How Data from Internal Safety Investigations and Processes Can be Used to Assess Performance of Safety Management

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# **Introduction**

The investigation of serious incidents and accidents has been a mandatory safety assurance method and the value of such investigations in learning from the past and improving the safety features of our systems is undebatable. Serious incidents and accidents are investigated by independent agencies/authorities and they are typically supported from all stakeholders involved or affected, who devote resources such as time, staff, equipment, facilities and expertise. However, when it comes to incidents that organizations investigate internally, the principle of independency and the expectation for adequate resources might not be guaranteed. This might occur partially because internal safety investigators report to managers of various organizational levels and they are not always positioned in the safety department/office that reports directly to senior management. It is not unusual that an internal investigation team is composed by employees and experts serving in positions other than safety related ones. Hence, internal safety investigators might face challenges in observing internal or external investigation standards and guidelines and ensuring that the outcomes of their investigations are of high quality and effectiveness. Furthermore, the support to internal investigations, exploitation of respective reports and response to those might indicate the importance that management assigns to internal investigations and reflect the level of safety management’s maturity within the organization.

This article presents the main parts of a study which was conducted at a large aviation organization and demonstrated how quantitative and qualitative data related to internal safety investigations can be used to assess: safety management’s role, speed of safety communication, timeliness of safety investigation processes and realization of safety recommendations, and the extent of convergence among safety management and investigation teams. The results of the study suggested an interfering role of the safety department into operations, severe delays of internal safety investigations, timely implementation of recommendations, quick dissemination of investigation reports to the employees, and a low ratio of investigation team recommendations included in the final safety investigation reports. Those finding were discussed with safety staff of the organization who attributed them to non-scalable safety investigation procedures, ineffective resource management, lack of consistent and bidirectional communication, lack of investigators’ awareness about the overall organizational context, and a weak commitment of operating departments to the realization of safety recommendations.

In overall, the specific research demonstrated an alternative way of exploiting available data from safety investigation processes and reports in the context of an internal performance-based evaluation of safety management.

# **Expectations from Safety Management**

Senior management is responsible for defining safety policies and procedures, allocating the resources required to accomplish safety activities, adapting best industry practices and incorporating regulations of state and international authorities and bodies (e.g., ICAO, 2013; CASA, 2005; FAA, 2006; Ridley, 2008; Stolzer, Halford and Goglia, 2008). In a clearly-scoped and mature safety management system, safety personnel should not interfere with operational decisions and remedial actions; it is the principal duty of department managers to implement solutions for safety deficiencies (Ferret & Hughes, 2011; Channing, 2008; Karanikas, 2014). Persons responsible for affected functional areas must be directly involved in the decision making process and assigned with the responsibility and accountability for implementing appropriate corrective actions (Manuele, 2003; CAA, 2002; TC, 2002; Stranks, 2008). This way, functional directors get actively involved in safety management and operationalize their safety responsibilities in their area.

Safety investigations comprise a fundamental safety management practice and their contribution in safety assurance is highly valuable. The distinct role of safety investigations in safety management stems from their potential to uncover causal and contributing factors and present the aftermaths derived from analyses of factual data. High quality investigations, in terms of depth, clarity, punctuality and objectivity, along with management support in realizing remedial actions, affect decisively an organization’s safety culture (Manuele, 2008). Resources allocated to investigations determine their extent and depth; as ICAO (2013) recognised, available resources will curtail some safety investigations. Nonetheless, the formulation of safety recommendations is the ultimate goal of safety investigations. ICAO (2003) set specific requirements for safety recommendations: they must be addressed to the most proper operational or management level that holds the authority to proceed to the necessary changes; the suggestions must address objectives instead of specific actions in order to meet objectives; the recommendations must be developed following a dialogue amongst the involved parts in order to avoid unexpected and undesirable denial and resistance to their implementation.

Also, safety communication is an inextricable part of a well-operated safety management scheme. Transport Canada coupled good communication and effective training with increased probability of a successful safety management (TC, 2004). Under this requirement, all organizational levels and functions must be aware of the strengths and weaknesses that affect operational activities. Information must not be restricted to safety topics; in a mature organizational culture, employees need to be knowledgeable about total organizational performance and benchmarking results (Karanikas, 2014). Inclusive electronic databases are expected to allow employees to retrieve information about industry and international standards, organizational plans and their incarnation progress, operational procedures, quality assurance findings and remedial actions (e.g., FOCA, 2013; TC, 2005; CANSO, 2014). Specifically, in the context of safety investigations, the goal is to maintain organizational memories alive, circulate aftermaths, and increase risk awareness so that similar negative events can be avoided.

# **Research Methodology**

The study was conducted at an aviation organization (AO) and explored how it could use data from safety investigation processes and reports in order to develop relevant safety management performance metrics, in addition to the measurement of incident rates and frequencies of contributing/causal factors. The AO’s hierarchical structure includes: senior management, where the safety department resides; three middle management sectors, each supported by a safety department; air operations, maintenance, logistics and ground support units, each reporting to a section and running a safety office.

The data exploited includes: AO’s safety investigation progress records, investigation team reports submitted to the AO’s safety department, final investigation reports released after the processing of investigation team reports, and recommendation logs. Those data existed already in the organization but had not been previously used on the scope of assessing aspects of its safety management. The sample was provided by the AO’s safety department and covered reports and records of 810 safety events occurred between 2004 and 2014 during flights or on ground.

Following the analysis of the datasets, the results were communicated to seven safety professionals of the AO and individual interviews were scheduled in order to discuss and explain the findings. The aim was to combine perspectives from safety professionals with various roles in the AO. All interviewees were experienced safety investigators and four of them were holding safety management related positions at the time of the interviews. The metrics employed to evaluate aspects of safety management and the results of the quantitative and qualitative analysis are jointly described in the following sections; the reader can refer to the full article for further details (Karanikas, 2016).

# **Metric 1: Duration of Safety Investigation Phases**

Description

This metric regarded the time elapsed amongst the several phases of safety investigations. A considerable deviation from the foreseen deadlines could be attributed to mismanagement or lack of resources in the investigation process, or unrealistic expectations. According to the AO’s safety investigation procedures:

* The investigation team should submit its report in 50 days’ time after the event’s occurrence, accompanied by comments from the operating unit involved and/or affected by the event. The combination of the report and comments constituted the draft investigation folder.
* Afterwards, the sector which the operational unit reports to, should comment on the investigation folder in 20 days. This additional commentary was becoming also part of the draft investigation folder.
* Next, the senior directorates addressed during the safety investigation were asked to add comments in the investigation folder in 20 days. Directorates’ comments supplemented the investigation folder too.
* After all commentary was collected, the safety department should publish the final investigation report in 60 days.
* Taking into account the time line referred above, along with an allowance of 20 days for secretarial procedures, the safety department should issue the official report in 170 days after the date the safety event had occurred.

Results

As Table I shows, the organization under study had experienced severe delays in its investigation phases at the operating unit and middle management sectors. All interviewees attributed those findings to ineffective resource management at the aforementioned organizational levels. Particularly, although investigation team members should be released from their normal duties during each safety investigation, this was not practiced by the managers of the operating units. At the middle management sector, the delays were linked to understaffing and the requirement for accomplishment of a variety of activities in addition to the coordination of the commentary of safety investigation folders. Safety staff of the operating unit and safety investigators claimed that the safety investigation procedures applied across the whole AO were not scalable and flexible enough to account for the variety of special conditions in each section and operating unit.

Table I. Duration of Safety Investigation Phases

| **Investigation Phase** | **Maximum Duration Foreseen****(days)** | **Actual Average Duration (days)** | **Deviation between Actual and Maximum Duration** |
| --- | --- | --- | --- |
| **Operating Unit** (accomplishment of investigation team tasks and first commentary) | 50 | 119 | +138% |
| **Middle Management Sector**(second commentary) | 20 | 50 | +150% |
| **Senior Management Directorates**(third commentary) | 20 | 15 | -25% |
| **Safety Department**(publication of final safety investigation report) | 60 | 60 | 0% |
| **Total process time** | 170\* | 432 | +154% |

# **Metric 2: Timeliness of Final Investigation Reports’ Communication**

Description

The specific metric regarded the time required for communicating the final investigation report to end-users at operating units and departments. The AO was distributing the reports in hard copy format and had imposed documentation controls in order to avoid publicity of the investigation reports and negative implications on persons and the organization as a whole. Albeit the AO had not set a specific timeframe for the communication of final investigation reports, such a metric was considered as indicative of safety management performance.

Results

In average, each report was communicated to the end-users of operating units in 11 days; communication of final safety investigation reports to the end-users did not show important delays, taking into account secretarial procedures. The AO’s safety personnel stated that the organization had recognised the merit of effective and timely communication of investigation reports across all organizational levels as a means to prevent unwanted events through the aftermaths formulated in such reports.

# **Metric 3: Number and Resemblance of Recommendations**

Description

This metric regarded two measurements: first, the difference between the number of recommendations stated in the investigation team reports and the ones included in the final reports; second, the number of common recommendations between investigation teams and the safety department. According to the AO’s procedures, the recommendations generated by the investigation teams were not binding and were subject to changes, additions etc. based on the comments received by the sectors and senior directorates and a final evaluation by the safety department. It is clarified that the AO had provided safety investigation training to staff that had been already trained as safety officers and implemented the risk assessment process of the organization as part of their duties. According to the safety investigation procedures of the AO, investigation teams were expected to formulate recommendations after evaluating various options, their possible effects on operability, side effects to other organizational functions, associated costs etc. This particular metric would indicate the distance between the investigation teams and AO’s safety department in terms of number and resemblance of recommendations. A significant distance could be attributed to flaws in information sharing amongst investigation teams and the safety department. This in turn, could imply ineffective communication across the organization.

Results

The final investigation reports included 48% more recommendations than the ones investigation teams formulated. Also, only 61% of the recommendations proposed by the investigation teams were stated in the final reports. During discussions on this topic, AO’s safety staff pointed out that safety investigators had put much effort in their tasks and were highly concerned about the quality and completeness of their reports. However, investigators did not acquire the “big” picture of the organization, in terms of complexity and resource constraints. Moreover, investigators were not able to estimate costs when they were designing recommendations and they were not aware of any other planned corrective actions that possibly were overlapping with the remedies proposed by the teams. The interviewees further attributed the findings in the incomplete information investigators had obtained regarding the organization’s plans, initiatives, constraints etc. This in turn was ascribed to the lack of a central data storage system where such information could have been stored and retrieved. Additionally, the safety department had not communicated to the investigators the reasons of the differences between what the investigation teams had suggested and what management adopted, because the AO lacks relevant procedures.

# **Metric 4: Type of Recommendations**

Description

Taking into consideration that standards propose a supportive role of safety managers and officers in developing remedial measures, each safety recommendation was classified as “assignment”, “action” or “reminder”, as explained below. The frequency of each recommendation type would indicate to what extent the role of the AO’s safety department had been supportive or interfering in operational managers’ duties concerning the generation and implementation of corrective actions.

* Assignment: The recommendation stated the objective to be achieved, meaning “what” should be fixed. This type of recommendations indicated a supportive role of the safety department because the latter did not restrict managers in the way they would tackle the problems revealed during safety investigations.
* Action: The recommendation stated specific methods to address a deficiency, thus minimizing the degree of managers’ freedom to devise solutions. This indicated an interfering role of the safety department.
* Reminder: The recommendation referred to an existing rule/procedure which was not followed by the employees and its reinforcement was suggested. In this case the role of the safety department was perceived as supportive since it did not introduce an action (i.e. how the reinforcement will be achieved).

Results

The safety department published about 39% “Action”, 22% “Assignment” and 39% “Reminder” recommendations. Safety staff of the safety department claimed that although the AO’s procedures described the distinct roles of several functions in the safety investigation process and generation of recommendations, results from corrective actions’ monitoring had showed that those roles had not been practiced. Operating units and/or middle management sectors had delayed, or even unilaterally rejected, corrective actions without providing relevant feedback to the safety department. Consequently, the safety department had been concerned that the deficiencies revealed through investigations would not be timely or at all addressed, and subsequently, in many cases the specific department had undertaken the role of managers.

The rest of the interviewees acknowledged that safety recommendations were frequently strict and did not allow flexibility to operating units and middle management levels in the implementation of remedies. These interviewees added that sometimes the “Action” recommendations were not matching the special conditions, resources and other factors of the various operating units, thus increasing occasionally the implementation time and possibly the quality of the corrective actions. The frequency of “Reminder” recommendation types in final investigation reports was perceived by the AO’s safety personnel as positive. They claimed that it was not necessary to overwhelm other organizational functions with publishing additional directives regarding reinforcement of established procedures and rules.

# **Metric 5: Timeliness of Recommendations’ Implementation**

Description

This metric regarded the time gap between delivery deadlines of recommendations and dates of their actual implementation, in total and per recommendation type. This metric would indicate potential delays in the implementation of corrective actions and trigger an exploration of underlying reasons.

Results

Managers implemented recommendations one month after the publication of the final safety investigation reports. The recommendations’ delivery deadline defined in those reports had a median value of zero. Statistical tests showed that “Assignment” type recommendations needed more time for implementation, followed by the “Action” and “Reminder” type ones. The same order was calculated for the time allotted by the safety department for the realization of each recommendation type.

The AO’s safety staff anticipated the aforementioned results, which suggested that safety department requested almost immediate implementation of recommendations. The interviewees argued that most of the “Action” type recommendations regarded easy to implement changes (e.g., subtle amendment of procedures) and “Reminder” type measures required by default short implementation time. Since “Action” and “Reminder” recommendations held 78% of the total number of the recommendations published by the AO, the short average implementation time revealed by the particular metric was expected. On the other hand, “Assignment” recommendations had usually referred to introduction of new technology or technical modifications, extensive changes of procedures, and further research for deficiencies identified during safety investigations. Such recommendations required detailed planning and research, and, consequently increased time for their delivery. However, they held about one fifth of all recommendations and they did not significantly affect the results of the specific metric.

# **The Overall Picture**

The analysis of data in combination with the discussions held with the organization’s staff revealed both positive and negative performance of the safety management aspects considered in the study. The significant delays in safety investigations were credited by the AO staff to ineffective resource management and investigation procedures, which had led to a gap between AO expectations and actual deliverables. Although a timely and adequate allocation of resources will benefit organizations in terms of depth and speed of investigations, it seems that the specific organization had not realised the extent to which such resources were not always available or committed to investigations. Hence, it was not always feasible for the AO to derive lessons from safety investigations in a timely manner.

The fact that 48% more recommendations were stated in the final reports compared to the number of remedies stated in the investigation team reports, and that only 61% of the latter were adopted, indicated a dissociation amongst the safety department and investigators. Although the AO was expecting from investigators to be aware of the wider organizational context when they were formulating recommendations, the quantitative and qualitative differences in the generation of safety recommendations were attributed to the lack of consistent information sharing between senior/middle management and investigators.

Moreover, the lack of a central information system had not supported investigators’ awareness of the overall organizational context and had led to the proposal of remedies which were not completely aligned with the plans, constraints and other conditions of the AO. In addition, it seems that, even under the lack of such a central system, a bidirectional communication between the safety department and investigators could have alleviated over time the discrepancy regarding the quantity and quality of safety recommendations. Thus, the organization had missed the opportunity to minimize the aforementioned gap over time.

On the positive side, the quick dissemination of safety investigation reports to the end-user level and the timely implementation of safety recommendations were attributed correspondingly to the appreciation of communication of such information across the organization, and the importance given to the efforts for preventing future accidents and incidents. It seems that the AO had successfully estimated the time planned and the resources allocated for the implementation of remedies. It is noticed that the metric of timely implementation of safety recommendations does not account for the quality and effectiveness of the remedial actions, which was not possible to be evaluated through the analysis of investigation reports and records.

The relatively high percentage of “Action” type recommendations indicates that the AO’s safety department had played an interfering role in the responsibilities of other departments. This was the result of inadequate commitment of managers to the realization of “Assignments” type recommendations in the past. This, in turn, had resulted to important delays in the implementation of remedies and increasingly forced the safety department to formulate safety recommendations in a way that those dictated what should be performed instead of stating what should be achieved. Such an approach literally violated the scope of the recommendations referred in standards; the AO’s staff attributed the aforesaid evolving practice of the safety department to the lack of a productive dialogue across the various organizational levels.

# **Concluding Remarks**

The study described in this paper demonstrated the potential of data from safety investigation records and reports to be used for assessing performance of various safety management aspects in addition to the monitoring of event rates and frequencies of contributing and causal factors. The findings from the analysis of such data triggered respective discussions, through which positive and negative areas of safety management performance were identified.

Each organization might record different data in regard to safety investigations, so the implementation of the whole set of metrics presented in this study may not be always feasible. However, organizations can follow the method of this study in order to develop metrics depending on the data they maintain in relation to safety investigation reports and processes, and use those as a means to improve their safety management. Quality of safety recommendations and depth of investigations are examples of aspects that can be also evaluated depending on the resources and type of data available. Nonetheless, it is of paramount importance the results of such metrics to be followed by interviews and/or questionnaire surveys in order to interpret figures and inform decisions.

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