Investigating for Safety Management System Failures

Abstract

Safety Management Systems (SMS) have become the primary framework for large air carriers, airport operators and air navigation service providers to proactively manage risks and avoid costly accidents and incidents. A dysfunctional SMS can create multiple, insidious and systemic risks that lead to unsafe operating conditions. This presentation suggests that SMS failure must be considered as a causal factor in every investigation. Two systemic causes of SMS breakdown will be examined: a negative compliance culture and inadequate safety leadership. Utilizing the concepts and models of the "Spectrum of Compliance" and "Safety Governance" as tools for the investigator to gather evidence, positive and negative indicators will be reviewed.

Authors

Mike Plottel *is a senior safety leader with over 40 years' experience in the aviation industry. His career as a pilot, manager and executive has covered regional, domestic and international operations. Since 1995, Mike has specialized in aviation safety focusing on safety management systems, causal analysis, flight data monitoring, fatigue risk management and safety leadership. Mike is currently a Senior Associate with GC Safety Solutions, a business unit of GoCrisis Management Pty Ltd.*

Elaine Parker *is a safety and management professional with over forty years of experience in the aviation industry. Throughout her career to date, she has served in many senior management positions in operations, marketing, safety, security and training both in the public and private sector. She has been a full member of the International Society of Air Safety Investigators (ISASI) since 1990 and sat as a member of the executive of the Canadian Society from 1994 till 2021. Elaine is currently the VP of Operations for Beyond Risk Management Ltd. in Canada.*

Investigating for Safety Management System Failures

Elaine Parker
VP of Operations, Beyond Risk Management Ltd.

Mike Plottel
Senior Associate, GC Safety Solutions

Introduction

Safety Management Systems (SMS) have become the operational risk management standard for a broad segment of our industry, including air carriers, air traffic service providers, airport operators and maintenance organizations. The applicability of SMS regulation continues to expand in most jurisdictions to cover additional industry segments as experience grows and increasingly complex systems require a more sophisticated risk management framework.

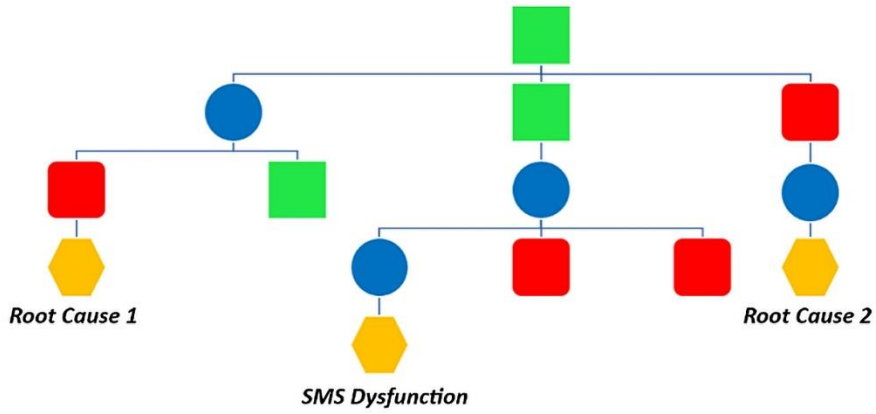
SMS is more frequently becoming an avenue of enquiry for air safety investigations (as well as for other modes of transportation where it has been adopted) because of its key role in preventing incidents and accidents.[1] Evidence of SMS dysfunction may indicate the failure of one or more specific risk management processes or the presence of systemic conditions that impact an entire SMS and expose the organization to undue risk. Some common indicators used to support findings of the SMS as a contributing or causal factor include inadequate or absent risk assessments, poor communication of safety information, issues with training and supervision, documentation shortfalls and organization factors.[2]

Failures in safety management systems or safety management processes have been identified in investigation reports for decades. Most often SMS dysfunction has been cited as a contributing factor or root cause for an occurrence or hazard (see Figure 1). But as adoption of SMS becomes more widespread and its role in operational risk management gains importance, the need to identify the reasons behind SMS breakdowns has become critical. To do so, we need to continue to ask "Why?" an SMS has become dysfunctional rather than declaring the SMS breakdown as a root cause. Understanding and addressing why an SMS breakdown has occurred will assist the organization to improve its risk management processes and reduce its risk exposure going forward.

Two underlying conditions that may lead to the failure a safety management process or dysfunction across an entire SMS are a poor compliance culture, which can be classified on the Spectrum of Compliance and ineffective safety leadership, which is highly influenced by the organization's safety governance framework. This paper will present models to examine the impacts of compliance culture

[1] NTSB (2022), TSBC (2014), BEA (2014)
[2] French and Steel (2017) pp.8,9

and safety governance on SMS performance and provide suggested methods to determine whether either one has contributed to a safety occurrence.



Generic Analysis Showing SMS Dysfunction as a Root Cause or Contributing Factor

Figure 1

A 2017 OECD Transportation Forum paper stated, "… good accident investigation will always look beyond questions of compliance and seek to understand the ways in which the management systems themselves contributed to the accident … Good investigation will pursue causal links from the factory floor to the board room whenever necessary to reveal important safety learning."[3] These observations are abundantly relevant when seeking the underlying causes for SMS breakdowns and their effect on operational risk exposure.

[3] French and Steel (2017) pp.6,7

Spectrum of Compliance – One model

There are a number of models used to quantify or place organizations in a recognizable order or hierarchy with respect to their regulatory and process compliance or their risk tolerance. All of these models have merit and all have similarities in common. Some examples include: "Compliance Maturity Model,[4]" "Risk Maturity Model," "Safety Maturity Model[5]". These models work well within an aspirational organization seeking to find its path to improvement. An investigator or investigating body could select any of these models as the framework to conduct the investigation into SMS as a contributor to the event.

The "Spectrum of Compliance" model graphic has been chosen as one of two base framework models for this paper as, unlike other models classifying organizational status with respect to compliance, risk management, safety, governance or other characteristics, it does not assume any aspirational intent of the organization to mature or to improve. It can be used to place the organization along the spectrum based upon evidentiary observations made during the investigation. The model may assist in providing an external view of the organization, one that a regulator may have, rather than one for organizational reflection.

In each of the spectrum areas there are factual observations that can be made regarding the organization's behaviours. Some of these behaviours cross over from one area to another, but in aggregate can give a clear picture of the organization's placement.

The definitions, behaviours and potential responses contained in this paper are a combination of those indicated in a number of models in addition to observations of the presenters.

The examples in this paper may provide a framework for the investigator in gathering of evidence of contributory factors and should be examined and expanded upon as they are used in the real-world environment.

[4] Kussero (2020)
[5] Foster and Hoult (2013)

Criminal

Definition
Substantial failure to meet a large proportion of safety regulatory requirements that have been pointed out to the operator in the past through audit / inspection with no improvement in practices.

Behaviours
- willful falsification or destruction of records
- repeated exceedance of limitations (overloading, weather minimums, extended time between required maintenance, use of incorrect/bogus parts)
- organization does not council employees to follow regulations and standards, takes no action when employees found to disregard them
- disinterest in learning regulations
- non-existent documentation for SMS or a generic and unused set of documents

Most effective response of regulator
- suspend or revoke the licence/certificate privileges or severely restrict
- deploy of substantial resources
- prepare for legal action

Chancer

Note the title of this partition of the model shows in other models with the following labels: Minimal, or Chaotic, AdHoc or Vulnerable.

Definition
The personnel within the organization do not believe that compliance is important; no overall value is seen in compliance. Willing to risk getting in trouble (Cultural "Failure to follow SOPs" due to the perceived consequences being Negative, Later, Uncertain)

Behaviours
- unlikely anyone assigned full time to SMS
- superficial or inadequate efforts to determine and address root causes of the problem
- when problems identified, corrections only – no long term solutions implemented
- minimal and/or inadequate SMS documentation

Most effective response of regulator
- conduct detailed auditing raising findings
- add resources for increased oversight

Careless

Note the title of this partition of the model shows in other models with the following labels: Reactive or Fragmented.

Definition
Organization believes compliance is a series of boxes to check.

Behaviours
- persons assigned to SMS express disillusionment as things do not change
- knowledge of requirements does not extend to employees outside of those directly assigned SMS
- other departments abdicate responsibility for SMS to those assigned “in SMS department”
- processes not documented or poorly/inadequately documented

Most effective response of regulator
- “tighten” (increase) auditing/assessment schedule
- conduct detailed auditing/assessments with resultant findings
- add resources for increased oversight
- offer information and support for education of organisation

Confused

Note the title of this partition of the model shows in other models with the following labels: Evolving or Defined.

Definition
Organization believes compliance is important, but has no functional process or framework.

Behaviours
- is unaware of regulatory change that impacts them until pointed out by regulator
- SMS staff express being overworked
- SMS documentation exists and meets basic requirements

Most effective response of regulator
- offer information and support for education of organisation
- retain regular schedule of auditing/assessment and oversight

Compliant

Note the title of this partition of the model shows in other models with the following label: Integrated.

Definition
Organization believes that operating in a mode of continuous compliance is beneficial. Has actual processes in place and does strive to make improvements.

Behaviours
- organization has dedicated personnel in SMS
- has process to monitor changes in regulations

- employees throughout organization know about compliance with regulations and internal processes
- regular amendment of documentation takes place

Most effective response of regulator
- work with the operation to improve investigation of events
- provide feedback to operation of best practices seen elsewhere

Champion

Note the title of this partition of the model shows in other models with the following labels: Strategic, Agile, or Resilient.

Definition
Organization sees true merit to operating to standards and above. Sees that compliance can drive a competitive advantage.

Behaviours
- Comments on proposed regulatory change
- At this level all of the indicators from the Compliant area will also be present

Most effective response of regulator
- Reduce oversight
- Offer mutual job share programs – learn from one another

In every area of the spectrum above, the investigator should consider the role the regulator might have had in the failure of the SMS system. In the "Criminal" or "Chancer" areas there is a potential for the regulatory response (or lack of response) to be contributory to the event. At those levels the behaviour of the regulator (that may indicate a failure of oversight) may include inappropriate responses to whistleblower reports, repeat findings in audits, repeat findings in inspections. On the positive side it is possible that the event may have been prevented from being as serious as it could have been with good regulatory oversight. This would be more likely evident in the "Confused" or "Careless" areas.

Safety Governance

What is Safety Governance?

An abundance of research supports the maxim that a positive safety culture is necessary to enable an effective safety management system. A key requirement for that positive safety culture is effective safety leadership, which starts at the top of an organization with its Chief Executive Officer (CEO) who is most often its Accountable Executive (AE). [6]

[6] Apanay (2023) p.8

But there is a level of organizational accountability above the CEO that establishes the foundation for effective safety leadership and is ultimately accountable to key stakeholders for all aspects of the organization's performance, including financial, regulatory, environmental, social and safety outcomes. That level of accountability rests with the Board of Directors (the Board).

As representatives of the organization's shareholders or sponsoring body, one of the Board's responsibilities is to act as employer, advisor, and enabler to the CEO. The Board hires the CEO, establishes their objectives, evaluates their performance, determines their compensation and provides the organization's strategic direction, which the CEO is expected to pursue.

The priorities of the Board become the priorities of the CEO. Board priorities will therefore have a profound influence on the organization's safety risk exposure and the effectiveness of its risk management systems: i.e., its SMS. Safety risk management expectations articulated by the Board will drive risk management processes established by the CEO. Furthermore, the Board's safety leadership expectations will drive executive safety leadership behaviours which, in turn, create the foundation for the organization's safety culture. The adage that says, "Whatever interests my boss fascinates me" is alive and well in the C-suite.

One of a Board's most important functions is to set strategic direction for the organization. The framework for guiding a CEO in establishing and executing an aligned corporate strategy is called the organization's governance framework or governance model. Likewise, the framework for reflecting the Board's ***safety priorities*** is called the organization's ***safety governance framework.*** An effective safety governance framework will support a successful SMS through good safety leadership and a positive safety culture.

Safety governance can be defined as the strategic framework established by a Board and senior executives to ensure effective safety leadership of their organization.

Ferguson[7] identifies the four key components of a safety governance framework: the structure through which the vision and commitment to safety is set, the means of attaining safety objectives, the framework for monitoring safety performance and the process for ensuring compliance with legislation.

A more detailed examination of safety governance indicators is covered below; however, some basic organizational indicators of a good safety governance framework include:

- safety accountabilities are appropriately assigned, documented and understood by all stakeholders, and are held by positions with the authority to control their outcome;
- the organization is appropriately structured to effectively manage operational risk, including the safety team, which retains its independence from line management;
- safety risk management is embedded in all policies, processes and procedures; and
- effective safety assurance processes are in place throughout the organization, including the Board.

A dysfunctional, inappropriate or poorly communicated safety governance framework can undermine any or all components of an SMS and reduce its effectiveness in preventing losses. A safety governance framework may directly affect the SMS through organizational factors or through its safety culture.

[7] Ferguson (2016) pp.15, 73

When investigating for specific indicators of good safety governance it is important to remember that the Board Chair is accountable for the organization's safety governance framework whereas the CEO (Accountable Executive) is accountable for its safety management system.

NOTE: In many countries, Board positions are normally non-executive roles, which is the convention incorporated into this paper.

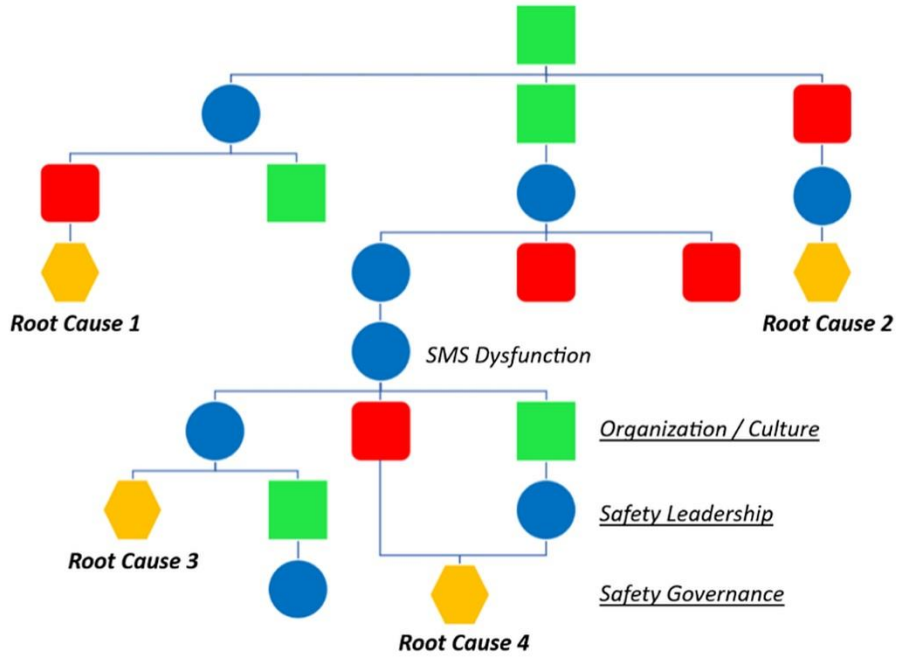
The Relationship Between SMS and Safety Governance

Evidence shows that key enablers of an effective SMS include a positive safety culture and the resulting organizational norms that it promotes**.** ICAO's Safety Management Manual says that safety culture is "… arguably the single most important influence on the management of safety [and if] an organization has instituted all the safety management requirements but does not have a positive safety culture, it is likely to underperform."[8] Safety culture is driven by good safety leadership which, in turn is enabled, encouraged and supported by good safety governance.[9]

Dependencies between the SMS, safety culture, latent organizational factors, safety leadership and the safety governance framework will always exist. The process below provides guidance for understanding these dependencies and asking the right questions to determine if they were causal to the occurrence or hazard under investigation.

Three distinct steps can be considered in establishing these causal relationships and how they led to an SMS failure; however, each one should be undertaken only if evidence in the previous step indicates it is an appropriate line of enquiry (see Figure 2). Furthermore, the suggested indicators for collecting evidence are not exhaustive nor do they represent exclusive causes for SMS dysfunction; they are simply representative of relevant lines of enquiry. Investigators should therefore consider this process to be just one asset in their toolkit for investigating a dysfunctional SMS or safety management process.

[8] ICAO (2018) p.3-1
[9] Ferguson (2015) p.200



Generic Analysis Showing Drill-down into the Causes for SMS Dysfunction

Figure 2

Evidence of Safety Culture Issues or Organizational Factors

The Transportation Safety Board of Canada's Guide to Investigating for Organizational and Management Factors[10] summarizes the importance of safety culture to an organization's risk management and risk exposure, as well as its influence on an SMS:

> Safety culture is a critical determinant of both the overall level of risk in an organization and the organization's ability to effectively manage safety since it:
>
> - Influences the level of risk through the creation of norms, which influence how work is accomplished on a day to day basis; and,
> - Defines the environment in which safety management structures are implemented. Values and beliefs are key elements of safety culture and determine how much individuals will trust, and participate in, safety management activities.

[10] Transportation Safety Board of Canada (2014) p.35

The search for evidence of organizational factors or safety culture gaps should be done in tandem as they share some common indicators, and it is almost impossible to accurately assess safety culture through in-person interviews following an occurrence. French and Steel conclude that culture perceptions in the workforce will likely be biased by the recent occurrence and will not be representative of the conditions in play at the time of the event.[11]

If a reliable assessment of safety culture conducted shortly before the occurrence, is available it can be used as an indicator of safety attitudes, values and practices which may have contributed to the occurrence or hazard under investigation. If such direct evidence is not available, a thorough review of organizational factors may lead to identifying safety culture challenges which contributed directly or indirectly to the occurrence.[12,13] Several methods are available to perform a deep dive into organizational factors, such as: Event and Causal Factor Analysis (ECFA), Root Cause Analysis (RCA) and Human Factors Analysis and Classification System (HFACS).

Underlying organizational factors may be the cause of one or more safety risk management deficiencies or failures. Examples of evidence that organizational factors played a causal role may include:

- policies or procedures are not appropriate for the size, nature, complexity or maturity of the organization;
- hazard reports or minor occurrences have not been investigated for root causes;
- managers with inadequate authority are named as accountable for corrective action plans;
- risk assessments are inadequate or inconsistently performed; and
- poor safety or technical training and communication.

Direct indication of the organization's safety culture can also be found in evidence (in addition to a current and reliable safety culture assessment). Some common indicators of a negative safety culture include:[14]

- hazard information is suppressed or ignored;
- responsibility for safety is avoided or fragmented;
- failures lead to cover-ups or local fixes;
- new ideas for safety improvements are ignored or summarily discounted.

Safety Leadership Indicators

Effective safety leadership is critical to support a positive safety culture which, in turn, enables a successful SMS. Safety culture (or a similar organizational dynamic) has been identified as a causal factor in many high profile accident investigations, including the Three Mile Island reactor meltdown (1979), the Bhopal gas leak (1984), the Chernobyl nuclear disaster (1986) and the two Space Shuttle accidents (1986 and 2003). In 1994, the NTSB's John Lauber stated that the probable cause for a fatal airline accident was the failure of senior management " … to establish a corporate culture that encouraged and enforced adherence to approved maintenance and quality assurance procedures."[15]

[11] French and Steel (2017) p.35
[12] French and Steel (2017) p.36
[13] Transportation Safety Board of Canada (2014) pp.22-23
[14] Transportation Safety Board of Canada (2014) p.36
[15] National Transportation Safety Board (1992) p.54

It is important to recognize that safety leadership issues are not the only cause for a dysfunctional safety culture. Investigators must carefully analyse the causes for any observed organizational factors or safety culture gaps and pursue safety leadership as a causal factor only when the evidence points in that direction.

Safety leadership indicators can be more difficult to quantify than those for other latent conditions such as technical designs, maintenance processes, environmental conditions or risk controls. A review of safety leadership indicators focuses on the behaviours of the organization's executive team and their associated impacts on managers and others in the organization. It may also focus, to some extent, on Board members' safety behaviours.

Executives' and board members' safety behaviours must be considered in their appropriate context. Executives, including the CEO, are charged with directing the day-to-day activities of the organization, pursuing the agreed strategies and achieving strategic objectives. Board members are not normally involved in the daily running of the organization but are accountable for setting its strategic direction, establishing overall risk tolerance, ensuring legislative compliance and oversighting organizational performance. Regardless of their position, all leaders should consistently model robust safety behaviours and demonstrate their ongoing commitment to safety in the workplace.

Ferguson[16] identifies four characteristics of effective safety leadership:

- a clear and compelling vision for safety;
- a genuine and visible personal commitment to safety;
- sound and inclusive safety decision-making; and
- a commitment to transparency on all safety activities.

Indicators of these characteristics can be observed directly through leaders' behaviour or indirectly through accepted norms and should be considered in the context of the size, nature, complexity and maturity of the organization. Several common indicators for each safety leadership characteristic are discussed below.

Evidence that leaders' hold a clear and compelling safety vision is evident when:

- a safety policy is communicated, understood and internalized throughout the organization:
- senior leaders continually articulate their consideration of safety impacts in all activities;
- non-negotiable safety standards are consistently communicated; and
- leaders ensure safety risk management is consistently incorporated into policies, processes and procedures across all business units.

Leaders' personal commitment to safety is evident when:

- safety is consistently visible in all executive relationships with internal and external stakeholders;
- contractors are held to the same safety standards as employees;
- executives consistently hold managers and employees accountable for compliance with safety processes and procedures; and
- all leaders consistently model positive safety behaviours.

[16] Ferguson (2015) p.21

Executives demonstrate their sound and inclusive safety decision-making when they think strategically, proactively and inclusively about safety. Examples of this behaviour include:

- motivating all members of the organization to internalize safety behaviours that exceed minimum regulatory requirements;
- ensuring front line employees, who have the best practical understanding of risks and risk controls, are engaged in risk management processes; and
- leading safety indicators are required in all executive and board safety reports.

Commitment to safety transparency is a powerful indicator of positive safety leadership. It not only requires systematic internal and external communication of leadership efforts to maintain effective operational risk management, but also requires open communication of safety successes and failures. Accepting this type of public scrutiny is a true test of leaders' commitment to safety. When adopted by an executive team or Board, a commitment to safety transparency can effectively drive safety ownership and continual safety improvement throughout the organization.

Indicators of a genuine commitment to safety transparency include evidence that:

- safety objectives, successes and failures are regularly communicated throughout the organization and to the Board;
- this same information is communicated in official company reports to shareholders; and
- leaders are committed to a Learning Culture where lessons from occurrences are always used to prevent similar occurrences by improving processes and increasing employee awareness.

Safety Governance Framework

An organization's CEO, or Accountable Executive, is accountable directly to its Board of Directors. It follows, therefore, that the Board's safety vision, priorities, values and objectives will direct how the CEO and their executive team view safety, pursue safety objectives and embrace effective safety leadership. The Board's safety expectations are communicated through the organization's safety governance framework.

Evidence of the safety governance framework will be visible in documentation, processes and actions related to the Board and Executive team. For example, references to safety in the charters and policies, communication channels, and reporting and measurement tools established by the Board and senior executives will provide evidence of their safety governance framework.

A safety governance framework must be appropriate for the organization and properly communicated to be effective. An appropriate framework must be compatible with the organization's size, nature, complexity and maturity. Ferguson[17] has developed a safety governance maturity model which provides characteristics of safety governance frameworks as they mature from "transactional" to "integrated." A poorly communicated safety governance framework may lead to misunderstanding of safety priorities, policies or accountabilities which can have a negative effect on safety leadership in the organization.

The four key components of a safety governance framework have been identified as: the structure through which the vision and commitment to safety is set, the means of attaining safety objectives, the

[17] Ferguson (2016) p.1

framework for monitoring safety performance, and the process for ensuring compliance with legislation. Sample of indicators for each component are discussed below.

The Board's vision and commitment to safety are evident when:

- safety is included in the Board charter and its corporate strategy;
- the safety vision/policy is adopted by the Board, effectively communicated to all employees and contractors and consistently promoted by Board members and Executives;
- the Board visibly supports the CEO in their safety leadership of the company; and
- the Board charter requires at least one member to have relevant safety risk management experience.

Various means for achieving safety objectives will be evidenced by how the Board prioritizes safety issues in its overall governance framework. For example:

- the Board establishes a safety sub-committee that meets regularly and reports consistently at Board meetings;
- safety is integrated into other sub-committees, such as those dealing with risk, audit and remuneration;
- safety objectives are embedded in the CEOs performance expectations and reviewed at all executive performance/compensation reviews;
- safety leadership is included in any assessment of Board effectiveness; and
- a safety impact assessment is required for all projects or business development initiatives requiring Board approval or Board reporting.

Some indicators of an effective framework for monitoring safety performance include:

- board visibility of all SMS, safety culture and safety climate reviews;
- regular Board briefings on safety performance, risks and risk controls;
- required reporting of leading and lagging safety performance indicators; and
- full access to the Board is made available to the Accountable Executive.

Finally, processes by which a Board can assure regulatory compliance might comprise:

- safety induction for all Board members covering applicable safety policies and regulations;
- Board briefings on changes to company risk management processes and safety regulations;
- Board visibility of internal and external compliance reports; and
- a requirement for the Accountable Executive to immediately report any violations or potential non-compliance to the Board.

To supplement internal processes for Board oversight and assurance, some organizations engage an outside expert to provide an independent assessment of the organization's risk management status at each Board meeting. Recent research by McKinsey and Company indicates that over 60% of all boards, and over 80% of very high impact Boards, now seek relevant information beyond that which management provides. [18] It is not practical for these assessments to take the form of a formal SMS audit; therefore, they are often based on widespread interviews at all levels of the organization. This process provides the Board with additional insight into their internal safety performance reports, periodic indications of the safety climate and benchmarking of the organization's safety performance within its industry sector.

[18] Huber et al (2022)

Conclusion

As Safety Management Systems continue to consolidate a multitude of risk management processes, it is essential that investigators gain the comfort and knowledge to consider SMS in all investigations and note the results in their reports. A single SMS process failure, multiple failures or widespread SMS breakdown can be causes or contributing factors to any hazard, incident or accident.

There are many causes for SMS dysfunction, two of which are a negative compliance culture and an inadequate, inappropriate or poorly understood safety governance framework. This paper has provided guidance to investigators in determining whether causal relationships exist between these factors and the occurrence or hazard under investigation.

When assessing the impacts of compliance culture or safety governance on an SMS, investigators will need to gather evidence of the organization's, practices, documents, records, processes, structure, culture, behaviours and leadership. Any finding of full or partial SMS breakdown, supported by evidence from this process, must be noted in the final investigation report.

Findings relating to SMS breakdowns can be very impactful to an organization on many levels, including operational, regulatory, commercial and cultural. For this reason, evidence against an SMS should be thoroughly discussed with all stakeholders before being included in a final investigation report.

Finally, drawing conclusions about an organization's SMS can be difficult for an investigator or Accident Investigation Board. It is important to remember that evidence of one or more ineffective SMS processes does not necessarily indicate a breakdown of the full SMS. On the other hand, evidence of several SMS shortcomings may indicate underlying organizational or cultural factors that have subverted numerous elements of the SMS, leading to a legitimate finding that the SMS has become dysfunctional and ineffective.

References

1. Accou, Bart and Renirs, Genserik (2020), Introducing the Extended Safety Fractal: Reusing the Concept of Safety Management Systems to Organize Resilient Organizations, 29 July 2020, International Journal of Environmental Research and Public Health

2. Apanay, John (2023), Safety Culture: *The Driving Force Towards a Safer Organization*, City University of London

3. Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile (BEA – 2014), *Accident on 16 October 2012 at Lorient Lann Bihoué (56) Aerodrome to the the Bombardier CRJ-700 registered F-GRZE operated by Brit Air*, Investigation Report

4. Ferguson, Kirstin (2015), *Study of Safety Leadership and Safety Governance For Board Members and Senior Executives*, PhD Thesis, QUT Business School, Queensland University of Technology

5. Ferguson, Kirstin (2016), Safety Governance - What Is It and Why Does It Matter, Safety and Health Practitioner Newsletter, April 2016 accessed at https://www.shponline.co.uk/safety-management/safety-governance-what-is-it-and-why-does-it-matter/

6. French, Simon and Steel, Tabitha (2017), *The Investigation of Safety Management Systems and Safety Culture*, International Transport Forum Discussion Paper 2017-20, OECD

7. Foster, Patrick and Hoult, Stuart (2013), The Safety Journey: Using a Safety Maturity Model for Safety Planning and Assurance in the UK Coal Mining Industry, Minerals Journal - ISSN 2075-163X

8. Huber, Celia; Lewis, Greg; Lund, Frithjof and Spielman, Nina (2022), Five Ways to Increase Your Board's Long-Term Impact, Strategy & Corporate Finance Insights, McKinsey & Company, July 2022 accessed at https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/five-ways-to-increase-your-boards-long-term-impact

9. International Civil Aviation Organization (2018), Doc 9859 Safety Management Manual - Fourth Edition, Montreal, ICAO

10. Iqbal, Hassan; Haider Husnain; Waheed, Bushra; Tesfamariam, Solomon & Sadiq, Rehan (2022) Benchmarking of Oil and Gas Pipeline Companies in British Columbia: Integrating Integrity Management Program and Safety Culture Using a Risk-Based Approach, Engineering Management Journal, 34:4, 526-542, DOI: 10.1080/10429247.2021.1954818

11. Kussero, Richard (2020), Compliance Program Maturity Models, Strategic Management Services Blog Healthcare

12. National Transportation Safety Board (NTSB - 1992), Aircraft accident report Britt Airways Inc d/b/a/ Continental Express Flight 2574 in flight structural break up EMB-120RT, N33701, Eagle Lake, Texas, NTSB, Washington

13. National Transportation Safety Board (NTSB - 2022), Collision into Terrain Safari Aviation Inc. Airbus AS350 B2, N985SA Kekaha, Hawaii December 26, 2019, Report AIR-22-05, NTSB, Washington

14. The Risk Maturity Model, accessed at https://www.riskmaturitymodel.org/risk-maturity-model-rmm-for-erm/

15. Transportation Safety Board of Canada (2014), *Guide to Investigating for Organizational and Management Factors – 2nd Edition*, TSBC, Gatineau

16. Transportation Safety Board of Canada (2014), Runaway and Main-Track Derailment, Lac-Mégantic, Quebec 06 July 2013, Railway Investigation Report R13d0054, TSBC, Gatineau