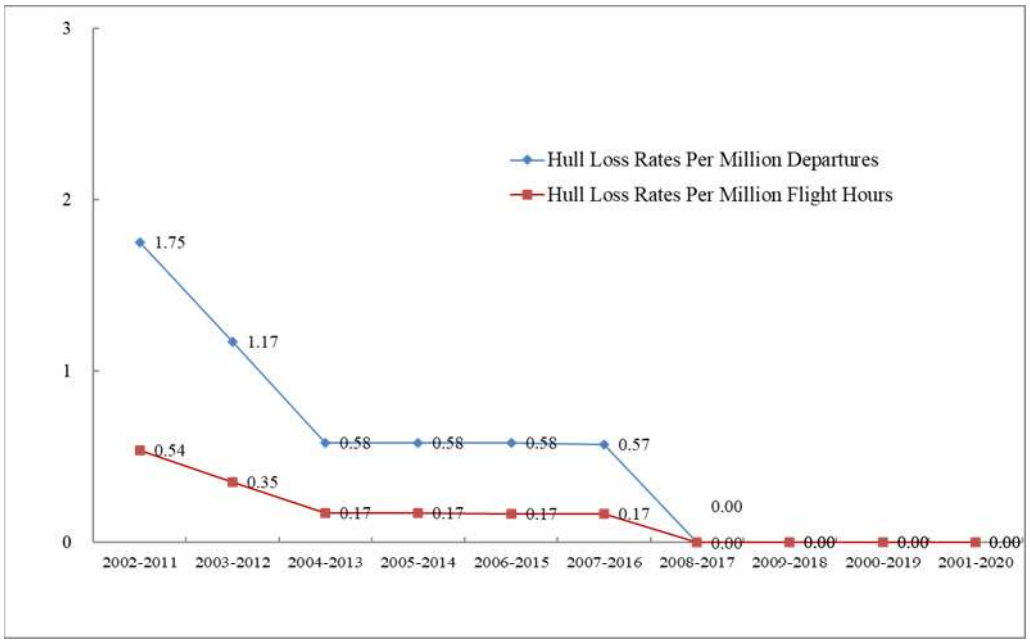

Figure 5. Ten years moving average hull loss rate of Taiwan turbojet aircraft

Although no two accidents are exactly same, the generic investigative procedures of any accident investigation, whether aviation, marine, railway or highway, can be concluded to have the same steps as follows: collect factual information, do analysis based on evidence, conclude findings obtained from analysis and make safety recommendations. Traditionally, training of accident investigators had emphasized on the acquisition of knowledge and technical skills of their specialty. Each applicant's educational background and former working experience may not be the most influential factors to be evaluated. To ensure that all newly recruited investigators acquire the necessary knowledge and techniques, understanding and proficiency in accident investigation, a similar evaluation system for investigators' qualification of each investigation mode was developed after the establishment of the TTSB.

There are highly regulated requirements for licensed aircraft pilots, air traffic controllers, and seafarers, but, there is no formal required qualification for transportation accident investigators. In the TTSB, four investigative grades are assigned for each division of the investigation branch. These grades are trainee investigator, investigator, group chair and investigator in charge (IIC) that specified in training manual of

Aviation/Marine/Railway/Highway Accident Investigators. In the case of a very serious transportation accident, investigators often need to face not only technical related issues but also many fatalities and family assistance affairs. Therefore, good personal characteristics and positive psychological status are important to accident investigators when facing the challenges of catastrophic accidents. The quality of accident investigation may be degraded if the investigation is conducted by poorly trained or mentally immature investigators. Therefore, an investigator, group chairperson, or the IIC should be evaluated to possess required qualification that commensurate with the assigned role in the investigation.

To evaluate investigative qualification of transportation accident investigators, an evaluation committee is organized first. Members of evaluation committee are all senior and they are all well experienced in accident investigation. The distinguishing features of them are that they all possessed professional knowledge and accumulated practical experiences from past investigations. Furthermore, they all had experience in knowing how to allocate required budget, control the expenditure and lead investigation team impartially during an accident investigation. The main function of this committee is to judge those applicants possessing required knowledge, skills and experience and good attributes commensurate with their investigative grades. If the applicant is newly recruited, committee members may review applicant's current qualification, background and past experiences in industry or academics to determine exemption. Applicant to be exempted from part of the required evaluation items of each investigative grade should be after deliberated discussion and concurred by the committee members.

The evaluation system for investigator's qualification does not break away from previous context. In addition to the evaluation procedure of aviation accident investigators, contents of this system is drafted and reorganized with the incorporation of procedures of marine, railway and highway accident investigators. Items to evaluate a transportation accident investigator include basic capabilities, training records, investigative performance and personal attributes. Main features and content of each item are summarized as follows.

1) Basic capabilities: knowledge and good understanding of transport vehicle operations, relevant technical skills of aviation/marine/railway/highway, familiar with domestic and international regulations related to transportation accident investigation, proficiency in English and good physical shape;
2) Training records: include certificates of course attendance or completion issued from domestic or foreign training providers/agencies;
3) Investigative performance: include the ability to collect, document and analyze factual data related to the accident, capable of interviewing witness and deal with all sorts of people, draw conclusions and make safety recommendations in accordance with analyses and findings, able to write investigation report within an allotted period of time, able to work with diverse groups and comply with the instructions of the IIC; allocate required budget, control the expenditure during an investigation;

4) Personal attributes: include integrity and impartiality in conducting accident investigation, tact in dealing with people who have been involved in the traumatic experience of an aircraft accident, and the ability to execute accident investigation under difficult conditions.

Among these four items, investigative performance and personal attributes are those items that can easily fall into subjective judgment by the committee members. An investigator should realize that transportation accident investigation is a team works challenge to all those who being involved in the same investigation. He/she should know his/her role in an investigation. Committee members will rely on the applicant's participation records of accident investigations and written opinions or comments from those who had previous working experience with the applicant in the same accident investigation to make their decisions. Generally, to apply and fulfill the evaluation requirements of each investigative grade should be involved and finish at least two accident investigations. The result of evaluation is passed only when each of the above-mentioned four items meets a qualified standard.

5. CONCLUSION

Preliminary achievements have been observed since the implementation of the reorganized evaluation system to qualify transportation accident investigators in the TTSB. Standardized evaluation procedures can reduce personal judgment to a minimum which guarantees an impartial outcome. The results of evaluation are reliable and consistent since all committee members draw the same baseline to evaluate investigators' qualification. Therefore, this reorganized evaluation system can replace the mentor - apprentice system to qualify transportation accident investigators. From the organizational point of view, the implementation of the evaluation system in the TTSB can guarantee investigation quality in the conduction of transportation accident investigations during the transition from a single mode to a multi modes accident investigation agency.

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