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An introduction of accidents' classification based on their outcome control

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ABSTRACT

Most safety oriented organizations have established their accidents classification taking into account the magnitude of the combined adverse outcomes on humans, assets and the environment without considering the accidents' potential and the actual attempts of the involved persons to intervene with the accident progress. The specific research exploited a large sample of an aviation organization accident records for an 11 years' time period and employed frequency and Chi-square analyses to test a new accident classification scheme based on the distinction among the safety events with or without human intervention on the accident scene, indicating the management or not of their ultimate consequences. Furthermore, the research depicted the effectiveness of personnel strains to alleviate the accident potential outcomes and studied the contribution of time, local and complexity factors on the accident control attempt and the humans' positive or negative interference. The specific newly proposed accident classification successfully addressed the "controlled" or "uncontrolled" traits of the safety events studies, prior their severities consideration, and unveiled the effectiveness of personnel efforts to compensate for the adverse accident march. The portion between controlled and uncontrolled accidents in terms of the human intervention along with the effectiveness of the later may comprise a useful safety performance indicator that can be adopted by any industry sector and may be recommended through international and state safety related authorities.

1. Introduction

In his work Geller (2001) supported that accidents do not inevitably result in actual injuries, and they are unusual and unexpected events. Therefore, an incident may also be classified as an accident if it embodies the potential for injury and damage, and accidents are caused and not just occurred due to present and insufficiently managed human, situational and environmental factors (e.g., improper use of tools and machines, inadequate use or provision of protective equipment, poor working conditions, improper maintenance, errors during procedures). Although ICAO (2013) highlights that there is practically no direct relation between the active failures and the type and extent of the adverse effects caused, safety cases' consequences comprise the basis for accidents' classification for most organizations and safety engaged authors.

Manuele (2003) noted that safety performance measurement in general is driven by incident recording and analysis. Bhagwati (2006) noticed that an accident might involve human injury and cost money, but an incident may cost money in the future; therefore a near-miss would be investigated as an accident although incidents are less visible than serious accidents, are not given sufficient attention, and they are not reported and recorded unless their damage cannot be hidden.

Bhagwati (2006) and Stranks (1994) stated that the direct and indirect consequences of the accidents involve victims and their family, colleagues and superiors, the workers morale, lost time due to injuries, treatment costs, training and time for workforce replacement, damages to infrastructure, need for replacement or repair of equipment, lost production time, spoiled materials, accident investigation time and downtime, loss of customers, adverse publicity, etc. Under this concept, Stranks (1994) suggested the organizations should issue standard accident costing forms to facilitate the estimation of the aforementioned costs; these costs determine the accident severity classes developed by many organizations.

Davies et al. (2003) claimed that major accidents often look more complex than incidents only because organizations spend on the former more resources (e.g. larger investigation committees, more time). This is the reason Stranks (1994) proposed that the priority of investigations must be based on the accident types

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(e.g. machinery, chemical), the severity and the potential of damages and injuries, any increasing trend according to the organization's experience, the probability of legal implications, and the potential of insurance and financial claims. In addition, Manuele (2008) suggested that safety professionals shall focus on the "vital few" incidents that result in serious injuries and their investigation will lead to management actions towards the mitigation of their reoccurrence potential.

Bowen (2004) supported that an ideal strategy for measuring safety performance should combine frequency measures, severity indices, non-injury cases measurement, and safety success assessment through staff perceptions surveys. The combination of more than one measurement, such as frequency, severity (e.g., injuries) and activity measures (e.g., audits) were proposed by Peterson (2005) towards safety performance assessment.

The FAA (2000) presented the common safety performance requirements: quantitative requirements expressed as failure or accident rates, accident risk levels defined by the organization, and standardization requirements linked to the compliance to regulations. Martin & Walters (2001) declared that metrics that are specific to the safety program under operation must be developed in order to measure performance and Galloway (2011) suggested the validation of measurement usability by questioning "What's in it for me?" The same author argued that, in the promotion of safety, there is a need for shifting from measuring the failure (e.g. accident rates) to the estimation of success; the goal of an organization might be not avoiding accidents but maintaining and increasing safety levels. Although the specific approach makes no difference in numbers since the success is literally the reciprocal of failure, such a view enhances positive organizational safety culture.

Easter et al. (2004) argued two discrete safety activities, the risk measurement and the risk subjective value, and related safety and health with a total loss control program, based on data from accident/incident investigation reports and cost analyses, and survey/inspection/audit reports.

As ICAO (2013) noticed personnel performance is unavoidable to fluctuate between the baseline and the ideal performance due to human variability and hazards' management during real operations. However, it must be noted that these same imperfect people make systems operate smoothly. Following a positive approach, Helmreich et al. (2001) argued that instead of emphasizing on human fallibility, organizations should consider the personnel's remarkable ability to compensate for their errors in the modern complex systems.

According to the FAA (2000) human performance may be measured quantitatively and qualitatively with time and accuracy parameters, the task safety and performance must have been determined in the system design stage and system performance is affected by operators' individual performance. As Gilbert (2008) appends, business survival and success is mostly relied on employees "who know what to do, know how to do it effectively and efficiently, and want to do it".

Reason (1990) and ICAO (2013) presented the distinction between active failures ("what", "who" and "when"), referring to errors and violations as symptoms of safety problems that cause adverse effects, and latent conditions ("how" and "why"); the latter include managerial decisions related to the unsuccessful allocation of resources, line management fallible practices that may provoke error and violation producing conditions, and adverse workplace conditions.

In the scope of managing human error Roland and Moriarty (1990) suggested that safety training shall include accident analysis and incident avoidance strategies, the installation of positive safety attitude, safety knowledge impartment, and hazard control enforcement. Also, in his comments on safety reward systems, McSween (2003) argued that the usual rewarding criteria do not encompass safety behaviors, whereas the focus on the individual or team safety performance, regardless of the fact that some candidates may have been lucky enough to avoid accidents/incidents although they were following unsafe practices and taking unwanted risks.

Taking into consideration the literature above, it seems that severity classes, even the distinction among accidents and incidents, dominate the contemporary accident rates computation in the scope of measuring safety performance, without, however, addressing the safety events' potential before calculating their adverse outcome magnitudes on the scope of defining their severity categories. Also, human attempts to control the accident progress towards the avoidance of more adverse implications are not considered. Following these remarks, the specific research exploited a large sample of accidents occurred in a large aviation organization and proposes a new accident classification scheme that accounts for the attempt to control the safety events' outcome prior the determination of its category according to the consequences provoked.

Under this concept, the study considered that since some safety events may have resulted to specific adverse outcomes without any control on the side of the end-user, their severity classification may apply only for the safety events whose consequences comprise the outcome of a management attempt during the accident progress. The ultimate scope of the research is to propose the industry an innovative safety performance measurement based on accident severities control and human on-scene intervention effectiveness and to provide organizations with an alternative decision tool for directing their safety investigations, training and potential reward schemes priorities and efforts.

2. Methodology

2.1. General framework

The research was conducted in a large aviation organization that already monitors safety performance using accident rates according to their severity (accidents/100.000 flying hours per accident severity class) and calculates their contributing factors percentages. One of the objectives of the research was to introduce safety performance indicators beyond the widely applied accident rates in order to assess the effectiveness of its safety program more substantially.

The specific aviation organization is divided into three (3) Sections (coded as F1, F2 and F3) with different roles. Each Section manages various types of aircraft spread in several operational Bases. The aircraft fleet is divided into two (2) generations (2nd and 3rd generation fleet) according to their age, all the Sections operating both aircraft generations fleet. The particular organization considers the fleet acquired prior year 1985 as 2nd generation aircraft.

More particularly

- F1 performs the principal flying operations using seven (7) Bases (coded as F1B1, F1B2, F1Bx...) with five (5) aircraft types (coded as F1A1, F1A2, F1Ax....).
- F2 has a supportive role to the F1 operations (e.g. cargo flights for maintenance support, transportation of high management level staff and audit teams, emergency team transfers) and conducts operations from three (3) Bases (coded as F2B1, F2B2 and F2B3) with twelve (12) aircraft types (coded as F2A1, F2A2, F2Ax....).
- F3 is the flight training section that manages two (2) Bases, coded as F3B1 and F3B2, and operates flights using four (4) aircraft types, coded as F3A1, F3A2, F3A3 and F3A4.