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Individual-related factors and Management-related factors in Aviation Maintenance

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Abstract

Aviation safety relies heavily on maintenance, yet improper maintenance contributes to a significant proportion of safety threats that cause aviation accidents or incidents. In order to fully understand the maintenance errors and contributing factors, this paper investigated a sample of 3,783 Aviation Safety Reporting System (ASRS) incident reports submitted in the period of January 1st 2008 to December 31st 2008, which are formed by maintenance personnel or non-maintenance personnel. The Maintenance Error Decision Aid (MEDA) and Correspondence Analysis (CA) methods are used to analysis maintenance error, its contributing factors and the relationship between them. The result shows both maintenance personnel and non-maintenance personnel considered human error accounts for a large proportion of maintenance error, and individual-related factors and management-related factors are the most frequent reasons for maintenance error. The outcomes also indicate that non-maintenance perspective should not be ignored because it can provide abundant information which is not included in maintenance personnel reports and helpful to reduce error. Meanwhile, the management-related factors are as crucial as individual-related factors, which should be paid more attention.

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Keywords: aviation safety; maintenance error; individual-related factor; management-related factor; ASRS

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1. Introduction

Aviation safety relies heavily on maintenance. Without maintenance, systems will deteriorate and performance will decline. In aircraft, maintenance is crucial to ensure continued safe operation. In previous research[1], maintenance was found to be related to 4.1% of all aviation accidents and 28.6% of maintenance-related fatalities from 1999 to 2008, indicating that it has a slightly higher fatality rate than accidents overall. Unfortunately, although all aviation accidents have fallen into the response to aircraft technology, and airline traffic safety have been generally improved over time, the number of maintenance-related accidents did not decreased commensurately in past five decades.

Many previous research have investigated the causes of maintenance-related accidents or incidents. In general, studies on maintenance-related factors can be divided in to two groups, examining either:(1) Individual-related factors as the reason to the maintenance error, or (2) management-related factors as the reason to the maintenance error. The first group includes studies that have concentrated on the direct-maintenance safety, most of studies focusing on maintenance error discuss maintainer performance as a cause of the accident or incident. Reason and Maddox[2] indicated more attempts to improve aviation safety have focused on reducing inspector and repair personnel error, not only maintenance operation but also technical knowledge and skills. Hobbs and Williamson[3] and Rankin and Sogg[4] supported this viewpoint by discovering that individual-related factors such as pressure and fatigue contribute a significant proportion to the incomplete installation and uninstalled parts maintenance error.

The second group of studies on maintenance-related accidents or incidents examines management-related factors as the reason to the maintenance error. Management-related factors have been an important component of maintenance to increase the safety reliability of aviation system since it became a major theme in the 1995 National Aviation Safety conference[5]. Another Hobbs paper[6] presented that maintenance error was not only because of individual failures, but reflected the interaction of personnel, workplace and organizational factors. There are several evidences to prove the importance of management-related factors. In a study of the normal job performance of 286 aircraft mechanics, McDonald et al.[7] found 34% mechanics admitted the performing of their recent task had contravened the formal procedures and organizational workflow to some extent. Similarly, Taylor[8] indicated organizational characteristics (e.g., definition of work groups, operation of pressures, and issues of trust and authority) could influence performance at the individual level, and further affected patterns of work in aviation maintenance operations. Later, Taylor[9] and Rogan[10] both emphasized human error in a major airline carrier's maintenance facility is also influenced by characteristics such as planning, scheduling and communications. A detailed analysis of 46 ASRS reports by Patankar et al.[11] also revealed a variety of factors contributing to procedural errors in maintenance, especially document deficiencies and user errors.

To conclude, above studies demonstrated that aviation maintenance errors are not solely due to maintenance personnel individual mistakes, but also induced by inadequate management, leadership/supervision or communication from across departments, which finally affect the quality of maintenance. Focusing back on the identification of maintenance error promoting factors, the Maintenance Error Decision Aid (MEDA) is a major process to investigate factors that contribute to various maintenance-related accidents and incidents[12]. Although the MEDA has been widely accepted by maintainers as a means that promoted such safety occurrences in aviation industry by displaying individuals' weak points as well as the latent management shortages, its information is not widely available to the research community. The incident databases maintained by the NASA Aviation Safety Reporting System (ASRS) can be a useful source of information on the nature and