FLIGHT SAFETY FOUNDATION

GLOBAL SAFETY INFORMATION PROJECT

GSIP Toolkits Introduction

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New Directions

Creative advances in data-driven risk management are poised to reshape how aviation safety professionals will continue to achieve year-to-year progress. In fact, precedents for the success of so-called *predictive* approaches exist within the history of aircraft accident investigation. A step change in the effectiveness of data analysis to reduce commercial air transport accident rates — conceivably by a factor of 10 — should not be out of reach if new structured methods can be optimized.

You have likely noticed that risk management is becoming prevalent in your industry sector. Typically, this process compares annual compilations of safety performance indicators (SPIs) and safety performance targets (SPTs) consistent with a global consensus about prioritization. This approach and its variations reflect a universal acceptance that "what gets measured gets noticed."

Findings of Flight Safety Foundation's Global Safety Information Project (GSIP) and contributing experts suggest that aviation service providers — such as airlines, aircraft maintenance and repair organizations, and air navigation service providers — and civil aviation authorities should rely primarily on their risk management to drive continual improvement, and also should ensure that they are familiar with the parts of all relevant accident reports that hold significance for them. Close monitoring of selected SPIs prevails as the best practice within what the International Civil Aviation Organization (ICAO) calls *safety data collection and processing systems (SDCPS)*.

Research and development for GSIP are being carried out in a 2015–2017 time frame under a cooperative agreement between the Foundation and the U.S. Federal Aviation Administration (FAA), supported by FAA funding. Generous contributions of expertise from aviation risk-management specialists and other professional stakeholders have made possible the compilation of these toolkits.

In several states within the Asia and Pacific and Pan America regions studied for GSIP, representatives of aviation service providers told us that their analyses of risk data fell short of expectations, complicating improvement processes in their safety management system (SMS). (Airlines were the predominant participants in GSIP research and toolkit development; a smaller number of non-providers, such as civil aviation authorities, participated.)

These stories and ICAO's work encouraged the Foundation to consider broad implications of SDCPS and to introduce this website's linked set of four GSIP components: the *Data Collection Toolkit, Data Analysis Toolkit, Information Sharing Toolkit* and *Information Protection Toolkit.*

Accident investigation has not lost its capability to positively influence fatal commercial aviation accident rates in the long term. Beyond preparing essential reports, this work lately includes identifying forensic trends by categories; breaking out statistics by subcategory, such as fatal accidents, hull losses or accidents by region; and publishing new types of statistics such as fatal accident loss equivalents — which rank risk according to probability of catastrophic consequences.

Yet, new risk-management structures contemplated by GSIP theoretically make it possible — with simple or complex bow-tie diagrams — to disrupt connections (interrelationships) among threats, barriers, undesired aircraft state, recoveries and outcomes, just as the aviation industry long ago learned to disrupt "causal chains" of events and factors.

Near-Term Objectives

Our first goal is to disseminate what Flight Safety Foundation recently learned and has proposed, making this information freely accessible to all SDCPS stakeholders. The set of toolkits serves as an architecture to facilitate further communication. The website enables us to link you to other programs and resources to help you gather practical information suitable for your organization. We also may point out the absence of certain resources that GSIP participants have wanted. One example is their reported difficulty finding summaries of information discovered during investigations of incidents of a particular type or category (although incident summaries are cited by the European Aviation Safety Agency, for example, in relation to its risk management initiatives).

The toolkits are dynamic in nature, unlike keeping a binder on your office bookshelf. They will support many types of readily updated content, in the same manner as the new FSF website and its all-digital *AeroSafety World* journal, both introduced in October 2016.

Our second goal is to interact with stakeholders, capturing your experiences and questions for the benefit of a network of people facing common issues. Your input about putting structures in place and documenting outcomes holds promise of being extremely valuable.

We will welcome contributions of de-identified examples that illustrate what we discuss in the toolkits. We will appreciate feedback on the content, such as GSIP intensity levels; your tools, means and techniques of bow-tie analysis; your definitions of terms; and your specific interests in information sharing.

During 2017, the Foundation expects to seek further expert validation and cooperation with stakeholders on best practices, methods and structures in SDCPS. We recognize already that discipline, structure and expertise are necessary to analyze each type of data and to pinpoint where to obtain the most significant risk mitigations.

Theoretical frameworks from accident investigation may be helpful, especially specific parallels or consistencies between the cause-and-effect logic/chains diagrammed by accident investigators and elements of a bow-tie analysis (Figure 1, p 3). At this early stage, the objective is for GSIP methods to enable any aviation safety professional to decide to strengthen exactly the right barrier — one that will block progression of events to an undesired aircraft state, for example.

A basic bow-tie–based analysis requires, left-to-right in the diagram, identification of the threats, barriers, undesired aircraft state, recovery actions and outcomes (such as accidents and incidents). Combined with statistics, a diagram this simple potentially can deliver risk-management insights that are not apparent otherwise to average analysts.

Good Data

SDCPSs have matured significantly in recent years. Individuals responsible for implementing the four components are not expected just to obtain appropriate data. Before their organizations will consider any significant changes in risk management, the aviation safety specialists involved will need to demonstrate to their entire organizational leadership why complex risk data suggest that something must be fixed. Then they must show how well any proposed risk mitigation will work, including the costs and benefits in the context of all safety initiatives.

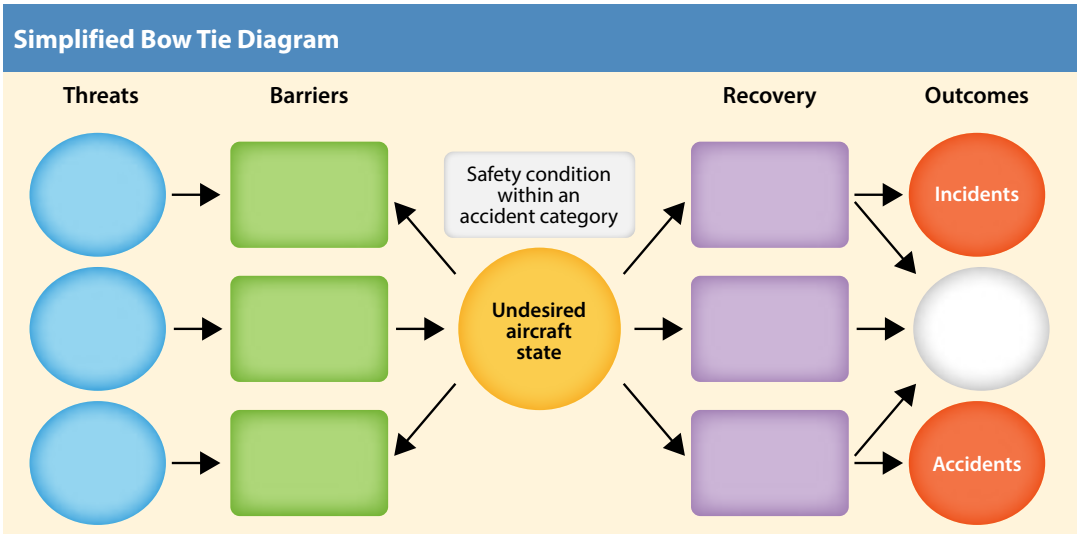

Figure 1

GSIP researchers noted an overriding need, expressed by stakeholders, for a better framework and methodological structure to follow in data collection, data analysis, information sharing and information protection. They want their SDCPSs to produce optimal and reliable analyses with robust quality assurance, i.e., standards equivalent to those of accident investigations for determining cause and effect.

We have reached a point where an SDCPS stakeholder's operational divisions and work groups are expected to provide access — at least internally — to routine operational data and to mandatory and voluntary safety reports from their front lines. During GSIP research, we heard about stakeholders struggling to cope with extremely high quantities of data, substandard data quality and analyses leading to premature conclusions that lacked full understanding of underlying operational issues.

One caution that Flight Safety Foundation heard from subject matter experts is that ineffectiveness of SDCPSs also has been attributed to extremely complex data streams, an excessive variety of safety performance metrics or software applications far exceeding analysts' requirements.

In several states, representatives of aviation service providers also told us that the risk data they collect and share with a regulator to improve safety performance sometimes are mismatched with the analytical capabilities of the regulator. Therefore, the data analysis falls short of what they expect to be accomplished.

As you may realize, many different global industries apply data collection, data analysis and information sharing using common approaches and standards — including data mining of massive quantities of data. For commercial aviation risk management, our toolkits describe the nature of selecting data and factual information that enable you to "get the analysis right" — that is, to deal objectively with real risks. (Data mining has fewer direct applications compared with some other industries because databases of SMSs and state safety programs tend not to be available for that type of analysis at this time.)

Intensity Levels

GSIP proposes use of the term *intensity levels* as a clear and simple way to differentiate among, and to self-assess, changes in an organization's SDCPS sophistication over time. Advancing in intensity level, data analysts will find more richly detailed ways of mapping the full range of potential accident paths within their bow-tie diagram–based analyses.

Flight Safety Foundation encourages the use of bow-tie analysis as part of SDCPS risk management, focusing first on predominant accident categories of each stakeholder's industry sector. That means

an airline, as a hypothetical example, would perform a bow-tie analysis for loss of control–in flight, one for controlled flight into terrain and one for runway safety events. A helicopter operator, however, first would perform bow-tie analyses for its (likely different) predominant accident categories (i.e., not for runway safety events).

Our researchers' practice with exercises involving bow-tie analysis produced valuable logical and statistical insights compatible with GSIP intensity levels. Benefits also include a stakeholder's capability to focus on SPIs, to perform better analysis, to standardize discussions of data, and to enhance their prospects for de-identified data exchange and/or information sharing. We welcome your feedback as to whether this concept seems appropriate and sufficiently valuable for the practical uses we tentatively recommend.

At the first (SMS basic) intensity level of an SDCPS, the aviation service provider's or state's data collection component gathers quantitative data about operational hazards — numbers and rates of accidents, serious incidents and selected undesired outcomes. Most of these processes and the associated data are viewed as fundamental components of an SMS. These data also generally include qualitative analysis of voluntary safety reports and their trends from front line staff, such as pilots at an airline or air traffic controllers at an air navigation service provider (ANSP), among other professional positions. The scope includes investigating special events according to certain predetermined criteria sometimes set by the civil aviation authority. This includes auditing, checks and inspection data.

At the second (expanded) intensity level, the SMS (or SMS within the state safety program) of the SDCPS adds sources to focus on the main drivers of the events and the front line reports of greatest interest. Airlines utilize data analyses from flight data monitoring programs to look at a multitude of hazards or threats. Analysts here begin to use more than one data stream to look for correlations and to better understand causes.

At the third (advanced) intensity level of an SDCPS, the SMS shows deeper sophistication as stakeholders understand underlying factors. These factors are contributors to potential accidents like specific distractions, fatigue, misunderstandings and sometimes common occurrences that somehow had a more disturbing effect in a specific situation. Stakeholders collect data regarding causal factors and circumstances and study how these contribute to other safety events. Stakeholders use many different data streams and not only identify correlations but also thoroughly understand causation and the linkages in a chain of events that could lead to an undesired aircraft state and, if recovery actions fail, to an unwanted outcome. Risk quantifications in bow-tie analyses might address multiple risks across a wide range of seriousness (e.g., probability of a barrier's effectiveness, undesired aircraft state, success of a recovery action, any aircraft damage or any occupant injury), not just the risk of a fatal accident.

At the fourth (industry) intensity level, as a stakeholder seeking to build a complete "risk picture" in your SDCPS, you will not be satisfied until you have a clear sense of how and why events and safety reports are experienced by everyone in commercial aviation. At this intensity level, stakeholders understand not only the risk picture for their operation but also how the risk picture looks across the industry.

In other words, at some point, it becomes important for leaders of your organization and peer organizations to determine the industry baseline in safety performance and metrics for comparisons. This does not just mean how the industry's "average" organization performs per SPIs, but how the safety performance of organizations compares among those that are in the same SDCPS tier (intensity level) and that are similar in their types of operations and operational risk exposure.

To summarize, just as accident investigators sift through massive volumes of data and conduct research to generate findings, probable causes and contributing factors, SDCPS stakeholders can recognize and exploit equivalent capabilities. Information sharing also expands from internal sharing, within an organization at the basic levels of intensity, to industry-wide sharing, at the highest levels of intensity. This theoretically makes it possible to disrupt the linkages that data analysts generate in bow-tie diagram–based analyses or equivalent analyses.