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Evaluating Psychological Aircraft Accident Reports for Differences in the Investigation of Human Factors

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ABSTRACT

Analyzing accidents clearly is an important method for maintaining and improving safety in aviation. Nevertheless, evaluating these accident reports is equally important. Still, such evaluations seem to be generally neglected, especially in the military domain. The aim of the current study was to shed light on this fact by analyzing investigated human factors in military aircraft accident reports of aviation psychologists. Therefore, the authors conducted a content analysis of 42 reports of the German Armed Forces from the years 1994-2014. Confidence intervals and effect sizes indicated various differences in human factors throughout the psychological aircraft accident reports. Further, confidence intervals and effect sizes indicated differences in the corresponding areas. Thus, differences concerning human factors exist in the investigated accident reports.

KEYWORDS

Accident Analysis, Accident Investigation, Aviation Safety, Bundeswehr, Content Analysis, Evaluation Flight Safety, German Armed Forces

INTRODUCTION

Analyzing aircraft accidents clearly is an important method for maintaining and improving safety in the aviation domain and is done frequently (e.g. Branford, 2011; De Voogt, 2011; Endsley, 1995a; Goh & Wiegmann, 2002; Van Doorn, 2014; Van Doorn & de Voogt, 2007, 2011). Nevertheless, evaluating these accident reports is equally important. Knowing how research is applied in practice and which methods find application is ultimately essential for improving the expertise of accident investigators and thus flight safety. However, such evaluations seem to be generally neglected, especially in the military aviation domain. Since such military reports are often classified, this is hardly surprising. Yet, we managed to obtain permission for analyzing aircraft accident reports issued by aviation psychologists of the German Armed Forces and aim on bridging that gap.

The aviation psychologist is one member of the aircraft accident investigation board and has the task to investigate the human factors contributing to the accident. Therefore, the aviation psychologist issues an accident report that provides one basis for the work of the accident investigation board.

Our leading question was which human factors for explaining aircraft accidents were applied in those psychological aircraft accident reports and if differences in the identified human factors exist. Therefore, we analyzed their content for established human factors known to be involved in accidents. As a first step, we examined, if guidelines on behalf of aviation-related organizations exist that suggest which human factors should be considered during an accident investigation. Indeed, such

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guidelines exist for example on behalf of the International Civil Aviation Organization (ICAO) or the International Society of Air Safety Investigators (ISASI). Nevertheless, these were not suitable as a basis for a category system. Therefore, as a second step, we conducted a literature research based on the recommendations by ICAO (1993). We focused on a) identifying particular human factors with relevance for accident incurrence and b) on aircraft accident models/taxonomies. As a result, we decided to focus on the following factors (for a detailed overview of the factors, please refer to the respective literature):1) Mental Workload (e.g. Kahneman, Beatty, & Pollack, 1967; Ruffel Smith, 1979; Young & Stanton, 2001), 2) Situation Awareness (e.g. Endsley, 1988, 1995a, 1995b; Sarter & Woods, 1991, 1995), 3) Decision making (e.g. Billings & Reynard, 1984; Flin, Salas, Strub, & Martin, 1997; Flin et al., 2003; Klein, Orasanu, Calderwood, & Zsambok, 1993; Shapell et al., 2007), 4) Cooperation (e.g. Flin et al., 2003), 5) Leadership and Management (e.g. Flin et al., 2003; Sumwalt & Lemos, 2010), 6) Fatigue (e.g. Caldwell & Caldwell, 2003; Rosekind, Co, Gregory, & Miller, 2000), 7) Stress (e.g. Harris, 2011; Lazarus & Folkman, 1984; NTSB, 2001; Salas, Driskell, & Hughes, 2016), 8) Spatial Disorientation (e.g. Cheung, Money, Wright, & Bateman 1995; Lyons, Ercoline, O'Toole, & Grayson, 2006; Singh & Navathe, 1994)., 9) Human Machine Interaction/ Design (e.g. Baxter, Besnard, & Riley, 2007; Billings, 1997; Sarter & Woods, 1995; Sarter, Woods, & Billings, 1997; Sherry, Polson, & Feary, 2002; Rudisill, 1995). Additionally, we decided to focus on the following aircraft accident models: 1) The Human Factors Analysis and Classification System (HFACS; e.g. Shappell & Wiegmann, 1997, 1998, 2000, 2001; Wiegmann & Shapell, 2001, 2004) and 2) the AcciMap approach (e.g. Rasmussen, 1997; Rasmussen & Svedung, 2000; Svedung & Rasmussen, 2002; Vicente & Christoffersen, 2006).

THE CURRENT STUDY

The current study aimed at examining how established human factors are being applied in the actual investigation process. Therefore, we conducted a content analysis (see Janis, 1965) on aircraft accident reports issued by aviation psychologists. In particular, as a first step, we analyzed if there are differences regarding the investigated human factors. As a second step, we analyzed if there are differences concerning the areas of the human factors. As such, individual/crew factors, supervision factors, organizational factors, over-organizational factors, and environmental factors were investigated. Meant by over-organizational factors are factors that go beyond the influence of a single organization as described in the AcciMap approach from Rasmussen (1997), Rasmussen and Svedung (2000), and Svedung and Rasmussen (2002).

MATERIAL AND METHODS

Fifty-five possible psychological aircraft accident reports from the years 1994-2014 were identified. Out of these, 47 were available at the time of the research process. Since 5 out of those accidents were not investigated by psychologists, 42 reports remained. Hence, data from $N = 42$ reports (pages: $M = 7.6$, $\sum=333$, range: 1-37) were analyzed using content analysis.

For conducting the content analysis an appropriate system of categories is needed, which consists of the categories´ names, respective definitions, and representative examples drawn from the text (Mayring, 2003). Our final system was created as follows. First, we examined, if guidelines on behalf of aviation-related organizations exist that suggest which human factors should be considered during an accident investigation. As a second step, we conducted a literature research while focusing on a) identifying particular human factors with relevance for accident incurrence and b) on accident models. As a third step, we matched the identified factors and models and aggregated them into our category system. Thus, the category system consisted of the nine particular factors stated above, the categories of HFACS (Shappell & Wiegmann, 1997, 1998, 2000, 2001; Wiegmann & Shapell, 2001, 2004) and the levels of the AcciMap approach (e.g. Rasmussen, 1997; Rasmussen & Svedung, 2000; Svedung