JESK J Ergon Soc Korea 2016; 35(3): 165-173
http://dx.doi.org/10.5143/JESK.2016.35.3.165
http://jesk.or.kr eISSN:2093-8462

An Research Into The Reactive Safety Action Program for Promoting Aviation Safety Culture

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Received : March 04, 2016
Revised : May 16, 2016
Accepted : May 25, 2016

Objective: The objective of this research is to inquire about safety information from the standpoint of its usefulness to suggest the significance of the Reactive Safety Action Program, which serves to promote aviation safety culture.

Background: Safety information plays an important role in operating safety programs. Each organization learns lessons from safety information collected from aviation accidents and incidents. When an accident occurs, it is only through safety investigation and a close inquiry on the cause that we can come up with an appropriate countermeasure which would contribute to preventing the recurrence of the same or similar accident. However, the usefulness of safety information produced from unsatisfactory safety investigation is insufficient.

Method: This research analyzed the characteristics of aviation accidents, the differences between safety investigations and legal accident investigations in systematic and operative perspectives, and safety culture as a measure to activate reporting systems (compulsory/voluntary).

Results: This research defined the investigation scope and processes of safety investigations and legal accident investigations. It also suggested factors such as just culture based on trust, non-punitiveness, confidentiality, the participation of the entire staff through the use of inclusive reporting base, ensuring the independence of the operating organization as a way to promote safety through reporting systems.

Conclusion: The organization's effort is the important aspect in obtaining exact and accurate safety information from accidents/incidents. The separate running of SIB (Safety Investigation Board) and AIB (Accident Investigation Board), the systematization of safety information reporting system, and prescribing (legislating) the composition of related organizations are some representative programs.

Application: This research inquired experiences that contributed in promoting aviation safety culture in a reactive perspective, and will serve a role in spreading safety culture by enabling the use of application experiences of the aviation field in other domains.

Keywords: Reactive action safety program, Aviation safety culture, Safety investigation, Compulsory reporting system, Voluntary reporting system

1. Introduction

Normally an organization with a mature safety culture regards preventive safety actions as very important to prevent accidents/incidents. When an accident/incident occurs in spite of such preventive safety managing measures, it puts in much effort in establishing a preventive countermeasure through a thorough safety investigation

so that identical or similar accident/incidents do not recur. The accident-frequency in highly-Reliability Organization (HRO) fields such as aviation, nuclear and railway industries is decreasing thanks to exertive safety measures taken by safety management organizations (Hollnagel, 1993).

However, since the expense and impact of an accident within the HRO surpass that of other fields, a more mature safety culture and well-developed safety measures are required. Also, as 70 to 80 percent of the accidents within the HRO is caused by human factors, managing it well is becoming more and more important (Boeing Company, 2015; Kim and Cho, 2013). The reason why safety investigation is important in the presence of an accident is because it is only through safety investigation and a close inquiry on the cause that we can come up with an appropriate countermeasure which would contribute in preventing the recurrence of the same or similar accident (HSE, 2004). However there are some factors that hamper precise safety investigation within the aviation field. Damage in the flight data recorder due to fire or explosion, restricted physical and environmental accessibility to the accident spot if located in a mountain or ocean are such. The simultaneous execution of safety investigation and legal accident investigation is also a restricting administrative and procedural factor. When they are executed simultaneously, it is probable that the process and result of the safety investigation may be affected by the legal accident investigation. The person concerned with the accident/ incident will hold a defensive posture during the investigation or may even avoid making sincere statements according to the circumstances since there is a conflicting exemption/liability article within the same provision.

In the aviation field, it is common for a flight attendant to be required to make a prompt decision in a complicated, momentarily changing situation and this causes the pilot to confront his physical and mental limitations. This leads to higher possibility of an accident or error triggered by human factors (Hawkins, 1987; Kim, 2011). Safety investigations on accidents triggered by human factors must be conducted professionally due to the complexity of its causes. However, in the absence of an investigator who specializes in human factors investigation, there is hindrance in conducting a precise and exact investigation (Shappell and Wiegmann, 2000).

In our time, safety information plays an essential role when operating safety programs (ICAO, 2006; 2009; 2013). Such safety information is earned from aviation accidents and incidents. However, the usefulness of the safety information produced from unsatisfactory safety investigation is insufficient. Therefore, in this research will be inquired methods to enhance the value of safety information obtained from Reactive Safety Action Program from the standpoint of safety culture, while taking characteristics of the aviation field, accident/incident and safety reporting system into account.

2. The Characteristics of Aviation Accident/Incident

The ICAO defines "Aircraft Accident" an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, in which a person is fatally injured or seriously injured as a result of being in the aircraft, or direct contact with any part of the aircraft, including parts which have become detached from the aircraft or the aircraft sustains serious damage or structural failure (ICAO Annex 13, 2010). The FAA defines (49 CFR 830.2) "Aircraft Accident" as occurrence related to aviation navigation that causes a person's death or severe injury, or substantial damage on the aircraft which occurred from the moment a person embarks the aircraft with the intention of flying and disembarks. The Republic of Korea Aviation Act defines "Aircraft Accident" as a person's death or being missing or seriously injured, a serious damage or wreckage of the aircraft or its structural deficiency, being impossible to locate the aircraft's whereabouts or unable to approach the aircraft from the moment a person embarks the aircraft with the intention of flying to the moment everyone disembarks (MOIT, 2015). The ROK Aviation Act also incorporates the concept of drone accident, for which the duration is changed into from the moment of drone's movement with the purpose of aviation to the termination of aviation and the drone's movement (Korea Air Force, 2015). The definition of Military Aircraft Accident is defined in the Korea Airforce Safety Rule as follows. A Military Aircraft with the intention of aviation incurring casualties or Air-

force/Non Air-force property damage due to all sorts of unplanned circumstances, provided that it was not in combat.

One of the characteristics of aviation accidents/incidents that are defined as above is that the severity of the damage is extreme (FAA, 2010; FAA 2009). This is because the majority of accidents/incidents is connected to the death or severe injury of attendants or passengers. Aircraft accidents lead to costly resource loss. In particular, losing a highly-trained attendant is a serious damage which is beyond a matter of money. Especially, if the site of accident is within the civilian area, not only does the amount of loss become colossal but it could also trigger a social problem. As the severity of the damage is extreme, and whether the related organizations are responsible or not depends on loss liability, objectivity in the outcome of the aviation accident/incident investigation is emphasized. Secondly, aviation accident/incident investigation requires highly scientific methods (DiNunno, 2014). This is because the aircraft itself is a technically-intensive equipment. From aviation dynamics to human engineering, scientific research data on all areas of study play a crucial role in preventive aviation safety management. Thirdly, aircraft accident/incident investigation outcomes are often such that it is not easy to find out the fundamental reason of the accident/incident (ICAO, 2003). Most aircraft accident/incidents kill the pilot and with it accompanies explosion or fire. In such occasions, it is often the case that sufficient scientific investigations cannot be conducted and thus estimated reasons are presented as outcomes instead. Fourthly, as was also noted in the introduction, a large proportion of aviation accidents/incidents are triggered by human factors (Shappell and Wiegmann, 2000). The cockpit is narrow and limited, the aircraft is fast, and pilots are demanded to process numerous and various tasks (communicating with the controller, taking care of the passengers, maintaining the airway, piloting the aircraft, etc.) in a very short time. The time pressure and complexity of aviation tasks make it more easier for human errors to occur. Among the well-known physical symptoms that pilots experience are orientation disturbance, loss of equilibrium, as well as other symptoms caused by the transfer of body fluids due to sudden change in G-force inside the aircraft such as stupefaction, stimulation, dizziness and digestive organs disorder. In addition, psychological and physiological symptoms are also factors that incur accidents. For a safe flight, the pilot and attendants must be able to overcome these symptoms and thus much training and evaluation is required to cultivate and preserve them. Lastly, most aviation accident/incidents occur because a large number of potential factors are correlated in a complex and complicated manner. When examined with HFACS, which is a representative human factors analyzing model, aviation accident/incidents occur when interacting factors fail to reciprocate properly. That is to say that if the analysis and establishment of countermeasures only focus on the root cause, potential accident incurring factors will not be fully removed. This could result in another similar aviation accident/incident in the future. In order to prevent the recurrence of one, it is important to focus on the overall improvement of related systems.

3. The Characteristics of Safety Investigation

Generally, an aircraft accident investigation means all kinds of investigations conducted after the accident's occurrence, which incorporates both 'Safety Investigation' and 'Legal Accident Investigation' (AFI 51-503, 2004). 'Safety Investigations' are investigations conducted for the purpose of clarifying the causes of the accident, whereas 'Legal Accident Investigations' are investigations that accompany the judgment of the court and the disciplinary committee, conducted for the purpose of clarifying the liabilities of related parties.

The purpose of safety investigation is to prevent the recurrence of similar accidents by removing the factors that cause accidents through the utilization of data obtained from safety investigations. Safety Investigation data are used by flight attendants, ground-crew, safety manager, CEOs, designers and can be applied to various fields such as deciding the amount of additional training demanded, setting the degree of required maintenance, improving the quality of materials, compartments and safety programs, and finally establishing designing standards (AFP 127-1, 1997). Therefore, the exactness and completeness of the safety investigation ultimately decides the appropriateness of follow-up measures.

In countries with well-developed aviation country, independent and professional aviation safety investigating organizations such

as the NTSB normally conduct safety investigations. However, in case of catastrophe, the situation occurs in which legal accident investigation by the court is conducted simultaneously with the safety investigation. In some accidents·incidents, 'legal accident investigation' and 'safety investigation' are conducted simultaneously and the outcome of safety investigation is used to censure or punish those responsible. This results in the former influencing the process and outcome of the latter. When a safety investigation and legal accident investigation are conducted simultaneously, the investigation only focus on finding the root cause to clarify responsibilities and fails to take potential hazards into consideration. Therefore, the investigations tend to center on the punishment of individuals instead of promoting safety culture of organizations. To promote safety culture, safety investigations and legal accident investigations must be conducted separately. The U.S. Air Force is an exemplary organization that mandates this and is operated accordingly. The U.S. Air Force, in the presence of a calamity, conducts safety investigation and legal accident investigation separately.

During a safety investigation, the testifier is systematically guaranteed to testify anything that could help discover the cause of the accident since all statements made by the person concerned with the accident is privileged and secured confidentiality (AFI 91-204, 2008). An investigation report consists of part I and II, of which part I states the outline of the accident and part II the specific and detailed contents related to the cause of the aviation accident. Among the two, part II is used solely for safety purposes; to prevent the recurrence of aviation accident. This is to help discover the root cause of the accident promptly and accurately by granting facts and evidence obtained from investigations the privilege to be used only for aviation safety and thus ultimately aims to prevent the recurrence of accidents and improve mission capabilities. Also, the investigator must not use any fact that was discovered in the course of investigation except for the purpose of clarifying the cause of the accident or disclose it to outward parties. Additionally, the investigator is obliged to sign a document that states as above and submit it to the head of the investigation committee prior to the investigation. This will enable those directly related with the accident to actively cooperate in the safety investigation. The protection of statements made during the process of safety investigation applies the same in witness inspection as well.

Legal accident investigation mainly focuses on identifying whether the accident was a crime or if there was deliberateness in it. All evidence is preserved for circumstances such as litigation, compensation, punishment and giving administrative disadvantage etc (AFI 51-503, 2004). The purpose of legal accident investigation is to document a report that can be opened to the public and use it to determine the accident's responsibilities. In case of an aircraft accident, safety investigation has priority over legal accident investigation in collecting the statements of witnesses and checking the accident site and wreckage. However, if the disaster or accident was found out to be a result of crime, safety investigation is suspended and legal accident investigation is conducted immediately. When litigation or punishment is expected, a legal accident investigation committee is constituted apart from a safety investigation committee, and is run independently without overlapping with it.

The records and evidence collected by the legal accident investigation committee can be used if necessary for punishing or taking administrative measures on the person related to the accident. If the safety investigation and legal accident investigation is conducted simultaneously, priority is given to the safety investigation committeeman in which is also included investigating the accident site and interrogating the witness. It is a basic principle that records or evidence obtained during safety investigation is not to be provided to the legal accident investigation committeeman. The legal accident investigation report is a factual explanation for possible causes of the accident and contains no recommending statements (safety advisory statements). It is thus available for all purposes of use and all contents can be opened to the public. Legal accident investigation reports refer to only Part I of the SIB report. It is also conducted only on parts that are directly related to the accident, and does not investigate indirect factors. The result data is provided in the following cases; a) at the request of the flight attendant or a member of the victim's family that was killed or severly injured b) at the request of Congress, public, or the press c) when used as evidence in a trial that deals with the human/material damage of the accident and d) when used for punishing those who triggered the accident or as judgment material by the human affairs committee.

Accidents/incidents caused by human factors (errors) require high-degree specialty during safety investigation due to the complexity of its causes. The psychological and physiological features of those related to the accident/incident and behavioral judgments regarding human errors must be duly considered. A safety culture that could be defined as Just Culture must be error tolerant and just (GAIN, 2004). It means that investigations must accompany a close inquiry on whether there was crime or deliberate infringement involved within the accident, and be just in dealing with deliberateness and errors. However, if an error revealed during the safety investigation which was conducted to prevent identical accidents in the future is used only for punishing the person related to the accident, investigating the underlying human factors (errors) becomes more difficult and thus research must be conducted by professional researchers that have expertise on human factors, and a prudent approach is required.

4. Non-Punitiveness and Safety Culture

Since regulatory and government supervisory organizations take punishment procedures regarding the outcome of accidents/incidents and violation of regulations, individuals involved with circumstances that could trigger such harm or incident are inclined to not providing the necessary information even though they could be of much help. The fear of punishment prohibits people from reporting or revealing information that could lead to the involvement or punishment of themselves and thus the flow of safety information that could be used valuably is blocked. For this very reason, the US Aviation Industry started running a voluntary reporting program since 1975 to collect information on incidents and hazard factors with the ultimate goal of promoting safety culture. This voluntary reporting program is the ASRS (Aviation Safety Reporting System). Also, the FAA and the US Air Force introduced the ASAP (Aviation Safety Acition Programs), a program with the trait of non-punitive collaborative approach (ASRS; FAA 14 CFR; AFI 91-202, 2015). This reporting program was adopted to collect more safety information from the accident site to prevent accidents more effectively through the cooperation of supervisory organizations and employers of the aviation industry. Currently, the ICAO Annex 13 (ICAO, 2010) orders member nations to establish a compulsory reporting system and also recommends them to set up a voluntary reporting system that could complement the compulsory one.

The compulsory reporting system makes workers necessarily report about major incidents and hence aims to utilize accident preventive resources more effectively. Therefore, this system requires a legal provision that clearly states who and what the reporter and reporting incident is. If not, the compulsory reporting system loses its efficacy. Since it deals with specific problems and incidents within a limited range, it is usually effective in collecting information about technical failures. It also has a tendency to collect more information regarding technical failures and deficiency than human activities and errors since it normally deals with hardware problems. To overcome this problem, a nation is demanded to run a voluntary reporting system that focuses on collecting information about human factors as well as establishing a compulsory reporting system.

In a voluntary reporting system, the reporter submits a report through the reporting system although there is no legal or administrative obligation to do so. In this system, the reporter is exempt from administrative actions such as imposing fines or suspending licenses as an incentive to stimulate reporting and the reported information is not used against the reporter. The voluntary reporting system is non-punitive, confidential, simple to report, direct and convenient. If the violation was not deliberate, the violator is privileged from legal executions such as taking administrative actions. Although the names of voluntary reporting systems differ across the world, most of them share similar functions and characteristics. To add on, many countries and airlines have established and are running this system by their own accord. In running the voluntary reporting system are included follow-up surveys on hazard factors and official procedures to solve problems. Representative systems operated on a national level are as the following (Table 1).

The purpose of guaranteeing confidentiality in reporting systems is to protect the identity of the reporter and those related. This is also used to ensure that voluntary reporting systems keep away from punishment. Confidential reporting is usually applied in voluntary reporting systems. The confidential reporting system allows reporters to reveal human errors without fear of punishment

Table 1. Voluntary reporting systems operated on a national level

Country	Name of the system	Organization in charge
US	ASRS (Aviation Safety Reporting System)	NASA Ames Research Center
England	CHIRP (Confidential Human Incident Reporting Program)	CHIRP Board of Trustees
Canada	SECURITAS	TSB (Transportation Safety Board)
Australia	ASRS (Aviation Self Reporting Scheme)	ATSB (Australian Transport Safety Bureau)
Taiwan	TACARE (Taiwan Confidential Aviation Safety Reporting System)	ASC (Aviation Safety Council)
Japan	ASI-NET (Aviation Safety Information Network)	ATEC (Association of Air Transport Engineering and Research)
S.Korea	KAIRS (Korea Confidential Aviation Incident Reporting System)	Korea Transportation Safety Authority
China	SCASS (Sino Confidential Aviation Safety System)	Research Institute of Civil Aviation Safety, Civil Aviation University of China
Singapore	SINCAIR (Singapore Confidential Aviation Incident Reporting	AAIB (Air Accident Invesigation Bureau)
Brazil	RCSV (Relatorio Confidencial para Seguranca de Voo)	SENIPA
France	REC (Recueil d'Evenements Confidentiel	BEA (Bureau Enquetes Accidents)
S.Africa	CAHRS (Confidential Aviation Hazard Reporting System)	CACAA

and being perplexed. To others, this provides an opportunity to learn from mistakes. The voluntary reporting system allows a wider range of reporting subjects and at the same time is more useful in collecting information related to human factors compared to compulsory reporting system.

Some general principles are required for a reporting system to overcome factors that hinder safety reporting. First of all, there is trust. The reporter that reports accidents/incidents must trust that the organization receiving the report (country or firm) will not use the information disadvantageously against the reporter's intention. Without it, people might avoid reporting their mistakes and other hazard factors. Trust is first formed as the reporting system is designed and implemented. An organization's positive safety culture helps to build up the trust necessary for a successful incident reporting system. Particularly, the safety culture of an organization must be error tolerant and just. Reporting systems must be just in dealing with errors, not intentional accidents. Such process is safety culture and just culture. Secondly, a reporting system should be founded upon the principles of non-punitiveness and confidentiality. For people serving in the aviation industry, getting assurances from regulatory offices or executives that the provided information will not be used to punish or disadvantage the reporter is more important than dealing with the problem of reporting freely. Also, the reporters, along with the statements reported, necessitate confidentiality. However, in some countries it is hard to guarantee confidentiality due to laws related to information opening. Thirdly, this kind of reporting system must have an inclusive reporting base, which means that the program should involve the participation of the entire personnel. Although the subject of initial reporting systems were merely flight attendants, the participation of entire personnel is crucial since gathering information from various perspectives promote the precise understanding on the case. For example, suppose an air-traffic controller commanded an incoming flight to reverse the plane because there was an unauthorized maintenance vehicle in the runway. The situation can be rearranged from the perspectives of the pilot, air traffic controller and the vehicle driver, all of which will influence in a more precise investigation. Fourthly, just as a safety investigation organization is guaranteed independence, it is also

ideal that the national voluntary reporting system is managed by an organization separate from the judicature. However, the compulsory reporting system should be managed by a government agency that has the rights and responsibilities of executing the law. Lastly, reactive safety information collected by reporting systems should be provided and spread to aviation organizations at the proper time through safety promotions. Monthly newsletters or periodicals can be included among these promotions, and other methods can also be utilized to maximize information sharing. Furthermore, incentives should be provided to motivate the persons concerned to submit more reports.

5. Conclusion

In the above were inquired major issues related to safety information investigation and reporting as a reactive action safety program to promote safety culture. The most important thing in obtaining accurate and precise safety information from accidents/incidents is the organization's effort to promote safety culture. Among it is included the separate management of SIB and AIB, the systematization of safety information reporting system (safety information sharing system with government agencies taking the lead in managing based on the principle of non-punitiveness), and legislating of the constitution of related organizations that can professionally run this kind of managing program. For this to happen, an organizational level resource management aiming at securing the independence, proficiency and professionalism of investigators and analyzers who deals, produces and provides safety information is required. Human factors, in particular, needs specialized investigators and analyzers who are fully in charge.

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