

A Study on Safety Culture in Aviation Maintenance Organization

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Abstract. Aviation maintenance mechanic's error is different from pilot's error. The pilot's error may lead directly to defects on airplane but generally, the aviation mechanic's error may lead to the defects which can cause the undesired aircraft states in the potential status at any moment. Therefore, the potential hazards such as mechanic's unreported errors, near miss, etc., can have a decisive effect on the accident. In order to eliminate these potential hazard factors, the establishment and the promotion of safety culture in aviation maintenance organization is absolutely necessary. The aim of this study was to derive improvement strategy by evaluating the safety culture of aviation maintenance organization and by analyzing the poor part of it.

Keywords: Aircraft Maintenance, Aviation Safety, Aviation Maintenance Safety Culture, Informed Culture, Learning Culture, Reporting Culture, Just Culture, Flexible Culture

1 Introduction

The knowledge and skill of individual maintenance personnel are important in the aircraft maintenance organization. However, aircraft maintenance organization is composed of a complex structure because the aircraft maintenance organization requires the close working cooperation and coordination among the job skills such as airframe, engine, electrical, electronic and instrument.

According to a Normal Accident Theory of Perrow(1984), it claims that the accident of complex organization is apt to occur inevitably[1]. However, hopefully being able to overcome the gloomy outlook for the normal accident theory is that the problem of complex organization such as aircraft maintenance organizations can be overcome through a device called a safety culture. In other words, the integrative system that can create a more secure management and operation can be built by combining safety culture with intentional manipulation of various organizational characteristics that affects safety [2].

Accordingly, this study reviews safety culture measurement methods and tools of the aviation maintenance organization. And it also assesses the level of safety culture

in the aviation maintenance organization by the developed methods and tools. Among the evaluation results, the analysis of a poor safety culture factors was done. And finally it proposes strategies for a positive safety culture in aviation maintenance, and it can contribute to the implementation of safety management systems.

2 Aviation Maintenance Job Characteristics

Technological advance for the aircraft maintenance has continued and the state-of-the-art equipment is introduced but the mechanics' operational errors are inevitable as long as the technology is beyond the mechanic's capability. Thus, accidents caused by human factors in aviation maintenance organization will occur continuously [3].

Especially with regard to aircraft maintenance, the term, "safety" commonly implies two meanings. One meaning is to emphasize the worker's safety and health because there have been sporadic risk factors such as machinery moving the heavy parts, toxic and hazardous substances and aerial work platforms around the workplace. The other meaning is the procedure to ensure that the aviation mechanic provides the airworthy aircraft for aircraft flight safety [4].

The type of aircraft maintenance job can be divided into line maintenance, base maintenance, and technical support.

3 Aviation Maintenance Safety Culture

Positive safety culture is organizational characteristics that help you learn to discover the potential hazards as well as norms and attitudes to safety [5], and provides a framework of recognition for guiding the behavior suitable to the work environment which workers share the work environment [6]. The formation of a positive safety culture enables workers to act safely in high-risk facilities [7].

To apply a safety culture in the aviation maintenance organization, necessary is to define conceptually that the aviation maintenance safety culture is the generally acceptable behavior during the aircraft maintenance. Aviation maintenance organizations should ensure the safety of the aircraft and shall provide a pleasant to customers while maintaining the punctuality of air transport services based on airworthiness. The tendency to act on the behavior of mechanics caused value and attitude for achieving the objectives of this organization can be understood by the concept of aviation maintenance safety culture.

A combination of organizational learning, reporting, justness, and flexibility is emphasized in aviation safety culture [5]. In a learning culture, there exist both the will and competence to learn from experience and readiness for improvements. In a justness culture, there are just consequences following the reporting of an incident or anomaly. This can enhance the willingness to forward information about work and safety, which is a fundamental element of a reporting culture and a proactive approach to safety. The flexible culture enables to transform the work organization to manage changing demands under heavy workload and also respects the individuals' skills and experiences [5].

With this background concerning safety culture, the following five aspects of safety culture; information, learning, reporting, justness, and flexibility were included in the assessment of the safety culture.

4 Method and Material

This paper evaluates the safety culture of aviation maintenance organization in the biggest airlines in Korea which has a lot of maintenance personnel and the ability to perform aircraft scheduled inspection and heavy maintenance such as overhaul of parts including the engine.

Measuring Tool were extracted measurement variables (assessment questions) suitable to research purpose from a questionnaire package used by Asa EK in order to evaluate the safety culture of airline ground handling, air traffic controllers and the shipping industry [8] and the safety culture score sheets of the GAIN (Global Aviation Information Network) being operated by alliance of international airlines and the aviation safety score sheet of International Civil Aviation Organization (ICAO), Federal Aviation Administration (FAA), etc.

The 64 questions, excluding the demographic questions, were classified as informed culture, reporting culture, just culture, learning Culture and flexibility culture which are element of five kinds of safety culture. 60 items in the questionnaire were composed of a Likert scale of 5 points and 4 items that requires additional question are composed of the nominal scale. At the end it was free to describe the proposals on safety.

A total of 300 questionnaires were distributed to Full Service Carrier, 249 of them were recovered. 236 survey responded, except 13 parts of insincere survey responded, were used in the analysis section. The average age of the respondents is 45.2 years (range = 25 to 59), the job career is 18.9 years (range = 1 to 38) and the line maintenance is 141 people (60%), the base maintenance is 64 (27%) and the technical support is 31 people (13%) respectively.

5 Results

As shown in Table 1, the analysis of the safety culture in the aviation maintenance organization showed $M = 3.50$. The average value from all aspects was perceived as more positive than the average of 3.00 over the middle position in the 5-point scale. For five aspects of safety culture, positive rate was calculated. Learning culture received the highest mean value ($M = 3.88$), and just culture received the lowest ($M = 3.13$). However, according to the 'Individual Safety Survey Tools' GAIN (2001), which consists of 25 questions, it is recommended to measure the airline safety culture with measurement of the degree of agreement or disagreement with a 5-point scale and total score of 125 points (25 items x 5 points) by divided into three areas ; 25-58 points are poor safety culture, 59-92 points are bureaucratic safety culture, and 93-125 points are positive safety culture[9]. Accordingly, up on the basis of GAIN's safety research tool, in case of analyzing the safety culture level by assuming that 1.0-

2.32 poor level, 2.33-3.71 bureaucratic level and 3.72–5.00 positive level by conversion of 25-125 point to 1-5 point, the only learning culture can be regarded as a positive safety culture level and the rest are evaluated to bureaucratic safety culture level as 3.13 ~ 3.53.

The internal consistency of 60 questionnaire except multi responses 4 items among the whole questionnaire for aviation maintenance safety culture is very high as .92 and in the five of safety culture aspects, an alpha value of at least four of the five is above .82 and only the reporting culture is .70

Table 1. Pearson Correlation among the Five Safety Culture Aspects.

Safety Culture Aspect	n of Items	Cronbar's a	Mean Score						
			Total Group M	Total Group SD	Manager M	Mechanic M	Line Maint M	Base Maint M	Tech' Support M
Information	13	.89	3.50	.50	3.65	3.49	3.48	3.55	3.54
Learning	15	.83	3.88	.39	4.02	3.87	3.86	3.87	3.98
Reporting	12	.85	3.45	.57	3.59	3.44	3.43	3.47	3.52
Justness	10	.72	3.13	.47	3.22	3.12	3.11	3.15	3.20
Flexibility	10	.83	3.53	.50	3.64	3.52	3.55	3.49	3.50
Total	60	.92	3.50	.41	3.62	3.49	3.49	3.50	3.55

6 Discussion

The safety culture consciousness of aviation mechanic is a bureaucratic level. It is estimated that this aspect should be further strengthened with respect to the safety culture of aviation mechanic. In particular, the perception of the just culture among the safety culture element is the lowest. The distinction for the error and violation is not clear and it shows that fear of punishment for the simple error.

In also reporting culture, the significant difference were found in career low-grade mechanics in reporting methods for injuries and risk factors as well as counseling on safety issues. It can be seen that suggests to strengthen safety training for the new employees.

It is lack of trust between the mechanics and the managers. Compared to the level of safety culture in the relationship between himself and his fellow mechanic, the level of safety culture in relationship between the company and the managers was evaluated as insufficient.

Aviation Mechanics are exposed to an unsafe work environment. Since most line maintenance is done outdoor such as ramp, the line mechanic has been exposed to the extreme cold and heavy snowfall in winter, as well as heat and heavy rain condition in summer, the safety facilities are outdated in technology for the safety, and safety and protective gear are described as incomplete.

7 Conclusions

Of 60 evaluation items except for the multiple response questions, 17 questionnaires were a positive level and the remaining 43 questionnaires were bureaucratic level. Accordingly, on the basis of the results discussed based on the result of factor analysis for the items which were evaluated as poor or bureaucratic level and the multi-response analysis, for the establishment of a positive safety culture in the aviation maintenance organization, the strategies to improve safety culture by a specific component derived as follows:

First, it must establish an efficient and positive learning culture for safety enhancement. Education and training cannot solve all the safety problems but the positive learning culture in the organization should be a prerequisite in order to become active. In other words, all personnel shall understand the organization's safety philosophy, policies and procedures throughout the study because they must fulfill their roles and responsibilities within a framework of safety management.

Second, for the effective safety reporting system, the positive reporting culture should be followed. Prevention of aircraft accidents is the complex activity which requires a lot of skill and effort. Effective accident prevention activities increase the efficiency of flight, as well as improvement of aviation safety. In order to prevent such an aircraft accident, the effective safety reporting system should be built.

Third, the positive just safety culture should be spread in the workplace. In order to spread the rational just safety culture, punishment due to safety issues should be based on agreed criteria for the non-punishment and punishment subjects. And also, the nature of the action than action itself should be the standard to determine the punishment.

Fourth, It should enable the information culture for effective information delivery system. Since safety is one that can be based on communication, it can be considered the first step of efficient information delivery system to enable inter-organizational communications within organization. Because its value is recognized only when time information is reflected in the decision to get any useful results, various kinds of required information should be provided at the right time.

Fifth, safety culture should be oriented positive flexible culture. At peak season for airlines, there are lack of line maintenance personnel to support the line maintenance, and also the base maintenance mechanic temporary shortage may occur when un-schedule work such as airworthiness directive are assigned. Lack of personnel or manpower makes time pressure and then it may cause human error. Therefore, the maintenance organization should have the flexibility to adjust the maintenance personnel in a short period of time.

Finally, this study had considered the maintenance safety culture in practical terms and evaluated and analyzed the safety culture of aviation maintenance organization in order to present a strategy for improving the safety culture in the positive aviation maintenance organization. If we zoom to apply this strategy on aviation ground handling sector, including flight operation, cabin and air traffic control by using this study result, it will contribute significantly to promoting aviation safety through the systematic evaluation of aviation safety culture.

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