FLIGHT SAFETY FOUNDATION

GSIP
GLOBAL SAFETY INFORMATION PROJECT

Year Two Report

OF THE GLOBAL SAFETY INFORMATION PROJECT

Year Two Report

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Executive Summary

In 13 workshops, capturing 130 surveys and many discussions of our proposed toolkits in fiscal year (FY) 2016, non-U.S. aviation service providers in Asia Pacific and Pan America told the Foundation they are ready to take control of safety performance through conscious and deliberate risk management. Remarkably, even when there may be threats of their own safety information being used against them, many have committed to moving ahead and implementing methods of collecting new safety data, performing effective analysis and sharing safety information.

The service provider and civil aviation authority (CAA) representatives who met with us agreed that risk management requires establishing the capability to rely on data collection, data analysis and information sharing — ideally coupled with just culture–compatible protections against inappropriate uses of safety information — to effectively prioritize risk mitigation. These components comprise safety data collection and processing systems (SDCPS), in the terminology of the International Civil Aviation Organization (ICAO Annex 13, *Aircraft Accident and Incident Investigation,* Attachment E).

The service providers we invited represented operators of airplanes or helicopters in international commercial air transport, maintenance organizations providing services to those operators, approved training organizations, organizations responsible for the type design or manufacture of aircraft, air traffic service providers and operators of certified airports.

This Global Safety Information Project (GSIP) *Year 2 Report* to the Federal Aviation Administration (FAA) updates how we are taking steps to help make that capability a reality for service providers individually and through partnership with their CAAs. The report highlights, for example, why service providers first set risk management priorities that closely track ICAO's highest-priority accident categories.

At the same time, they point to their SDCPS experiences that go beyond just looking at traditional "close call" safety performance indicators (SPIs). They also monitor frontline operational events and analyses of safety data that come from their supporting safety management system (SMS) processes or from audit findings.

Nevertheless, we found signs that the commercial aviation industry — at least in these regions — has yet to put together all these approaches and data analyses in an organized way to see where the gaps are. We expect GSIP to help the industry to focus on those gaps.

Achieving control of safety performance through an individual stakeholder's SDCPS has been extremely challenging, we were told. Among other reasons, service providers saw their efforts as subject to frequent changes in regulatory oversight and internal expectations. They anticipate further changes to fundamental guidance documents, such as amendments to ICAO Annex 19, *Safety Management*, in 2018.

The risk-management structures we advocate, much like thorough accident investigations, include guidance that *theoretically* makes it possible to disrupt connections in the chain of events that can lead to an accident. It takes diligent efforts to understand the links in the chain, also known as threats, barriers, undesired aircraft states, recoveries and outcomes. These structures include techniques such as preliminary screening of new issues with a risk matrix, and conducting either simple or complex bow-tie diagram–based safety data analyses as appropriate.

Our GSIP workshops in 13 cities in the Asia and Pacific Region and in the Pan America Region yielded a second round of insights, reaching beyond our *GSIP Year 1 Report* on FY 2015 focus groups, surveys, objectives and plans for these regions. This time, workshops generated precise comments and suggestions of potential examples of SDCPS experiences from a large and diverse group of service providers, and from several CAAs.

Presentations, discussions and surveys during the FY 2016 workshops helped the Foundation to refine its website-centric concept for all-digital "GSIP toolkits." The workshops were *f*ollowed by several webinars and informal follow-up communication with participants and other interested individuals. All these activities enhanced FSF awareness of industry best practices and creative approaches in SDCPS.

The context for these GSIP efforts is a business environment in which, some experts say, the volume of data exploration activity, data analyses and data-driven learning more than doubles every year. The business side of the commercial aviation industry, like many other industries, especially benefits from rapid expansion of data mining and enhanced understanding of staggering quantities of new information.

The commercial aviation industry has equally high demands for its SDCPS work to be effective. With those in mind, the Foundation designed GSIP workshops as venues for presenting perspectives and proposals on risk management processes within SMS. We listened carefully to get the participants' preliminary reactions to our concepts.

They told us that some FSF concepts for sharing proprietary safety data or results of data analysis among aviation stakeholders — and eventually across national borders — may not be feasible. One impediment discussed was that leaders of too many service providers foresee serious risk of potential enforcement action if safety information is used inappropriately. Surprisingly, as noted, concerns voiced about unknown or inadequate safety information protection did not stand in the way of implementing SDCPS data sharing and information sharing.

We opened our workshop presentations with an introduction to today's many different approaches to risk management in an SDCPS. In typical and basic risk management, this starts with simple hazard identification by frontline personnel who are closest to the operation. When these employees are given the necessary authority and local response mechanisms, basic risk management can be done well. Many GSIP workshop participants agreed. Later presentations compared appropriate methodologies in cases when major changes, special resources or significant expenses are required. We noted how those cases demand a deeper level of strategic deliberation, data analysis and organization to develop and implement effective risk mitigations.

Our key message was that it is always important to focus on local safety solutions, but at times, complex collaborative work best suits the situation. SDCPS complements traditional approaches to risk management that may have devised only technological solutions or influenced personnel behavior by "telling the story" of lessons learned from accidents.

The Foundation has no plans to conduct data collection, data analysis or information sharing. Rather, we are drawing attention to SDCPS methods that few CAAs or service providers have implemented. We have seen the basic principles of SMS create extraordinary potential to address the risks an individual service provider is exposed to in its operations. But we are advocating through the GSIP toolkits that the industry's sights need to also include broader levels of collaboration. Some have said, "All safety is local." Maybe this can be better stated, "Almost all safety is local."

Flight Safety Foundation's intention is to facilitate sharing of theoretical and practical knowledge, and to curate the real-world challenges and de-identified examples entrusted to us by the global community of SDCPS specialists. We expect to identify and to pass along characteristics of an effective SDCPS. As existing GSIP participants and new visitors repeatedly check the latest toolkit content on the GSIP website <flightsafety.org/gsip>, we hope many simply will say, "Let's do those things."

Definitions

Terms

Asia Pacific — After a first reference to the official name ICAO Regional Aviation Safety Group–Asia and Pacific Regions (APAC), this report refers to associated regional GSIP participants/stakeholders by the term Asia Pacific. States grouped as the ICAO Asia and Pacific Regions are: Afghanistan; Australia; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; Hong Kong, China; Macao, China; Cook Islands; Democratic People's Republic of Korea; Fiji; India; Indonesia; Japan; Kiribati; Lao People's Democratic Republic; Malaysia; Maldives; Marshall Islands; Federated States of Micronesia; Mongolia; Myanmar; Nauru; Nepal; New Zealand; Pakistan; Palau; Papua New Guinea; Philippines; Republic of Korea; Samoa; Singapore; Solomon Islands; Sri Lanka; Thailand; Timor-Leste; Tonga; Vanuatu; and Vietnam. ICAO maintains liaison in this geographic area with the non-contracting state of Tuvalu and with the territories of other states, including Chile (Easter Island); France (French Polynesia, New Caledonia, Wallis and Futuna Islands); New Zealand (Niue); United Kingdom (Pitcairn Island); and United States (American Samoa, Guam, Johnston Island, Kingman Reef, Midway, Northern Mariana Islands, Palmyra, and Wake Island).

Bow-tie analysis/diagram — A logical and graphical method of identifying key risk indicators, and relationships among them, that could provide early warning of impending risk events such as undesired aircraft states. The method typically involves evaluating root causes and risk responses related to the specified risk event; facilitating the identification of preventive and reactive measures (recovery actions); clarifying the responsible organization's ability to control the event's occurrence; developing defenses (barriers) that could reduce probability of a risk event occurring; and mitigating the effects of barrier failures and unwanted outcomes (such as an aircraft accident).

Cooperative agreement —The form of contract between the FAA and Flight Safety Foundation under which GSIP activities are funded.

Exchange — The ICAO term for activities that involve SDCPS activities such as pooling, sharing and networking safety information derived from safety data analysis.

Flight data monitoring — One type of automated data-collection system typically used by aircraft operators for recording and analyzing selected, aircraft-generated data parameters from routine flight operations, also known among GSIP participants as flight data analysis and flight operational quality assurance.

Just culture — As defined by human factors expert James Reason, an atmosphere of trust in which people are encouraged to provide essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behavior.

Maturity curve/maturity elements — Terms in the GSIP Year 1 Report replaced in FY 2016 by the GSIP term intensity level (see the separate listing for this term in "Definitions"). The intent has been to have a term for stakeholders to use as they self-assess the desired-versus-actual scope and sophistication of their SDSCPS over time.

Intensity level — FSF researchers introduced this term to GSIP in FY 2016 as a clear and simple way to categorize a stakeholder's net SDCPS capacity without offending any organization.

Intensity level encourages self-assessing the differences in organizations' SDCPS scope and sophistication, and openly discussing changes over time.

LAC — FSF Legal Advisory Committee. The committee's members are international experts in the legal aspects of aviation safety. They are involved in developing and advocating safety information protection, and advising FSF researchers.

Pan America — After a first reference to the official name, ICAO Regional Aviation Safety Group–Pan America (PA), this report refers to associated regional GSIP participants/stakeholders by the term Pan America. States and territories of states grouped as the ICAO Pan America Region comprise those in the Central American and Caribbean Region (Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, British Virgin Islands, Bonaire, Cayman Islands, Costa Rica, Cuba, Curaçao, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Nicaragua, Puerto Rico, Saba, Saint Barthélemy, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Saint Eustatius, Saint Maarten, Trinidad and Tobago, Turks and Caicos Islands, and Virgin Islands); the North American Region (Bermuda, Canada, Saint-Pierre and Miquelon, and United States) and the South American Region (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, French Guiana, Guyana, Panama, Paraguay, Peru, Suriname, Uruguay and Venezuela). Territories include those of France (French Antilles [Guadeloupe, Martinique and Saint Barthélemy]); Netherlands (Aruba, Curaçao, Saint Maarten, Bonaire, Saba and Saint Eustatius); United Kingdom (Anguilla, Bermuda, British Virgin Islands, Cayman Islands, Montserrat, and Turks and Caicos Islands); and United States (Puerto Rico and Virgin Islands).

Pillsbury — The law firm of Pillsbury Winthrop Shaw Pittman LLP.

Poisson regression model — A statistical model used for determining the expected rate of occurrence of an event.

Risk picture — A GSIP term for the full scope of risk-management activities undertaken by an SDCPS stakeholder with respect to a specific aviation safety issue. The term also summarizes the graphical organization, text, symbols and interconnections in a bow-tie diagram.

Risks vs. hazards — Hazards are the events/situations/occurrences/ threats/errors that could lead to an undesired outcome. Risks refer to calculated probability of how often the undesired outcomes will happen. Risk also is an assessment of the severity of any undesired outcome. Fatal risks are the probability of how often an event resulting in fatalities will happen.

Safety data pooling — Hazard information that is shared among organizations, often by a third party, and used for joint risk analysis.

Safety data sharing — Hazard and risk information that is shared (exchanged) among organizations in any form.

Safety data vs. safety information — ICAO coordinates the integration of *safety information* provided by the international community and, in its words, the "dissemination of safety intelligence" (i.e., conclusions driven by integrating safety information). ICAO also works to define and harmonize service providers' underlying safety metrics, associated data requirements and analysis processes. Typical of ICAO's distinction between the terms *safety data* and *safety information*, ICAO Annex 19, *Safety Management*, requires service providers to develop and maintain a hazard-identification process in their SMS based on a combination of reactive, proactive and predictive methods of *safety data* collection (i.e., to begin with discrete or irreducible elements such as numerical values and to transform them into valuable safety

information). To conduct safety risk assessment and mitigation, Annex 19 says, "The service provider shall develop and maintain a process that ensures analysis, assessment and control of the safety risks associated with identified hazards." ICAO also has taken the position that safety information must be used "solely to improve aviation safety and not for retribution or the purpose of gaining economic advantage."

Safety performance indicator — Per ICAO, a safety performance indicator is "a data-based parameter used for monitoring and assessing safety performance."

Safety performance target — Per ICAO, a safety performance target is "the planned or intended objective for safety performance indicator(s) over a given period."

Service providers — In the context of this report, the term *service provider* refers to organizations listed in ICAO Annex 19, *Safety Management*, Chapter 3, 3.1.3., and includes approved training organizations in accordance with Annex 1, *Personnel Licensing*; operators of airplanes or helicopters authorized to conduct international commercial air transport in accordance with Annex 6, *Operation of Aircraft*; approved maintenance organizations providing services to those operators; organizations responsible for the type design or manufacture of aircraft in accordance with Annex 8, *Airworthiness of Aircraft*; air traffic service providers in accordance with Annex 11, *Air Traffic Services*; and operators of certified airports in accordance with Annex 14, *Aerodromes*. International general aviation operators are not considered to be service providers in the context of Annex 19.

State — A term synonymous with country or nation in ICAO documents.

State safety program — An ICAO-defined "management system for the management of safety by a state." The state safety program framework comprises state safety policy and objectives, state safety risk management, state safety assurance and state safety promotion.

Acronyms

ANSP — Air navigation service provider

ASIAS — FAA Aviation Safety Information Analysis and Sharing program, which has access to international data sources that include voluntary safety data. ASIAS partners with the U.S. Commercial Aviation Safety Team and General Aviation Joint Steering Committee to monitor known risk, evaluate the effectiveness of deployed mitigations, and detect emerging hazards.

CAA — Civil aviation authority

CAST — U.S. Commercial Aviation Safety Team

FAA — U.S. Federal Aviation Administration

FDX — International Air Transport Association's Flight Data eXchange is an aggregated de-identified data base of FDA/ FOQA type events that allows the user to identify commercial flight safety issues for a variety of safety topics, for numerous aircraft types, and allows for the proactive identification of safety hazards.

FSF — Flight Safety Foundation

FY — Fiscal year

GSIP — FSF Global Safety Information Project

IATA — International Air Transport Association

iSTARS — ICAO integrated Safety Trend Analysis and Reporting System

ICAO — International Civil Aviation Organization

LAC — FSF Legal Advisory Committee

LOSA — Line operations safety audit/assessment

ME — Maintenance event

MEDA — Maintenance error decision aid

MRO — Approved maintenance and repair organization

RASG-APAC — Regional Aviation Safety Group–Asia and Pacific Regions (see "Asia Pacific" in Definitions for further detail)

RASG-PA — Regional Aviation Safety Group–Pan America (see "Pan America" in Definitions for further detail)

SARPs — ICAO standards and recommended practices

SDCPS — Safety data collection and processing systems

SIP — Safety information protection

SMS — Safety management system

SPI — Safety performance indicator

SPT — Safety performance target

SSP — State safety program

STEADES — IATA's Safety Trend Evaluation, Analysis and Data Exchange System is one of the data sources of the Global Aviation Data Management (GADM) and includes a database of de-identified airline incident reports. It offers airlines a secure environment to pool safety information for benchmarking and analysis needs.

TCAS RA — Resolution advisory from a traffic-alert and collision avoidance system

USOAP CMA — ICAO Universal Safety Oversight Audit Programme, Continuous Monitoring Approach

WAs — GSIP work activities

Introduction

What Is This Report?

In fiscal year (FY) 2016, the FSF Global Safety Information Project (GSIP) completed additional research and development work for the U.S. Federal Aviation Administration (FAA) based on our growing awareness of the challenges of creating and sustaining effective safety data collection and processing systems (SDCPS). As in FY 2015, this research was focused on the Pan America and the Asia and Pacific regions of the world, as defined by the International Civil Aviation Organization (ICAO) (see the FSF *Year 1 Report of the Global Safety Information Project*, presented to the FAA on Nov. 23, 2015).

This *Year 2 Report of the Global Safety Information Project* describes the context of each original work activity under an FAA-FSF cooperative agreement, but devotes the most detail to the project objective formally assigned as "Conduct workshops that introduce the GSIP tool kit about SDCPS and safety information protection." In practice, these workshops formed part of an iterative process of planning and drafting GSIP toolkits, incorporating stakeholder feedback and increasing our knowledge of stakeholders' practical needs, challenges and preferences.

The Asia and Pacific cities selected for the 2016 GSIP toolkit–focused workshops were: Sydney, Australia (March 22–23); Hong Kong, China (April 19–20); New Delhi, India (June 16–17); Tokyo, Japan (April 14-15); Kuala Lumpur, Malaysia (May 11–12); Singapore (March 16); and Taipei, Taiwan (June 21–22). The Pan America cities were: Rio de Janeiro and São Paulo, Brazil (April 11 and April 13–14, respectively); Santiago, Chile (March 29–30); Mexico City, Mexico (July 13–14); Panama City, Panama (May 18–19); and Lima, Peru (June 8–9).

During our third year of work activity, we plan to complete all initial objectives set for GSIP. Therefore, in FY 2017 (which ends Sept. 30, 2017), Flight Safety Foundation primarily will focus on two of the main areas of the FAA-FSF cooperative agreement: publication of three SDCPS-focused toolkits on the GSIP website <flightsafety.org/gsip> with additions and refinements, along with a companion toolkit for tactical implementation of safety information protection (SIP). SIP work also comprises guidance for implementing existing and upcoming ICAO standards and recommended practices, writing model laws and regulations, describing model advance arrangements and information safeguards, and explaining legal implications in the fields of civil aviation regulation and law enforcement.

Attachments to this report (Appendixes B thru F, "GSIP Toolkits, Version 1.0" starting on p. 54) include the SDCPS-focused toolkits launched on the GSIP website, and a draft *Information Protection Toolkit* prepared by experts in the legal aspects of aviation safety who also helped to develop related guidance in ICAO Annex 13, *Aircraft Accident and Incident Investigation*, and Annex 19, *Safety Management*. This fourth toolkit provides specific assistance to states interested in advocating for legislative and regulatory changes to assure that critical safety information and the processes used to gather that information are protected from public disclosure and inappropriate uses in law enforcement and civil litigation processes.

GSIP toolkits will be enhanced throughout FY 2017 by applying feedback received from the FAA, previous GSIP focus group and workshop participants, and continued interaction by FSF researchers with SDCPS experts, experts in the legal aspects of aviation safety and other SDCPS stakeholders. The toolkit enhancements most requested by SDCPS stakeholders include practical examples of safety data, data analysis and information sharing; an

FSF-curated repository of stakeholder experiences with SMS best practices and SDCPS methods; and case studies of how de-identified stakeholders solved specific problems in risk management through an SDCPS (i.e., situations in which service providers applied safety management system [SMS] concepts and civil aviation authorities (CAAs) took action within the framework of a state safety program [SSP]).

Brief Context and Insights

As an account of the past year's GSIP activities, this report includes contextual background of FSF presentations, technical details and de-identified information selected from documents and notes about 130 participants' survey responses, comments and questions. We cover the significant facts and opinions that these SDCPS stakeholders shared publicly or privately with FSF researchers about their organizations' experiences implementing the SMS provisions of ICAO Annex 19.

Many of these aviation safety professionals self-identified as accountable individuals in their organization who are doing their best to piece together timely, accurate knowledge of flight operations risks and to put into place mitigations that measurably improve safety performance. They also make real-time judgments about what works and what does not work in a local environment. They consistently invited Flight Safety Foundation to support their requests to CAAs and international aviation authorities to optimize a common technical language for communicating about risk-management practices so that one stakeholder organization can easily share its understanding of a specific risk with similar organizations anywhere.

The report also maps out interactions that FSF researchers observed, reflecting SDCPS status and evolution of the industry, during their work — especially a common drive to collect and process the "right" source data, perform effective analysis and produce high quality safety information. In some cases, we recognized how basic elements of SDCPS need attention every day. We also found reasons to conclude that the most advanced insights from SDCPS tend to come only after a stakeholder organization gets a "good feel" for effective, data-driven risk analysis of routine operations. Good practitioners quickly learn where and when their data and analyses are too limited; only then can they change SDCPS practices to gain deeper insights.

We paid attention to what airline participants said about the sophistication of their safety performance indicators (SPIs) and safety performance targets (SPTs). Their most effective SPIs today uncover risks that may lead to undesired aircraft states. Some stakeholder organizations said they foresee a near-term shift in methodology as the aviation industry evolves. Specifically, the highly effective SPIs now in use suggest that the SMS quest to optimize risk management is likely to move upstream (i.e., to opportunities that enable earlier risk detection). Critically important data characteristics, such as combinations of data with a unique risk signature, may only be possible to recognize when such upstream data are better understood.

In GSIP workshop presentations, Flight Safety Foundation strongly emphasized ICAO's key tenets of SMS as essential to an SDCPS. This emphasis includes education of frontline personnel about how safety data can have reactive, proactive or predictive functions. The tenets, for example, include just culture principles, in which stakeholder organizations deal with the reality of imperfect human performance by recognizing that typical aviation professionals try hard to operate safely and to learn from their mistakes. SMS hazard processes

throughout an organization, meanwhile, should encourage employees to devote adequate time to freely talking about (or voluntarily reporting) what needs to be improved in risk management and in flight operations.

By following SMS tenets, for example, stakeholder organizations can track mitigation-related data to determine whether their actions improved SPIs or safety outcomes. FSF presenters said, "Don't just guess or continue to be sold on a theory that someone else's mitigation should work. What worked for you yesterday may still need to be improved today."

Although attendance by representatives of CAAs was lower during FY 2016 GSIP workshops than during FY 2015 GSIP focus groups, a need for the regulators' role to evolve was a matter that often elicited strong opinions. There was wide agreement that CAAs must be champions that identify high-priority risks for the service providers under their oversight, and champions in helping service providers to continually improve the risk management capacity of their SDCPS. Flight Safety Foundation has a similar interest in making GSIP toolkits as relevant to a CAA's SSP as to a service provider's SMS, encouraging robust state-level SPIs and SPTs for advanced safety oversight.

Finally, compelled by our conclusion that FSF guidance materials about SDCPS must be all-inclusive — covering everything from "the basics" up to some of the most sophisticated techniques known for collecting and analyzing safety data, and sharing and protecting data-derived safety information — we have proposed *intensity levels* as a very useful concept and terminology for every stakeholder to self-identify and to adjust its SDCPS capabilities over time.

Objectives of the Original Program

Assessment

The FAA-FSF cooperative agreement, as noted, contains the background and purpose of GSIP. In this document, five specific work activities (WAs) are defined and specific outputs are required. While each of these WAs has reached a different stage of completion, the entire project can be summarized as having three main objectives: Perform assessments of today's work on SDCPS; conduct workshops that introduce the GSIP toolkit about SDCPS and safety information protection; and complete a basis for the legal framework that enables implementation of related ICAO initiatives. Moreover, the last main objective was redefined in 2016, with help from the FAA, to clarify the scope of the implementation.

In planning and inviting people to attend the FY 2016 workshops, we did not want to engage with only the most SDCPS-advanced CAAs and service providers. We consciously chose mostly cities in the two regions that we considered major centers of airline flight operations or that had high volumes of commercial air transport traffic, and where we knew many stakeholders would have interest regardless of their current SDCPS capabilities. Our choices were not necessarily tied to highest known risks but could reflect relatively high risk exposures in the respective region. Diversity in the experience level of the participants was considered useful for healthy and robust discussions, recognizing that GSIP toolkits need to suit all levels of experience.

In conversations before and during GSIP workshops, our presenters occasionally encountered the misconception that we would focus on SMS. In fact, GSIP focuses on SDCPS. We covered risk management in which appropriate safety data continually drive the identification of threats and hazards through data collection and analysis, sharing the derived safety information, and protecting that information so it remains a perpetually productive tool.

The Foundation did not set out to create "another SMS course" for the industry. Rather, we designed GSIP to complement the high quality, comprehensive SMS training that other organizations offer.

We want each GSIP toolkit to help stakeholders generate the best possible information from their SDCPS process, which will help to make the mitigations more effective (i.e., actionable). We also want the toolkits to complement SMS. SMS courses typically advise stakeholders to implement a hazard-identification process. However, GSIP participants told the Foundation that the training they received omitted how to assess sources, appropriateness or quality of safety data, or how best to analyze data for effective risk management.

By design, as noted, the toolkits must evolve as the stakeholders in international commercial air transport, including Flight Safety Foundation, learn ways for CAAs and service providers to enhance risk management. Toolkit content acknowledges all stakeholders' approaches to doing this work — wherever they fall on a range from basic to advanced to industry-leading.

Workshops and Toolkits

Workshop presentations framed all safety data as originating from three source categories we call: public safety information, reportable occurrences and safety program information. The first category comprises the final reports of official accident or incident investigations, supplemented by consequent summaries of knowledge by others extracted from individual investigations or from analyses of multiple accident investigations with relevant aspects in common. The *GSIP Data Collection Toolkit* in the appendixes to this report contains further descriptions and examples.

Aviation operations generate distinctive reportable occurrences that have characteristics of lower severity than an *accident*, and that may not fit an accident investigation authority's definition of *incident*. Typically, regulations and/or the service provider's policy require that the event be reported to the CAA or the responsible service provider, respectively. In some places, this data-generating process is called mandatory occurrence reporting. As with accidents and incidents, data from a single event or summaries of knowledge derived from multiple relevant events are valuable for an SDCPS.

Safety program information comprises information from employee voluntary safety reports, from safety assurance data and from any type of safety auditing/assessment process, whether internal or external. These data/information summary–generating processes probably are most familiar to service providers and vary greatly in scope and detail, depending on the nature and size of the service provider (or other type of organization).

Information Protection

Our plan for FY 2016 workshops included how Flight Safety Foundation's presenters would broadly describe and discuss SIP and this subject's treatment in the *GSIP Information Protection Toolkit*. Although these discussions with participants predominantly focused on this subject as a global issue with overarching legal and regulatory elements, we planned our presentations to cover aspects of immediate interest to service providers.

Among these aspects are states having principles of protection, principles of exception, protections against the public disclosure of safety information, a competent authority that will balance the interests of aviation safety with the need for the proper administration of justice, advance arrangements for using safety information, and other appropriate

safeguards to ensure that safety information is protected. We also planned to cover the equivalent service provider safeguards that will help ensure continuous availability of safety data and safety information for maintaining and improving aviation safety.

The experts in the legal aspects of aviation safety who proposed guidance and ICAO annex amendments continued to advise FSF researchers about the ICAO annexes and subsequent education of the professional communities influenced by the annexes or required to comply with them. The experts' focus is on key elements to SIP implementation, namely laws and/or regulations, but also — as noted — on organizational policies, advance arrangements, education and training programs, and expanding the just culture environment. As with the other toolkits, the Foundation plans to share industry-leading best practices to assist all countries to implement SIP for mutual safety benefits.

The Foundation also recognizes that many CAAs have, or will have, the capability to distill, summarize and advocate how safety data analyses should identify the leading risk-management challenges facing the industry. Regulatory experts should define the broadest objectives — making sense of the full spectrum of aviation risks based not just on accident investigations, but also on in-depth awareness of systemic precursors, incidents, undesired aircraft states and unwanted outcomes if defensive barriers fail. In our view, they must be able to encourage the stakeholders they oversee to focus upstream on the SDCPS components and proven analytical techniques, such as risk matrix and bow-tie diagram–based analysis.

All of these activities and partnerships ultimately require SIP to be established in national laws, defined in CAA regulations and entrusted to the policies of service providers for front-line implementation.

Year 1 Review

Focus Groups

The FSF *GSIP Year 1 Report,* submitted in December 2015 to the FAA, highlighted our first round of insights into international commercial aviation stakeholders' aspirations for SDCPS. These insights included descriptions of their current challenges and experiences during focus groups and in surveys. (All GSIP sources are de-identified in FSF reports to the FAA.)

So far, we see indicators from the two regions that this segment of the aviation industry only monitors SPIs at a high level. In some cases, only data from outside the region are analyzed or studied in developing local risk mitigations. That implies that some stakeholders have a long way to go before identifying trends in specific segments of the industry.

Main Outcomes of First Year Work

As noted in the "Executive Summary" section of this *GSIP Year 2 Report*, Flight Safety Foundation's first set of insights came from focus group sessions and written surveys conducted during FSF researchers' FY 2015 visits to the Asia Pacific and Pan American cities, listed in the *Year 1* report.

Generally, focus group participants reported that airline associations and airline alliances conduct a basic level of safety data/information exchange for specific types of events, and that they sometimes share the broad event-per-exposure rates they are tracking and the responses they have initiated within their SMS processes. These exchanges have benefits for sharing program-management approaches to certain problems, but they may not help much in getting a full understanding of key risk issues that would stimulate industry specialists and regulators to begin highly collaborative work.

Focus group participants said they were especially interested in better opportunities to study examples of how other stakeholders conduct risk analysis and how those stakeholders factor specific considerations, such as prevailing safety culture, into their SDCPS. Participants recalled hearing — during academic courses and in reading regulatory guidance on SMS — strong emphasis on the need for a rigorous SDCPS structure. But they also recalled an absence of practical case studies of effective data collection and analysis. Also missing were "how to" orientations on explanatory and visualization techniques that would them help them to communicate to frontline personnel the steps that led to specific risk mitigations and how those mitigations are grounded in safety data analyses.

Our first report to the FAA, therefore, sketched out GSIP toolkits that would focus on, and be named for, the commonly understood components of SDCPS: the *Data Collection Toolkit*, *Data Analysis Toolkit*, *Information Sharing Toolkit* and *Information Protection Toolkit*. We proposed this framework as a cost-effective way to package current and future responses to the workshop participants' and other stakeholders' expressed needs and priority interests. The latest drafts of GSIP toolkits are included as appendixes to this report.

The Foundation also published a graphical matrix defining the GSIP toolkit structure, including a proposal for a robust set of SDCPS "maturity elements," which evolved in 2016 into the concept of SDCPS intensity levels. The *GSIP Year 1 Report* notably said, "We expect to validate portions of these toolkits, as noted, with stakeholder experts who already have participated in GSIP focus group sessions, as well as others who have become familiar with our project through the GSIP website. In essence, we plan to build some details and then

validate them (or vet them in other ways) with these stakeholders through a collaborative, web-enabled process."

Bow-Tie Analysis

Regional specialists were aware of a heavily used tool in today's aviation risk management: showing relationships in a bow-tie diagram. A basic bow-tie diagram–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, even a simple diagram potentially can reveal risk-management insights that are not apparent otherwise to average analysts.

The diagrams are considered valuable by GSIP workshop participants in APAC and PA because they improve understanding of the hazards, the planned protection systems and the recovery methods for undesired aircraft states, for example. One growing area of analysis noted by focus group participants is the simultaneous understanding of multiple data streams.

Flight Safety Foundation encourages the use of bow-tie diagram–based 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.

Benefits of bow-tie analysis also include stakeholders' capability to focus on SPIs, to perform better analyses, to standardize discussions of data, and to enhance their prospects for de-identified data exchange and/or information sharing.

ICAO Regional Aviation Safety Groups

FSF researchers' GSIP work during the first year involved interacting regularly with the ICAO Regional Aviation Safety Groups (RASGs) for Asia Pacific and Pan America. Our work activities were mainly to advise these groups on our plans for conducting focus groups and to solicit their support and engagement in these meetings. Flight Safety Foundation provided a working paper and informational papers at the RASG-PA/ESC Executive Steering Committee, the RASG-PA plenary, the ICAO Asia Pacific Regional Aviation Safety Team (APRAST) and the RASG Asia and Pacific (RASG-APAC) groups. Our work continues with all of these groups through information paper updates.

Year 2 Review

Approach to Toolkit Concepts

Why Toolkits?

This section of the *GSIP Year 2 Report* summarizes what Flight Safety Foundation learned from the 13 one-day and two-day workshops held during FY 2016 in 13 APAC and PA cities. The 130 participants were briefed on the second phase of GSIP work, and FSF presenters frequently asked for their advice and experiences. As expected, this input significantly influenced how we refined the original GSIP toolkit concepts and began to implement their website-based publication. Interactions after the workshops, with participants and other stakeholders involved in SDCPS, also were an important part of collecting and applying the best of this second round of insights.

The second-year work focused primarily on settling on details (including terminology and specific SDCPS methods), additions, deletions, clarifications and corrections to enable the launch in early 2017 of our Version 1.0 set of four toolkits within the existing GSIP website <flightsafety.org/gsip>.

All-digital toolkits were conceptualized first as an architecture that facilitates further communication. Updating them on the GSIP website will enable the Foundation to link stakeholders to other programs and resources and help them gather practical information suitable for their organizations.

Another FSF objective is to interact often with stakeholders, capturing their experiences for the benefit of a worldwide network of people facing common SDCPS issues. Continued input on establishing structures for SDCPS components and documenting outcomes has the potential to be extremely valuable. We especially will welcome contributions of de-identified, case-study examples that illustrate the problems and solutions we discuss in the GSIP toolkits. We also will seek feedback on the initial toolkit content, such as GSIP intensity levels; suitable tools, means and techniques of bow-tie analysis; improved definitions of terms; and stakeholders' specific interests in safety information sharing.

Among advantages of all-digital toolkits are that they can be searched, downloaded, printed and shared. References to related research can be linked to their sources. Linked data-visualization models can adjust to additional information and revisions.

Aviation safety professionals who have a background in quality assurance and process improvement also will notice another influence on GSIP toolkit concepts. Quality control specialists traditionally have practiced a sequence of steps before introducing change to the system— such as W. Edwards Deming's plan-do-check-act cycle in 1950, which evolved in the 1990s into the plan-do-study-adjust cycle. These toolkits are an attempt to make good use of the data we have as we work to improve how we are performing. We have very sophisticated and integrated processes in aviation that require a sensible forecast about whether proposed changes will improve safety.

The GSIP toolkit concepts anticipate that stakeholders will establish unique mixes of emphases within their SMS or SSP. Many are likely to focus, for example, on SPIs for specific known issues but also focus on monitoring data streams from routine flight operations for early detection of unexplained operational anomalies. With process improvement in mind, workshop presenters essentially told participants, "GSIP does not focus on mitigation — the 'act/adjust' step — because we intentionally leave those plans, decisions and details to the stakeholders' aviation safety specialists. We advise you to examine your own safety data,

understand your data analysis and gauge the impact on risk before writing a risk-mitigation plan. The plan should specify the deficiency you want to address so that you are not overwhelmed by the volume of SDCPS data."

Workshop participants generally preferred that the GSIP toolkits emphasize SDCPS guidance, links to global resources and, as noted, a gradually built repository of examples showing how risk management theories have been applied to situations faced by stakeholders. The Foundation, along with the workshop participants, believe this will benefit all regions of the world.

Participants likewise preferred that toolkits offer "how-to" solutions for SDCPS impediments, such as ways to assure timely, high-quality, post-event submission of safety concerns and occurrence reports, recognizing that simple, easy-to-use reporting tools, improve the frequency of how often they are used.

In the short term, our toolkits gradually will introduce interactive features. During FY 2017, subject matter experts, experienced SDCPS users and stakeholders-at-large will have a private forum to upload/download content, engage in discussions, and suggest and refine conclusions and practical applications of risk management concepts and techniques. The Foundation will ensure the integrity of the overall website content; responses to inquiries; the vetting of proposed toolkit additions and revisions; access permissions; and email alerting of website visitors about GSIP toolkit news.

Toolkit Concepts

Internal FSF discussions, imagining ways SDCPS could evolve, led to our concept of *intensity levels*, explained in "Discussion Highlights" in this section. GSIP research efforts found that not every CAA or service provider assesses risk at an advanced level. Moreover, some stakeholders do *not* need to manage risk at a level characterized by routine and secure exchange of methodologies; aggregate analytical results, risk-mitigation decisions and/or safety outcomes among large peer, regional or global organizations. Rather, that subset of stakeholders likely will evolve and naturally fit into communities engaged in SDCPS at advanced intensity levels. The Foundation advises stakeholders to be realistic about their objectives and to think first in terms of an appropriate SDCPS intensity level for their current risk management priorities.

We mention realism about SDCPS intensity levels for a reason. Workshop feedback about our concepts for GSIP toolkits soon raised a concern within Flight Safety Foundation. A few service providers — particularly safety specialists at participating airlines — seemed to zero in on the advanced intensity levels. They jumped to the conclusion that their airline immediately should get involved in activities such as aggregated data analysis, information sharing and leading-edge risk-analysis techniques.

The Foundation discourages "diving into the deep end" of SDCPS on day one. Instead, we advise stakeholders, "There is a basic intensity level — the fundamentals — that you do not ever want to ignore. Begin by doing your own risk management consistently and routinely. Stay *focused on that basic intensity* level — first, foremost and all the time. Then consider adding refinements from the advanced practices reported by colleagues working at a different intensity level. The colleagues functioning at an advanced intensity level may or may not be able to help resolve an SDCPS issue identified by your SMS."

When we talked with workshop participants about SDCPS models that function at an advanced intensity level — for example, the International Air Transport Association's

(IATA's) Flight Data eXchange (FDX), the U.S. Commercial Aviation Safety Team's (CAST's) safety enhancements or the FAA's Aviation Safety Information Analysis and Sharing (ASIAS) program — we highlighted the models' differences in their members' capability, engagement and benchmarking. We asked GSIP participants to reflect on how these examples exceed the capabilities of any one organization, and to realize that, unlike an airline, these organizations are not analyzing their own data or managing risk in their own flight operations.

As in FY 2015, workshop participants in both regions said that choices of safety data for their SDCPS often seem "wide open and endless." Some have access to internal data streams not designed for flight operations–related risk management. So the question arises: "Although capturing data is easy to do, given that our people and sensors can record almost anything generated by our company's operations, does a particular dataset actually correlate with significant risks we face in flight operations?" We answered that nailing down which data are important cannot be overemphasized (e.g., identifying one undesired aircraft state and how often it occurs).

One GSIP workshop participant discussed his company's use of employee-turnover rate as an SPI (without mentioning the context of other SPIs or flight data monitoring). Service providers should select risk metrics that reveal operational risks caused by changes in operations. In this case, the employee turnover might correlate with flight operations risks. But apparent correlations also might be explained by lack of proper training or support, which leaves new employees unable to become proficient enough to safely perform all duties on their own. Carefully selecting safety metrics that have strong correlations with specific risks could show whether employee-turnover data are a worthwhile SPI.

People overseeing another SDCPS might decide that — for certain employee positions and duties, and given the nature of employment opportunities — relatively high turnover is normal and not inherently a significant risk (for ground employees, for example). For these cases, the best approach might be to revise the training program to continually assess competency and proficiency, and to implement risk barriers rather than to count each replacement of an individual employee.

Toolkit Refinement

Some workshop participants said their organizations need to address any threat that causes an undesired aircraft state. They see this as their best opportunity, given the extreme rarity of major accidents, to avoid an accident, incident, mandatory occurrence report event or similar outcome. These participants primarily were service providers such as airlines, air navigation service providers (ANSPs) and approved maintenance and repair organizations (MROs), but also included representatives of CAAs.

> *Overall, FSF presenters heard a consensus that real-world threats during flight operations do not occur in isolation. Most participants agree that effective defensive barriers cannot be established in all cases. But if, at the outset, aviation professionals discern the highest-priority risks and threats, they can be effective in counteracting them. The Foundation also heard a general agreement that people responsible for SDCPS count on standardized taxonomies, definitions, terminology and methodology to accomplish top-level analyses. These tools later facilitate safety information sharing.*
>
> *We heard accounts of business partners establishing their own definitions of safety events and then sharing their confidential event rates and trend records — most often with*

customers and peers. In many cases, this practice allowed them to perform simple comparisons and to better understand risks during flight operations–related interactions.

Airline representatives also explained why and how they join relatively large safety data exchanges (including models that function at an advanced intensity level). These exchanges conduct continuous analysis of de-identified data streams flowing into a shared data pool, they said. This allows the data contributors to compare their SPIs, in a standardized fashion, with SPIs of de-identified counterparts and with mean performance for an industry sector, fleet, geographic area, airport type or other breakdown of interest. The data aggregation and analysis process also helps all exchange contributors to stay aware of newly validated forms of analysis, including risks that otherwise fall below their own thresholds for flagging or other close attention.

Among topics that other participants raised were how to analyze risk in airplane flight crews' go-around decisions during approach and landing; how to manage risks across all systems that affect an airline's ability to operate flights safely using required navigation performance technology (e.g., maintenance processes, proper equipage and up-to-date software and databases); and what maintenance factors and quality assurance metrics should be analyzed to assure that flight deck emergency oxygen systems function reliably.

Informal Feedback

During FY 2016, FSF researchers also participated in discussions with international SDCPS specialists, separate from GSIP workshops and webinars. At one runway safety workshop, for example, a session on effective methods of using SPIs corroborated several GSIP concepts.

As noted in the "Executive Summary," CAAs' internal analyses of mandatory occurrence reports and follow-up runway safety investigations ideally should be shared with service providers in a de-identified aggregate form. This practice would help assure that — beyond short lists of top global priorities — all local stakeholders consistently receive timely briefings about critical safety issues. In the domain of runway safety, for example, subject matter experts said the aggregate summary of the accidents/incidents was not always readily available for every industry sector. This leaves some organizations less informed about what risks they should be looking for and seeking to improve.

Such instances of insufficient safety data align with the FY 2016 GSIP survey results. People responsible for an SDCPS typically said they are internally tracking large volumes of safety data, but few engage in ongoing collaborative work (i.e., sharing safety data analyses) — except perhaps when sharing is requested by a customer or a business partner. The lack of information sharing is detrimental to identifying and mitigating the unknown risks and the most prevalent risks.

Moreover, GSIP workshop discussions questioned whether existing global safety data sharing programs such as IATA's FDX will fully address information sharing needs at all GSIP intensity levels. Regarding runway safety, for example, an SDCPS analyst should be able to access de-identified mandatory occurrence reports and incident investigation data as noted. Otherwise, if the risk management process must rely almost solely on accidents and flight data monitoring — e.g., analysis of parameters reflecting stabilization of approach, touchdown point, airspeeds and deceleration — mitigation planning may be well understood for runway excursions but not for other runway safety events.

Reluctance to Share

FSF researchers were struck sometimes by service providers' wariness of sharing SMS risk metrics and findings with safety professionals who work in different industry specialties. For example, some airline safety specialists said they are open to discussions of broad safety issues with their airport and ANSP counterparts, but they refuse to exchange proprietary, data-derived operational safety information, lessons learned from flight data monitoring or details from their internal investigations of safety events.

As a related example, several service providers said that their CAA has no regulations that encourage them to voluntarily submit non-mandatory occurrence reports. Therefore, if reports disclose a deviation from a regulatory standard, there is no rule in force to assure that submitters who acknowledge a deviation will not be punished. They said, "So we are reluctant to report as we are worried about punishment."

Discussion Highlights

Framework of FSF Proposed Toolkits

FSF researchers' own practice with exercises involving bow-tie diagram–based analysis produced valuable logical and statistical insights suitable for the whole range of stakeholder capabilities. The Foundation proposed open and transparent discussions about the nature of this range, introducing the term *intensity level* as a clear and simple way to categorize capabilities without offending any organization. The term lends itself to self-assessing differences in an organization's SDCPS scope and sophistication over time.

At an advanced intensity level, the data analysts have richly detailed ways of mapping the full range of potential accident paths within their bow-tie diagram–based analyses. Yet, at the basic intensity level, a service provider or a CAA also can exercise powerful capabilities that suffice for many years.

At the first (basic) intensity level of an SDCPS, the service provider's or CAA'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 employee voluntary safety reports and their trends from frontline staff, such as pilots at an airline or air traffic controllers at an ANSP, among other professional positions. The scope includes investigating special events according to certain predetermined criteria sometimes set by the CAA. This includes auditing, checks and inspection data.

At the second (more advanced) SDCPS intensity level, the service provider's SMS (or the CAA's SSP) adds data sources to focus on the main drivers of the events and the frontline reports of greatest interest. Airlines utilize data analyses from flight data monitoring programs to look at known and unknown 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 intensity level of an SDCPS, the SMS shows deeper sophistication as stakeholders understand underlying factors. They collect data regarding causal factors and circumstances and study how these contribute to other events and safety reports. 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 quantification in bow-tie analyses then 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 intensity level, as a stakeholder seeks to build a complete "risk picture" in an SDCPS, the organization's leaders will not be satisfied until they have a clear sense of how and why events and safety reports are experienced by everyone in international commercial air transport. At this intensity level, stakeholders understand not only the risk picture for their operation but also how the risk picture looks across the industry.

While introducing intensity levels in FY 2016, FSF workshop presenters repeatedly received feedback requesting clarification of proposed toolkit terms such as *industry-driving* intensity level that appeared in an SDCPS matrix. Version 1.0 of GSIP toolkits on the website incorporates many revisions that address these requests.

Feedback on SDCPS Experiences

Participants sometimes characterized their SDCPS experiences as involving well-intentioned people who can be overwhelmed by the expense and man-hours required to manage and process vast volumes of data selected for analysis by their organization. This can occur in either an SSP or an SMS.

Some workshop participants emphasized that their risk-management analyses of safety data adhere to processes they regard as universal best practices — especially steps for identifying risks of loss of control–in flight (LOC-I), controlled flight into terrain (CFIT), runway excursion, runway incursion and midair collision (MAC). Their taxonomies and processes establish a normalized ratio (i.e., divide total events in the category of interest by a factor representing risk exposure, such as number of flight departures) when observing and tracking trends, and identifying changes in risk or event patterns.

One Asia Pacific participant said that every airline in the region seems to have its own ideas of how to mitigate risk. "Before we can do the deep learning and can have industry-driving changes, we must normalize [the SDCPS process] across the industry and have industry standards of data analysis so that there is a baseline understanding of the methodology behind the analysis," he said.

A counterpart in Pan America said that efforts to create and share a uniform safety-event database can collapse over conflicts such as how different taxonomies define a term such as undesired aircraft state. Having one taxonomy is important for internal safety information sharing, and absence of such a taxonomy makes it extremely difficult to share any analytical results outside of the organization if SDCPS partners use a different taxonomy, he said.

Participants discussed following up their data-normalization step, if appropriate, by populating a typical green/yellow/red–colored graphical risk matrix with event data to plot hazard severity versus probability. Workshop discussions also explained the many templates available to guide the completion of a risk matrix for any of the major accident categories and to use bow-tie diagram–based analysis to set safety data–collection priorities.

Participants' support for the GSIP concept of intensity levels in GSIP toolkits was reflected in distinctions that participants drew between the data-driven risk-management capabilities of major airlines and those of much smaller counterparts. "Airlines know the key risks already," one participant said. "Now, they need to look for outliers."

At one large airline, automated application of algorithms to the parameters selected by its flight data monitoring program generated data that first appeared to show an anomalous airspeed indication usually attributable to bad sensor data. Internal analysts' post-flight

investigation determined that an unreliable-airspeed event — unfamiliar to the industry for the aircraft type in question — had occurred and warranted risk management.

Some service providers said they look forward to such automatic analysis of empirical operational data becoming the way of the future. Automation can overcome several impediments to SDCPS effectiveness, such as extremely high data volume, analysts' workload and delayed awareness of threats. In one country, airline personnel other than analysts are being trained to screen such automated results and to forward reports to analysts that meet special criteria for further assessment. This is a simple solution that avoids automation investments and makes good use of an analysts' expertise and costs.

Some FY 2016 workshop participants reiterated an issue raised during the FY 2015 focus groups. These airline safety professionals acknowledged they do not know yet how to effectively analyze the flight data streams they receive. This weakness can lead to almost exclusive focus on flight-parameter exceedances or events that are triggered by the flight data monitoring system, they said.

In several states, representatives of service providers told FSF researchers that the risk data they collect and share with their CAA sometimes are mismatched with the analytical capabilities of the regulator. Therefore, the data analysis falls short of what they expect to be accomplished. A participant in Pan America added that the *Information Sharing Toolkit* similarly should discuss the importance of effective state-to-state SDCPS collaboration. "That has been on our wish list for a long time. Each state should be auditing and sharing with other states," he said.

In other workshop discussions, stakeholders suggested toolkits should include how service providers can create dashboards that constantly summarize results from automated analyses of data streams, Poisson modeling of trends in as many as 500 different exceedance/occurrence types, and guidance to CAAs on how to procure input from subject matter experts to identify which new risks warrant in-depth study.

In summary, workshop participants in both regions typically said that CAAs, in the not too distant past, were content if service providers simply implemented SPIs and SPTs. In FY 2016, regulatory oversight program officials are highly concerned with the *quality* of SPIs/SPTs — exactly what organizations measure, and why.

Other Toolkit Content Considerations

GSIP workshop presenters also invited people responsible for SDCPS to consider the following checklist questions as signposts along the "right track" in data collection, data analysis, information sharing and information protection.

Regarding data collection, ask: Do we only collect safety data relevant to identified hazards or significant risk areas? Do we collect data in the right areas of our operation? Do we collect sufficient data for complete analysis and results? Do we regularly repeat our data collection effort? Do we consider what we possibly might be missing?

Regarding data analysis, ask: Do we properly normalize these data (i.e., incidence and severity against exposure) and properly trend the data? Do we set objectives for improving critical metrics? Do we make objective assessments of SPIs against the acceptable risk? Do we conduct dynamic risk assessment and systemic risk assessment? Do we regularly repeat our assessments? Do we search all across our operations for the worst hot spots before prioritizing our improvements? Do we correlate the results of analyzing more than one safety data source to determine the actual cause and effect?

Regarding information sharing, ask: Is the risk information we developed clear enough for others to act on in a mitigation plan? Do we share the information from our risk management work throughout our own organization? Do we share this information with peers within our aviation industry segment? Do we share this information with our business partners and customers? Should we share the results of internal risk assessments with our civil aviation authority? Should we share our SPIs over time with our civil aviation authority?

Regarding information protection, ask: Do we have a commitment from our highest-level leadership to protect individual aviation professionals against punitive consequences of submitting employee voluntary safety reports (with clear exceptions)? Is the promised protection actually practiced? Do we have agreements with labor groups where applicable? Does our CAA have a regulatory policy protecting individuals and our organization from enforcement actions? Do the laws of our country extend protections to our people and our organization while participating in voluntary safety reporting programs? Do the volume and quality of reports voluntarily submitted to our programs confirm that we have a consistent flow of data into our risk management?

Surveys

Pre-meeting and post-meeting survey questionnaires completed by 37 GSIP focus group participants in FY 2015 were meant to give Flight Safety Foundation preliminary indications of how robust their SDCPS knowledge and capability were in relation to each participant's involvement in an SMS or SSP. Most of the questions/items on these stakeholder inventories of SDCPS, therefore, asked about the existence of data collection and data analysis activities in key areas of service providers' operations and in their data/information exchanges with the CAA.

The focus group participants not affiliated with CAAs were asked to complete a survey version specifically prepared for their service provider category. If multiple focus group participants were present from the same organization, one representative was asked to complete a survey on behalf of that organization. Due to the limited size and demographic characteristics of the survey samples, we regarded the responses as having only preliminary informational value; nevertheless, the survey did produce some interesting initial results

These results gave us a sense of what individual service providers used as sources of safety data and information as we discussed, during the focus groups, their specific challenges and any planned improvements in their SMS. Some portions of the surveys were very detailed.

As we designed a new stakeholder inventory for our GSIP Year 2 toolkit–focused workshops, we broadened the terminology used on the survey form and constructed questionnaire items in a mix of multiple-choice and open-ended questions seeking brief narrative responses. This allowed space for the workshop participants to explain what safety data and safety information they had collected and analyzed, and what safety information they were managing in an SMS or SSP.

Our survey was split into five basic sections: the participant's basic demographic data; safety data sources; data processing and analysis; information sharing; and information protection. This design was meant to align closely with the toolkit-focused content of the workshops. In each workshop section, there was a review of relevant ICAO standards and recommended practices for the components of an SDCPS.

Pages 23 through 46 contain brief facts and FSF comments about the quantitative methods and results from the FY 2016 surveys. Each of these pages contains infographics, such as tables and figures, with matching comments and/or notes about some of the interesting results. Refer to Appendix A for the specifics of the survey.

The Analysis of Surveys

1. Survey Demographics

The Foundation specifically chose 13 cities to conduct the GSIP Workshops. The cities have a high concentration of international commercial aircraft operations and a number of experienced risk management stakeholders exposed to a wide variety of operational risk. These cities were not assessed by the Foundation as having experienced unusual operational risks. In fact, the participating service providers said they rarely discover a serious risk not already mitigated by the SDCPS components within their SMS.

1. Survey Demographics

All Workshops (130 Survey Participants)

Survey Responses by Workshop

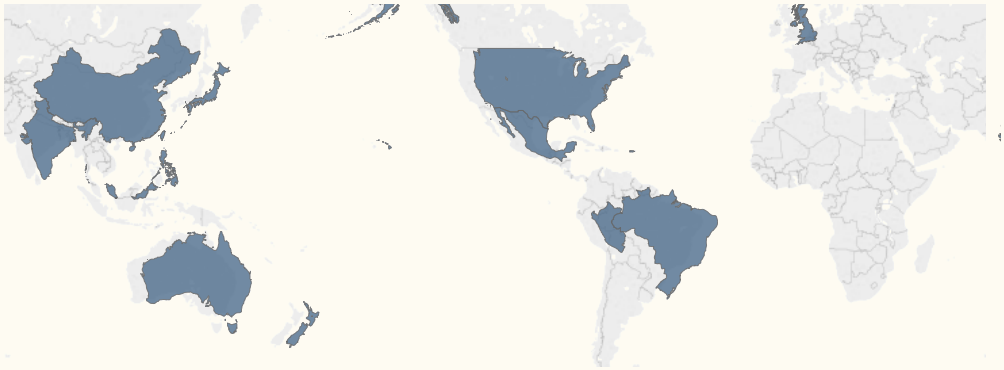
Information Collected from Public Safety Information

What type of organization do you represent?

Workshop City	Airline	Airport	ANSP	Manufacturer	Other	Regulator	Total
Singapore	19		1		8	3	31
Tokyo	11			6	1		18
Taipei	7	1	1		2	1	12
Mexico City	6				5		11
São Paulo	4		1		5	1	11
Hong Kong	6				2		8
Lima	4		1		1	2	8
Panama City	3	1	1		1	2	8
Sydney	3				4	1	8
New Delhi	4				1	1	6
Rio de Janeiro		1			3	2	6
Kuala Lumpur	3						3
Total	70	3	5	6	33	13	130

Operating Countries Represented

What is your organization's country and office location



2. Safety Data Collection and Processing Systems

The infographics on the next page show three source categories of risk data that typically figured into workshop participants' SDCPS-related studies. The categories are: mandatory occurrence reports (information about operational events that is shared, at a minimum, between the service providers and their CAA); accident reports and similar public safety information; and safety assurance program analyses (generated from SMS-selected data; that is, information derived from these analyses may be shared between a service provider and the CAA).

Often each source of data is used for different purposes. Our survey asked to what extent safety professionals used each portion of the information contained in these sources from 1) Factual information – usually the details of an event – date, time, people, equipment involved, basic description of the event 2) Direct causes – what was the primary driver of why the event happened 3) Contributing factors – what had some influence on why the event took place 4) Safety recommendations - What was recommended to prevent the issue from happening again.

Audit data and runway safety data were the strongest preferred sources for data collection by respondents overall. For airlines, data collection responses described across-the-board preferences; that is, use of all safety data sources under discussion in the workshops.

Notably, despite their wide scope of data, Asia Pacific airline participants reported stronger source preferences within their entire data collection effort than their Pan American counterparts.

CAAs had strong preferences for collecting audit data and maintenance event data. Collecting data relevant to ICAO's three most critical risk issues — CFIT, LOC-I and runway safety–related events — was the highest priority of the survey respondents from CAAs, however. ANSP respondents strongly preferred that their SDCPS include audit data, runway safety event data and event data for loss of separation of aircraft. Among these, the ANSP respondents called runway safety and loss of separation the primary issues they cover in their SPIs.

2. Safety Data Collection and Processing Systems

All Workshops (130 Survey Participants)

Information Collected for Reportable Occurrences

My organization collects the following information for Reportable Occurrences

	Factual Information	Direct Causes	Contributing Factors	Safety Recommendations
Airline	97.14% 68 Responses	84.29% 59 Responses	82.86% 58 Responses	84.29% 59 Responses
Regulator	76.92% 10 Responses	92.31% 12 Responses	69.23% 9 Responses	69.23% 9 Responses
ANSP	80.00% 4 Responses	100.00% 5 Responses	80.00% 4 Responses	80.00% 4 Responses
Manufacturer	66.67% 4 Responses	66.67% 4 Responses	66.67% 4 Responses	66.67% 4 Responses
Airport	66.67% 2 Responses	33.33% 1 Response	33.33% 1 Response	100.00% 3 Responses
Other	69.70% 23 Responses	45.45% 15 Responses	45.45% 15 Responses	42.42% 14 Responses

Information Collected from Public Safety Information

My organization collects the following information from Public Safety Information

	Factual Information	Direct Causes	Contributing Factors	Safety Recommendations
Airline	85.71% 60 Responses	75.71% 53 Responses	74.29% 52 Responses	82.86% 58 Responses
Regulator	69.23% 9 Responses	84.62% 11 Response	53.85% 7 Responses	84.62% 11 Response
ANSP	20.00% 1 Response	40.00% 2 Responses	40.00% 2 Responses	40.00% 2 Responses
Manufacturer	100.00% 6 Responses	66.67% 4 Responses	66.67% 4 Responses	83.33% 5 Responses
Airport			33.33% 1 Response	33.33% 1 Response
Other	66.67% 22 Responses	39.39% 13 Responses	51.52% 17 Responses	57.58% 19 Responses

Information Collected for Safety Assurance

My organization collects the following information to support Safety Assurance activities

	Factual Information	Direct Causes	Contributing Factors	Safety Recommendations
Airline	90.00% 63 Responses	84.29% 59 Responses	84.29% 59 Responses	91.43% 64 Responses
Regulator	84.62% 11 Response	69.23% 9 Responses	46.15% 6 Responses	53.85% 7 Responses
ANSP	60.00% 3 Responses	80.00% 4 Responses	60.00% 3 Responses	100.00% 5 Responses
Manufacturer	66.67% 4 Responses	66.67% 4 Responses	66.67% 4 Responses	66.67% 4 Responses
Airport	66.67% 2 Responses	66.67% 2 Responses	100.00% 3 Responses	66.67% 2 Responses
Other	60.61% 20 Responses	36.36% 12 Responses	45.45% 15 Responses	57.58% 19 Responses

3. Employee Voluntary Reporting Programs

The infographics on the next page show that more than three-fourths of all respondents use these programs. Among the categories of workshop participants shown, airlines — almost without exception — were strongest (i.e., in showing a predominant preference compared with other categories of service providers) in receiving reports from frontline employees, operations support employees, and supervisors and managers. (ANSPs and manufacturers also were relatively strong in these areas.)

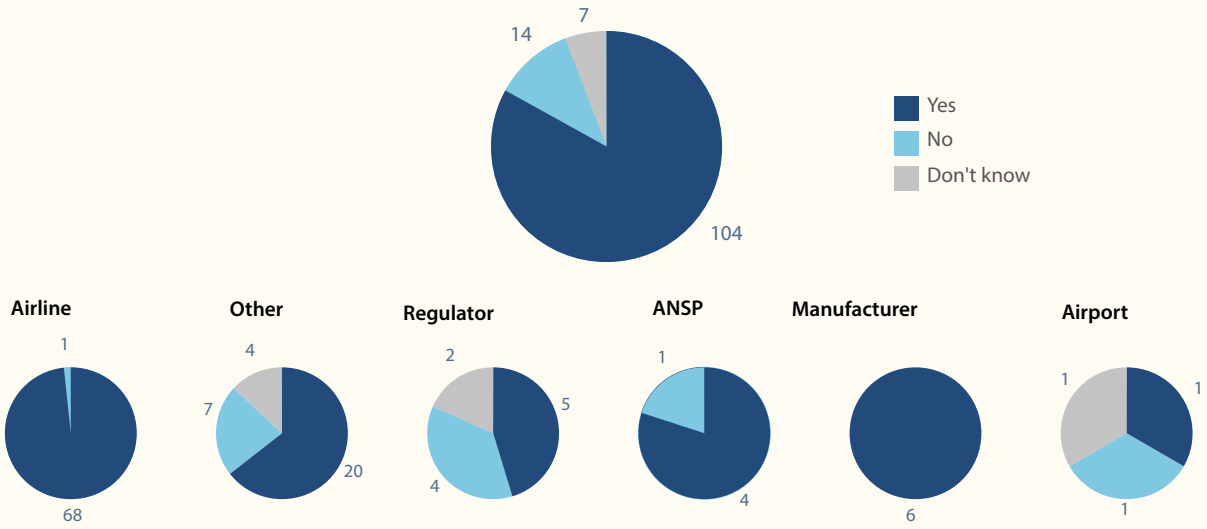
Airlines also were strongest in obtaining factual information, direct causes, contributing factors and safety recommendations through employee voluntary safety reporting programs. The predominant source of reports is frontline flight operations, and operations support personnel also are well represented in their voluntary reporting. That source has been especially effective because of the rich factual narratives these reports provide. The responses also show that for most other service providers, data from investigations — the event causes, contributing factors and safety recommendations — are rated as having about the same importance for risk management.

3. Employee Voluntary Reporting Programs

All Workshops (130 Survey Participants)

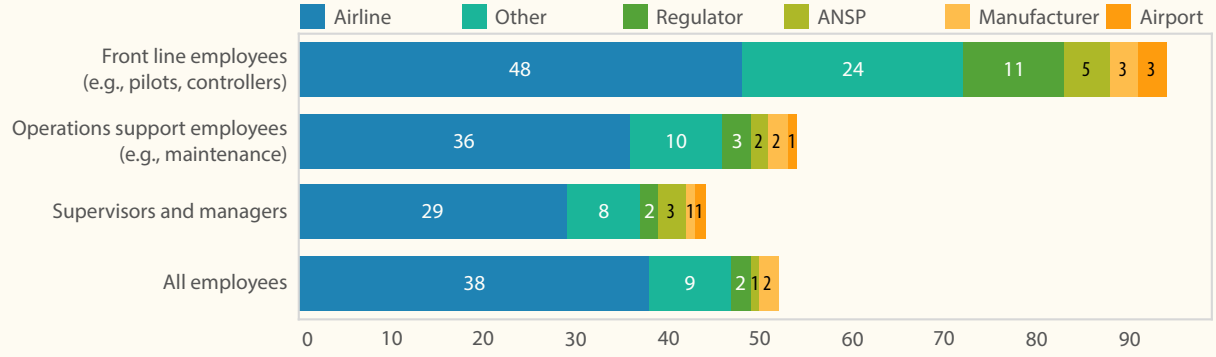
My Organization Utilizes an Employee Voluntary Reporting Program

My organization uses an Employee Voluntary Reporting Program to collect voluntary safety information



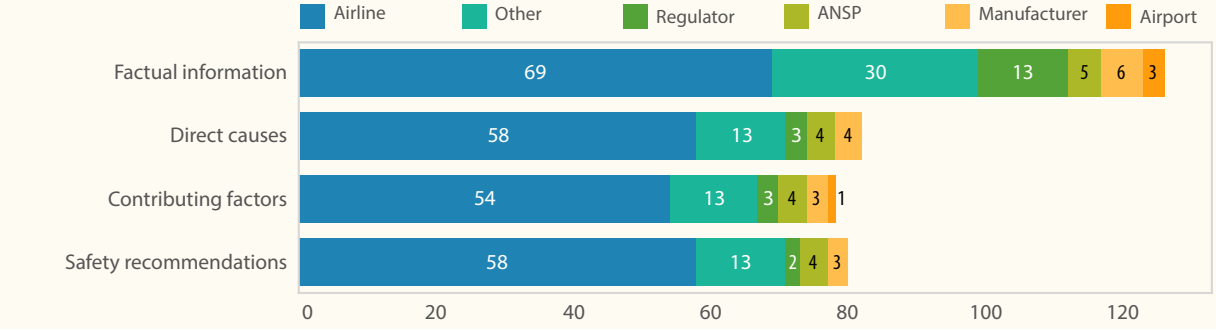
Employee Voluntary Reporting Program Participants

The following best describes the reporters participating in my organization's Employee Voluntary Reporting Program



Employee Voluntary Reporting Data Collected

My organization's Employee Voluntary Reporting Program allows for participants to report the following information



4. Collection of Risk Data

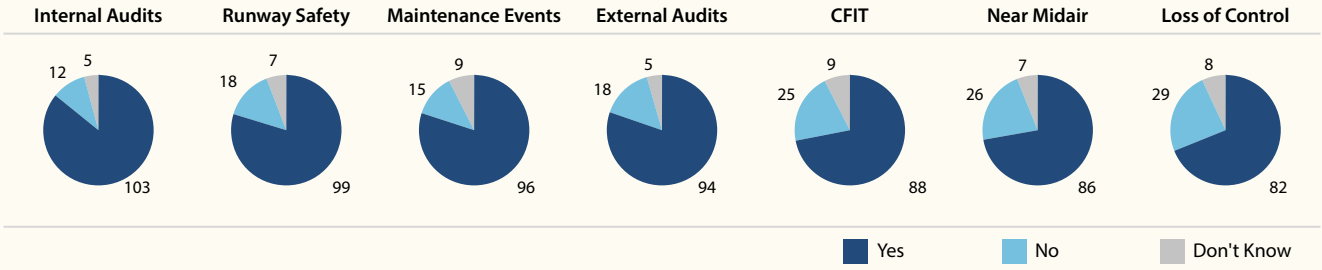
The infographics on the next page show CAAs (identified in the infographics as *regulators*) to have strong preferences for collecting types of risk-measure data associated with two sources: mandatory occurrence reports, and causes and safety recommendations found in public safety information. Regulators appeared to collect fewer risk-measure data that originate as contributing factors or as safety recommendations associated with ICAO's highest-priority issues.

4. Collection of Risk Data

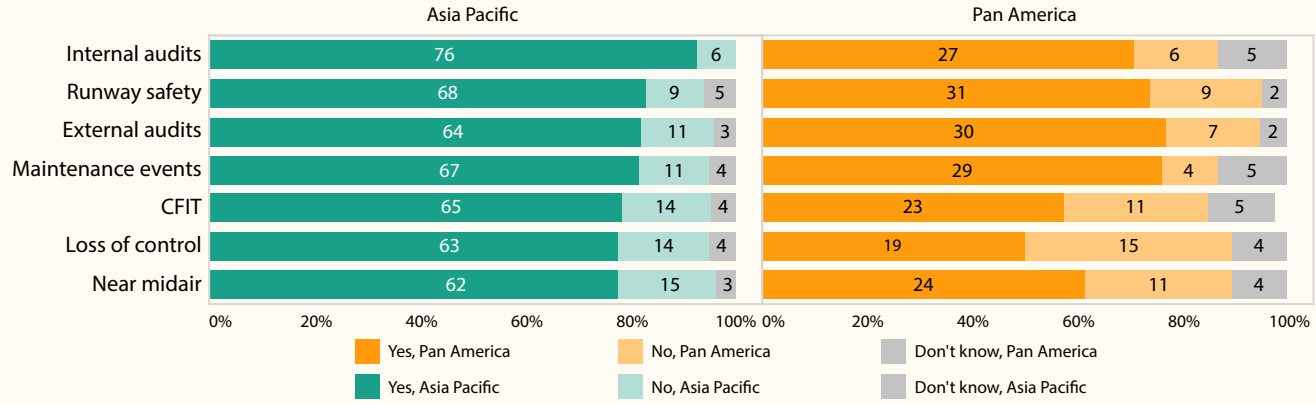
All Workshops (130 Survey Participants)

Risk Measures Collected By My Organization

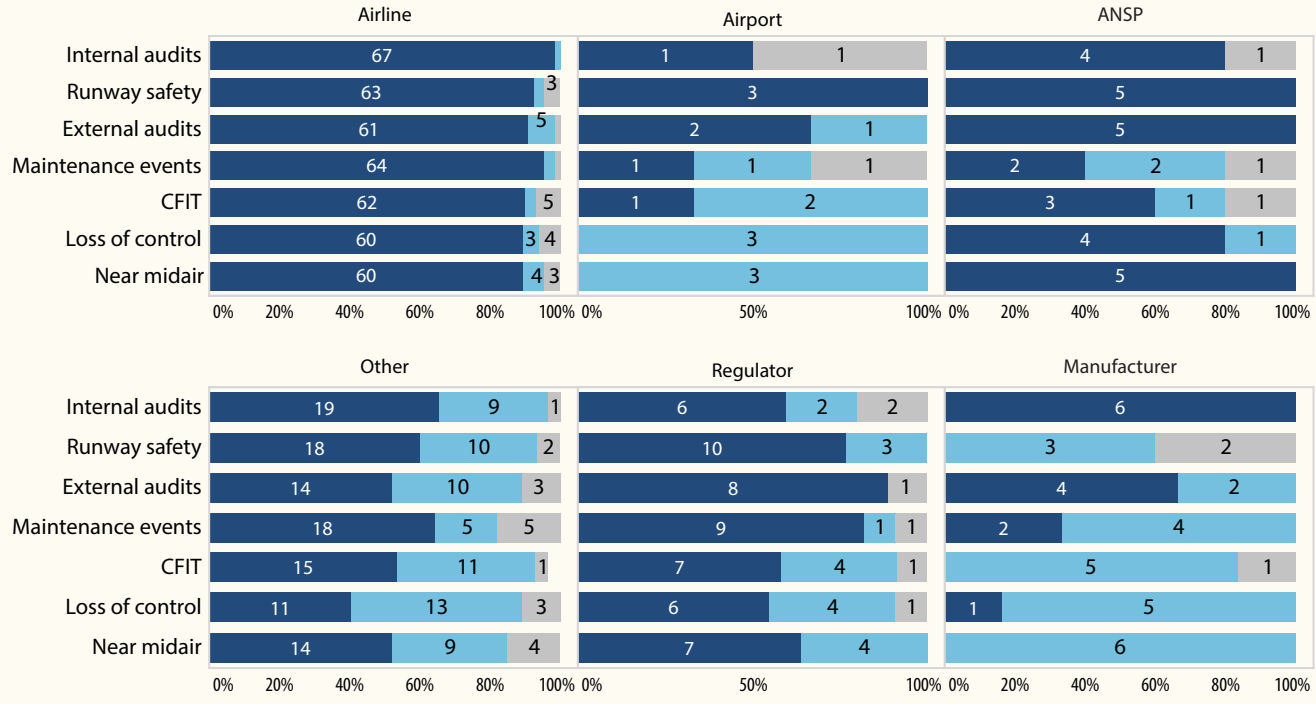
My organization collects information on RSI/CFIT/LOC/MX Events/MAC/Audits



Risk Measure Collection by Workshop Region



Risk Measure Collection by Stakeholder Type



5. Safety Performance Indicators

The infographics on the next page show manufacturers (service providers that ICAO defines for SSPs as "organizations responsible for the type design or manufacture of aircraft") strongly preferring SPIs associated with causes and recommendations derived from public safety information sources (e.g., SPIs related to CFIT and LOC-I). We cannot predict whether responses would be similar from other manufacturers because everyone in this small number of survey respondents attended the same GSIP workshop.

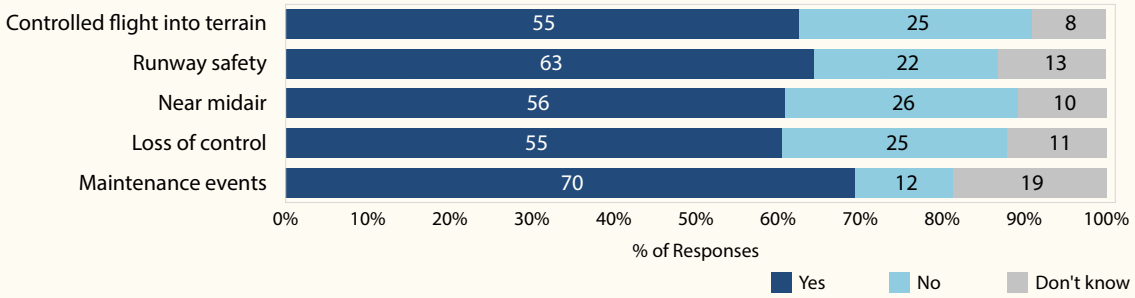
Airlines were strongest in preferring SPIs within their SMS across all stakeholders and for the five highest-priority global safety issues that the Foundation emphasized in GSIP toolkits. We were surprised to note in the GSIP survey responses that maintenance events (MEs) were selected more often as SPIs than flight operations events. Overall, it was interesting to note the exceptional high proportion of airlines using ME information as an SPI. Flight Safety Foundation, as noted in the *Executive Summary,* sees a target of opportunity here for improvements in this aspect of risk management.

5. Safety Performance Indicators

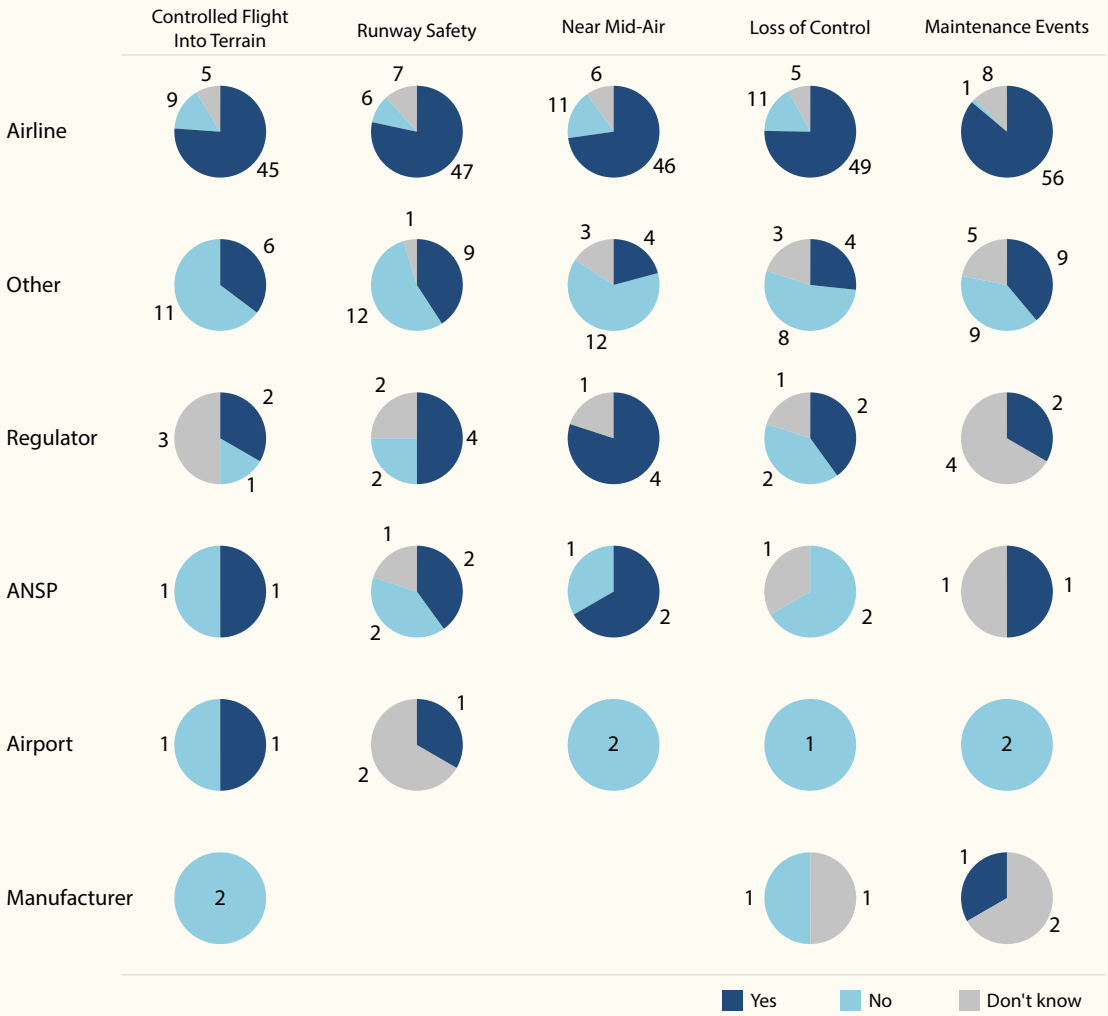
All Workshops (130 Survey Participants)

Risk Measures Used as Key Performance Indicators

My organization tracks risk of CFIT/RSI/NMAC/LOC/MX metrics as a key performance indicator



Key Performance Indicators by Stakeholder



6. Regulatory Collaboration

The tables on the next page have qualitative/subjective interest, but no conclusions could be drawn from survey-response data about any of the stakeholder categories overall because of the small number of responses from CAAs. However, from our subjective observations of workshop discussions of collaboration between CAAs and service providers, we can say that mandatory occurrence reports appear to be the primary focus — in other words, safety information sharing occurs in both regions. This seems to hold true, at least when examples emerged of the exchanges initiated or report analyses shared with the CAA.

Audit data were used this way to a lesser extent, and the least-used source for information sharing seemed to be employee voluntary safety reports. Both regions' participants mentioned examples of CAAs including these sources in their annual safety reports. However, the service providers among the GSIP workshop participants typically said they have not had routine access to any type of summary of such analyses by a CAA.

Our discussions indicated that, instead, such information sharing happens only if a service provider raises questions and specifically requests one-time information sharing in conjunction with regulatory investigation of a specific mandatory occurrence report.

6. Regulatory Collaboration

All Workshops (130 Survey Participants)

My Organization Collects the Following Information From:

Airline	Reportable occurrences	9
	Safety assurance data	6
	Employee voluntary safety reports	3
Airport	Reportable occurrences	8
	Safety assurance data	6
	Employee voluntary safety reports	3
ANSP	Reportable occurrences	8
	Safety assurance data	5
Manufacturer	Reportable occurrences	5
	Safety assurance data	4
	Employee voluntary safety reports	3
Other regulators	Reportable occurrences	5
	Safety assurance data	2
	Employee voluntary safety reports	1
Other	Audit data	8
	Surveillance	7
	Air inspections	1
	Aoa inspections	1
	Bird strike	1
	Intelligence assessment	1
	Operations	1
	Ops inspections	1
	Public data	1

Direct Feedback Your Organization Provides Back to the Organizations Providing Data:

Annual safety report that shows a picture of system safety issues
De-identified information from voluntary reports
Explicit feedback is given for voluntary reports
Feedback on analysis of data (i.e., maintenance events)
Feedback to manage identified issues
Final accident/incident reports for reportable occurrences
Outcomes of any related investigations
Reports, statistical data, change in rules, seminars

7. Safety Audits and Compliance

Line operations safety audit/assessment (LOSA) and maintenance error decision aid (MEDA) programs play a secondary role with respect to mitigating risks of the highest-priority accidents referenced in GSIP toolkits.

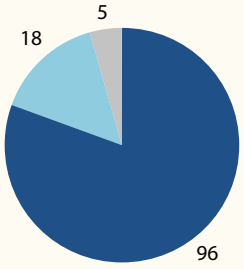
Airlines also heavily use IATA Operational Safety Audit (IOSA)–sourced information while CAAs and ANSPs preferred to use ICAO-sourced information. This was not surprising considering states' intense focus on ICAO's Universal Safety Oversight Audit Programme–Continuous Monitoring Approach (USOAP-CMA) audits. The Foundation has begun to inquire about whether, if this practice of constraining data sources proves to be the norm, a stakeholder likely would miss critical information or risk-mitigation opportunities.

7. Safety Audits and Compliance

All Workshops (130 Survey Participants)

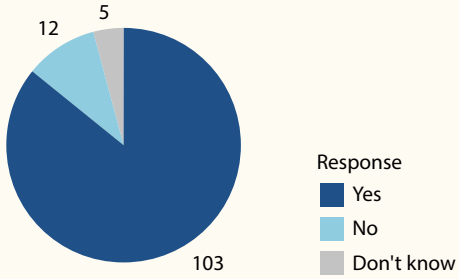
Internal Safety Audits and Compliance

My organization collects information to support the conduct and/or response to internal safety audit and compliance activities:



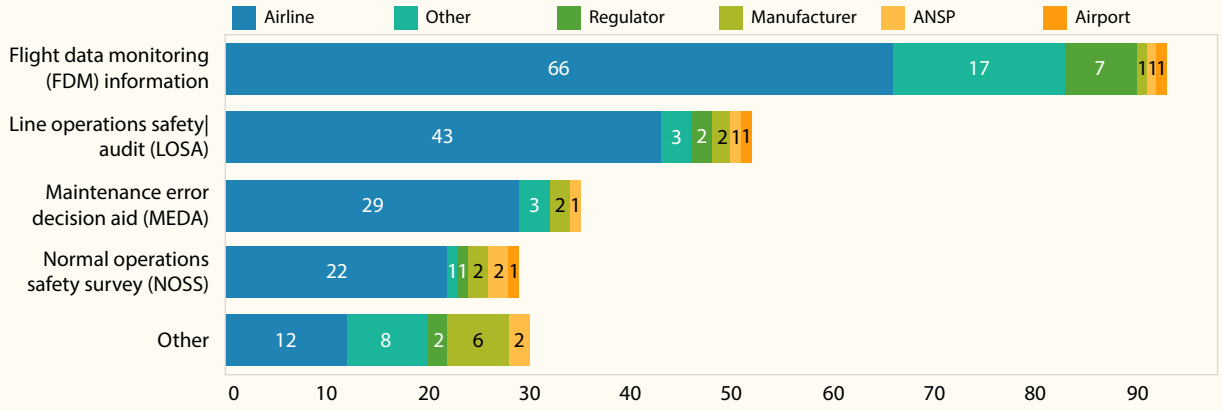
External Safety Audits and Compliance

My organization collects information to support the conduct and/or response to external safety audit and compliance activities:



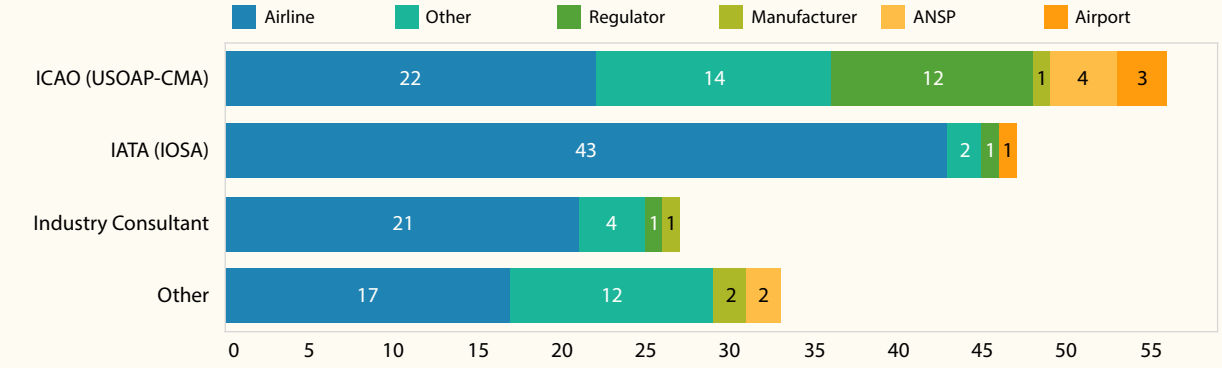
Internal Safety Audits and Compliance Methods

My organization uses the following methods to collect and evaluate day-to-day operational performance:



External Safety Audits and Compliance Methods

My organization collects information to support the conduct and/or response to external safety audit and compliance activities:



8. Information Protection – How Satisfied Is Your Organization?

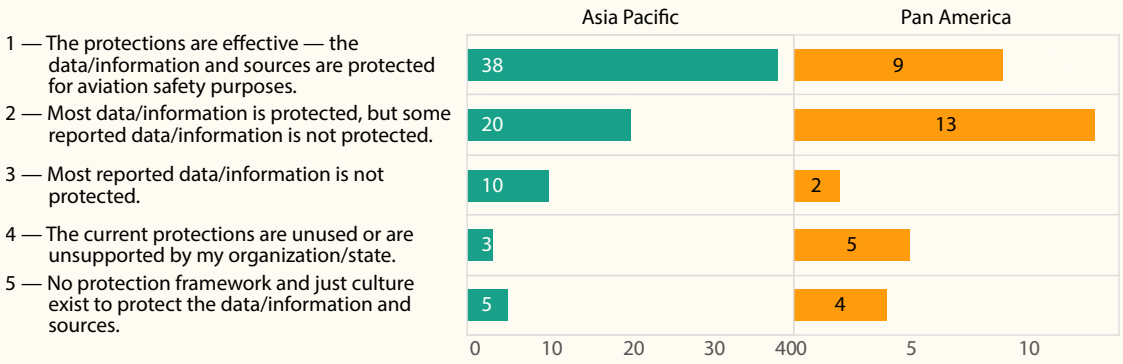
The bar charts on the next page show how satisfied — on a scale from 1 "protections are effective" to 5 "no protection framework" — GSIP survey respondents said they are. Asia Pacific respondents, overall, were more satisfied about protections for their safety data and/or safety information than their Pan American counterparts. With the exception of a few countries, Flight Safety Foundation's FY 2015 GSIP focus group and survey findings did not show a significant difference in satisfaction across the two regions.

8. Information Protection — How Satisfied Is Your Organization?

All Workshops (130 Survey Participants)

Utilization of Information to Support Audits and Compliance Activities

How would you assess the effectiveness of safety information protection in your country/organization?



9. Information Protection – What information Is Protected?

GSIP survey questions about SIP were fairly general in FY 2016. They probed participants' current beliefs about how effectively sensitive safety information is protected by their company and/or the laws and regulations in their state. Sometimes the protection of this information is limited to specific programs or reporting processes, so we asked about the level of protections for many different types of safety data

The bar charts on the next page show their understanding that these protections, if any, are contained in company policies and just culture–driven practices of the company, rather than in laws and regulations that apply to them as individuals.

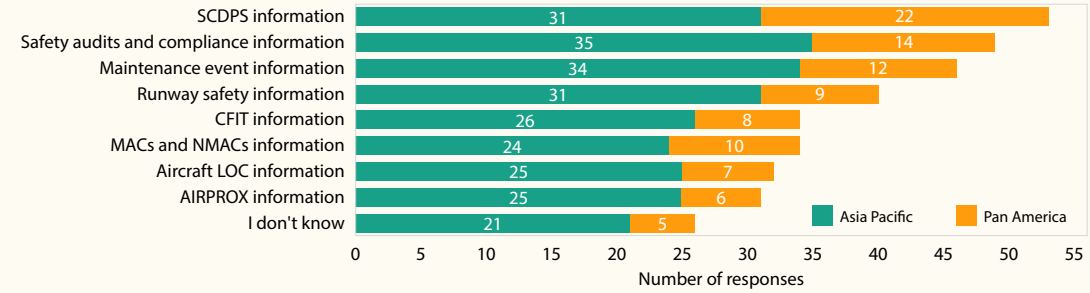
With respect to employees voluntarily submitting safety reports to states, a large proportion of the respondents believe that laws and regulations already exist to prevent the state from taking punitive enforcement actions. This was a surprising finding for Flight Safety Foundation. Their responses also show a mix of issues involving strong cultural resistance to change (especially the Western concepts of just culture) and legal hurdles in government transparency (freedom of information) laws, constitutional requirements and criminal laws.

9. Information Protection – What information Is Protected?

All Workshops (130 Survey Participants)

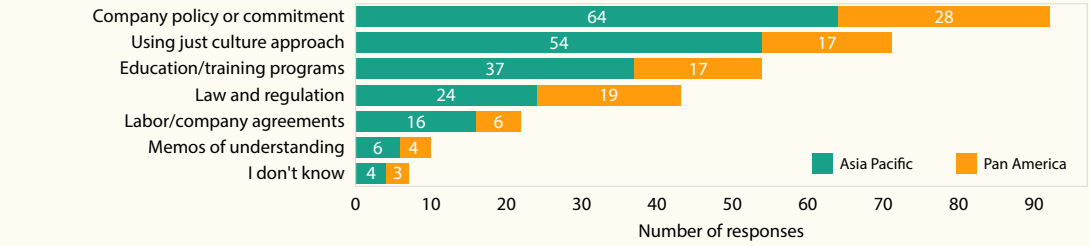
Protected safety data and information in your organization or country

What safety data and safety information reported or collected by your organization or country is protected?



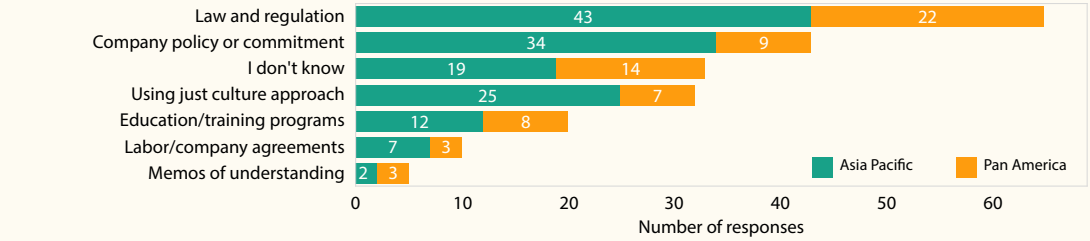
Protections for individuals when reporting in your organization

When reporting to an organization in a SMS, how are individuals protected from employer's disciplinary actions or punishments?



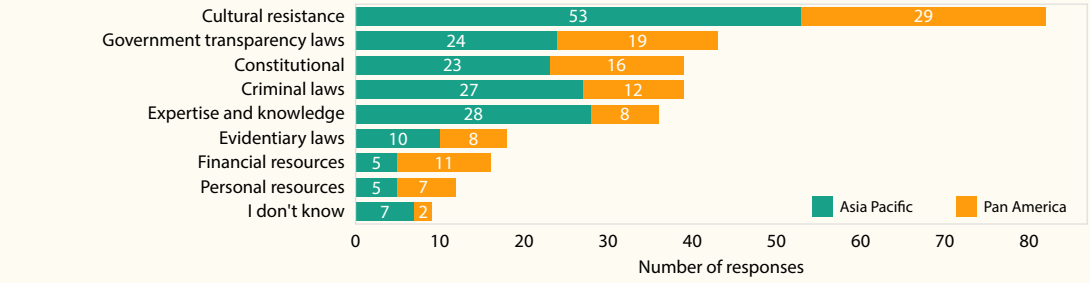
Protections against enforcement actions and administrative, civil and criminal actions

When reporting to a state in a SSP, how are reporters of safety data and safety information, whether individuals or organizations, protected against enforcement actions, and administrative, civil and criminal proceedings?



Major barriers to additional protections

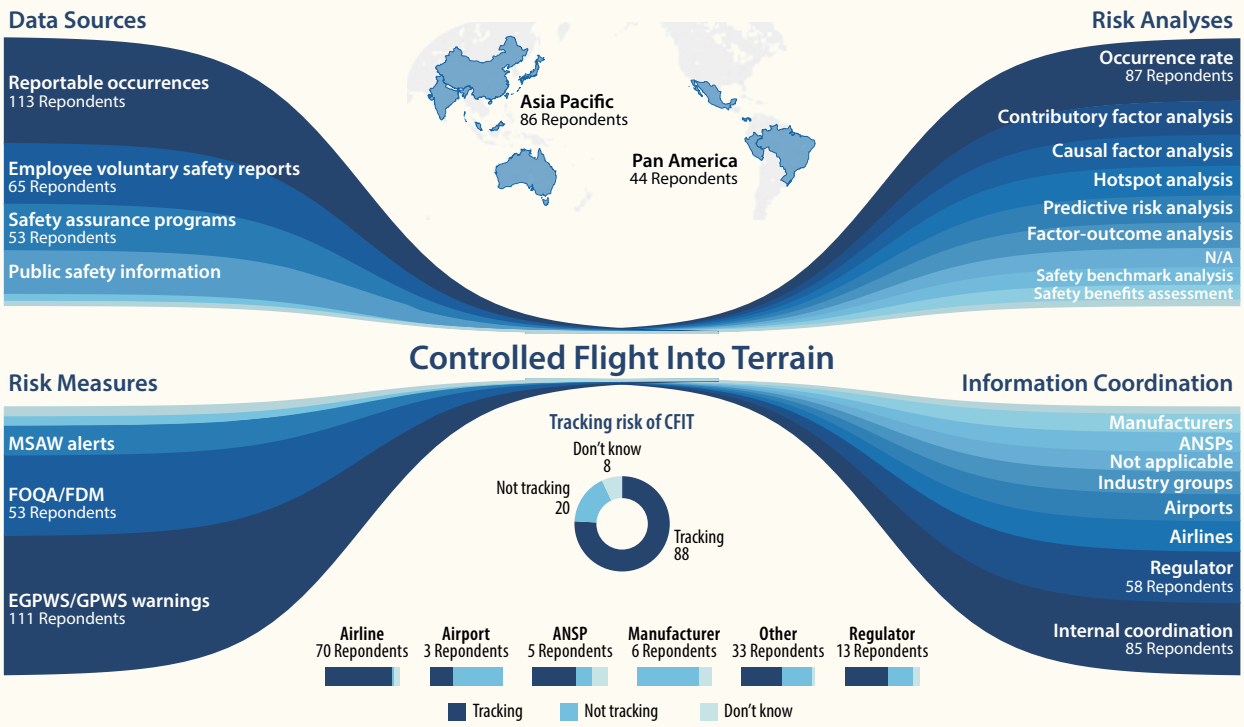
What do you see as the major barriers to establishing further protections?



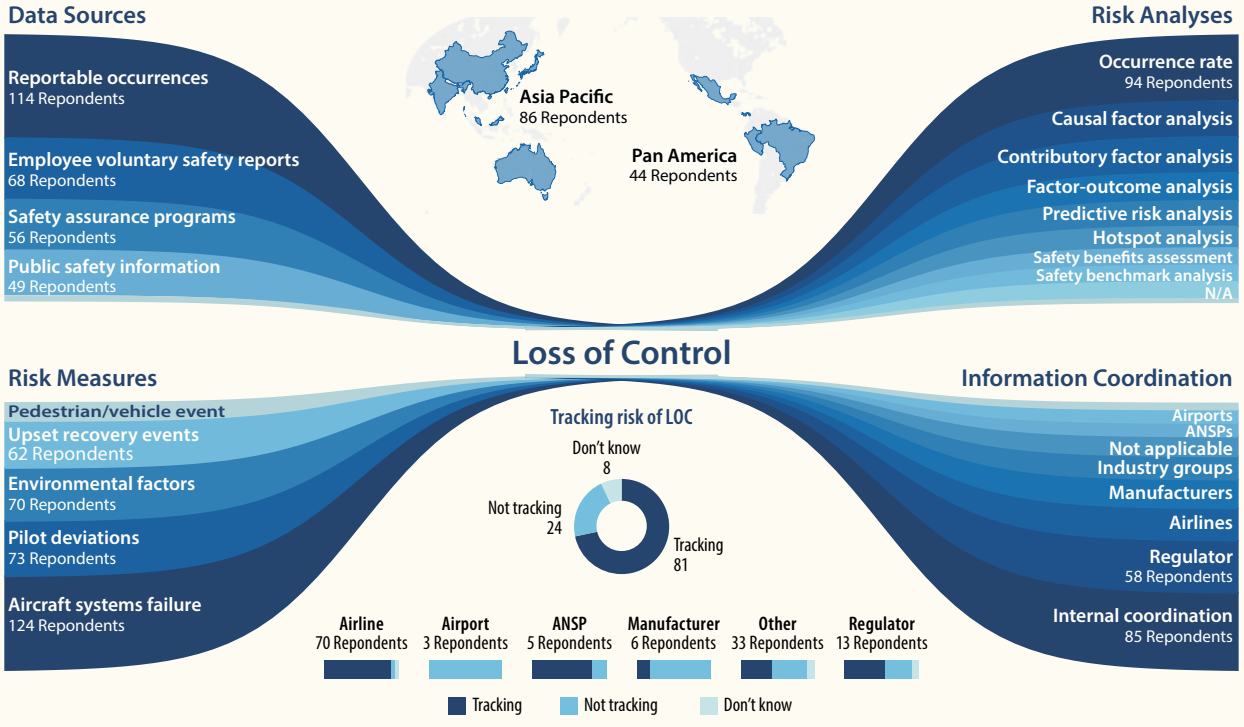
10. Bow-Tie Diagrams

These examples of bow-tie diagrams, used in some GSIP toolkits, provide a simplified way to illustrate choices of possible data sources, risk measures, analysis performed and information shared for risk management related to CFIT, LOC-I, MAC, ME and runway safety initiatives. The CFIT, LOC and MAC bow-tie diagrams show relatively high stakeholder reliance on analyses from flight data monitoring programs, while bow-tie diagrams for runway safety initiatives and MEs show greater reliance on other forms of data collection. All the bow-tie diagrams show the stakeholder's strong preference for acquiring data from mandatory occurrence reports and employee voluntary safety reports. Nearly every example also is consistent in showing the stakeholder's tracking of occurrence rates along with causal and contributory factors.

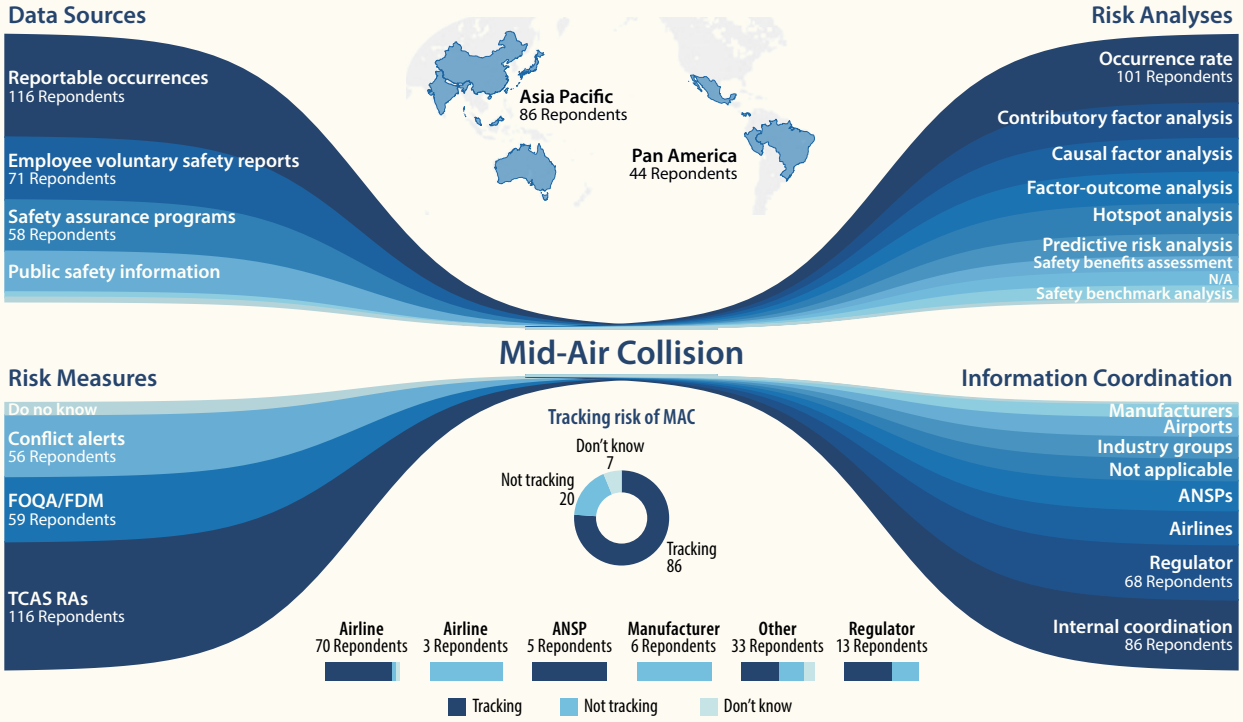
10a. Bow-Tie Diagrams — Controlled Flight Into Terrain



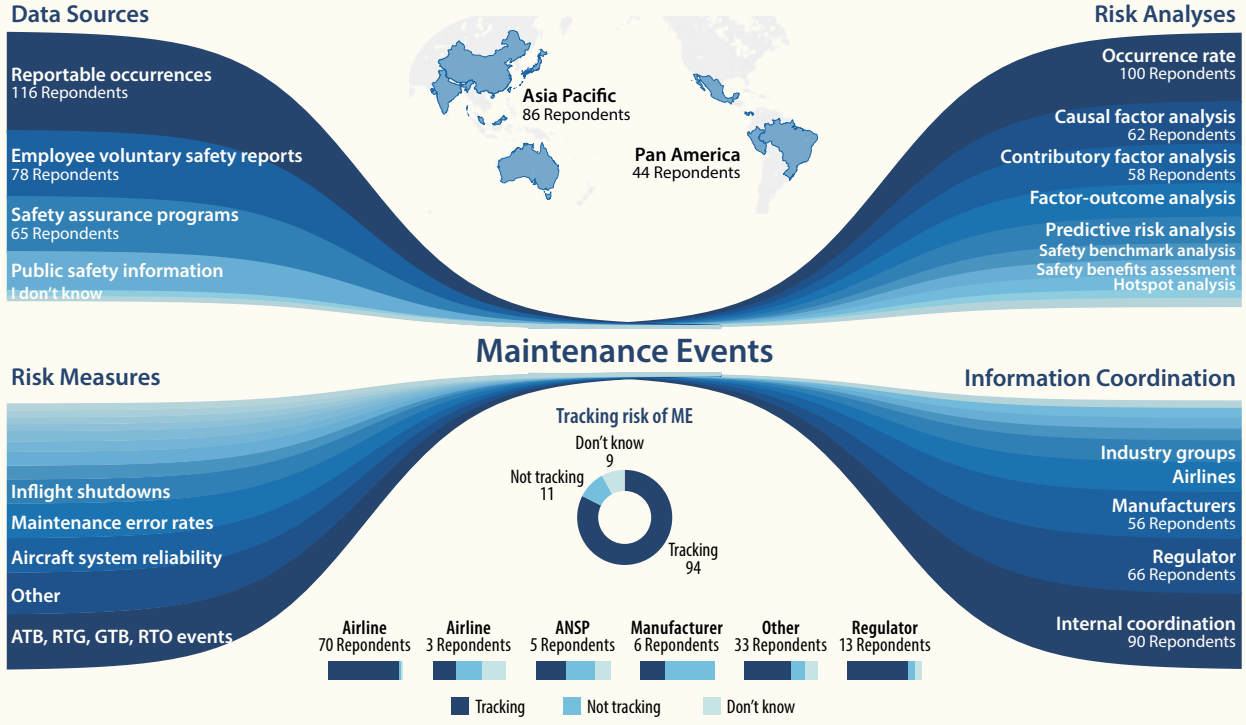
10b. Bow-Tie Diagrams — Loss of Control



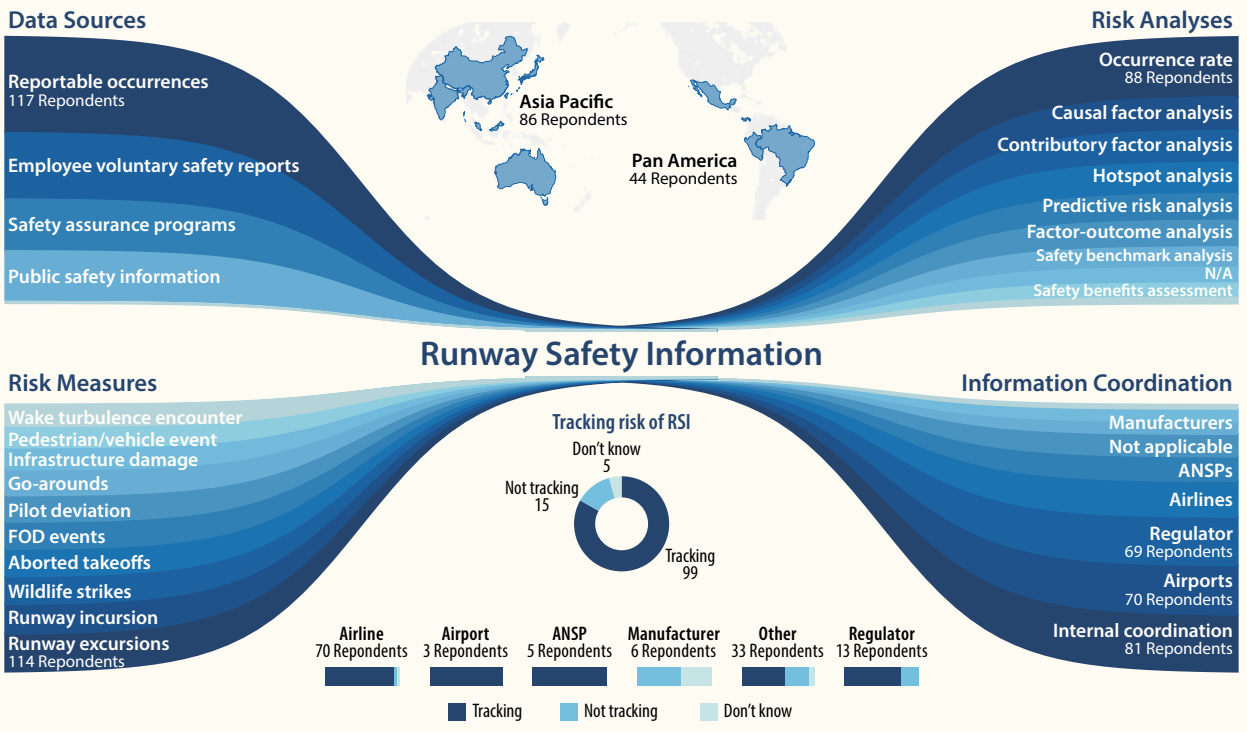
10c. Bow-Tie Diagrams — Mid-Air Collision



10d. Bow-Tie Diagrams — Maintenance Events



10c. Bow-Tie Diagrams — Runway Safety Information



Webinar and Results

To make sure that all participants have access to a promised summary of the overall results of the FY 2016 GSIP workshops, and our analysis of the 130 stakeholder-inventory survey questionnaires completed during the workshops, Flight Safety Foundation hosted three identical webinars scheduled to enable participation during daytime business hours of cities in the two regions. As the first priority, invitations to the webinar were sent to all participants, then invitations were sent to all FSF members. A link to replay one of the recorded webinars can be found at <<ADD LINK TO WEBSITE PAGE HERE>>.

The interactive webinar was organized into four sections and a question-and-answer session. The sections were titled:

- State of the Industry;
- Results From the Workshops;
- Proposed Toolkits and Increasing Intensity; and,
- Going Forward.

Interspersed throughout the sections' scripted presentations, we conducted real-time audience polling asking about the status of SPIs, SMS/SSPs and other elements of risk management from the participants' perspective.

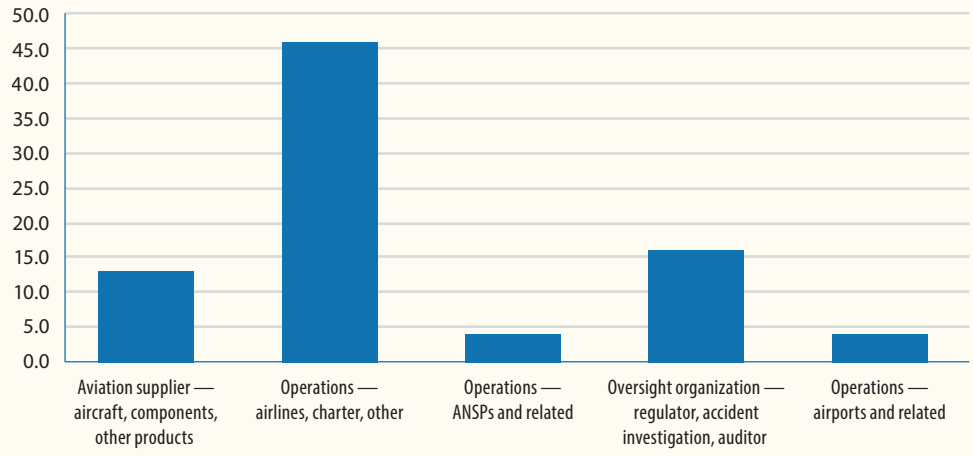
In the final 30-minute session of the webinar, open-ended questions to the presenters provided Flight Safety Foundation the opportunity to answer in more detail about several subjects and to hear about particular interests. We also asked for feedback about the webinar content.

The responses to the audience polling are shown in the graphs 10 through 13.

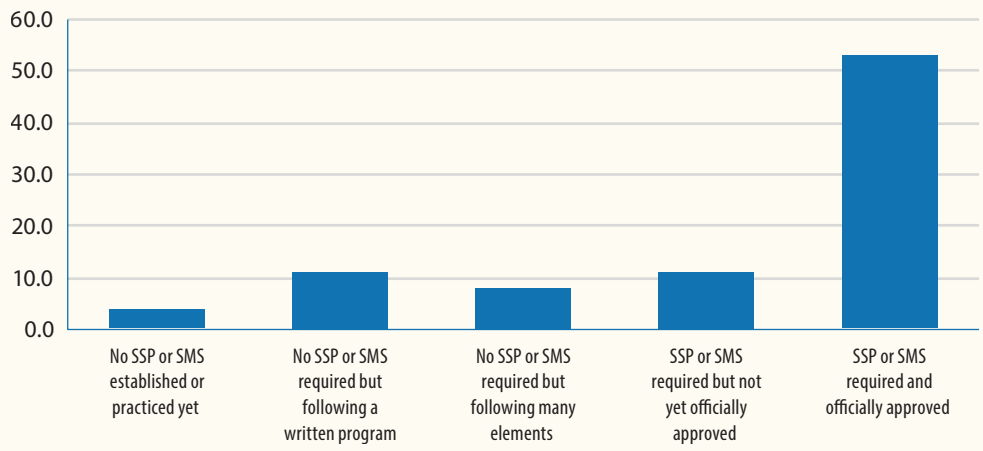
The feedback we received on the webinar was positive, and responses overall showed that the webinar clearly communicated GSIP information.

Workshop-participant and other webinar-participant responses tended to support our previously noted impression that in the Asia and Pacific Region and in the Pan America Region, there is great interest in sharing and receiving more details about the SPIs that are in use by service providers and, potentially, by CAAs.

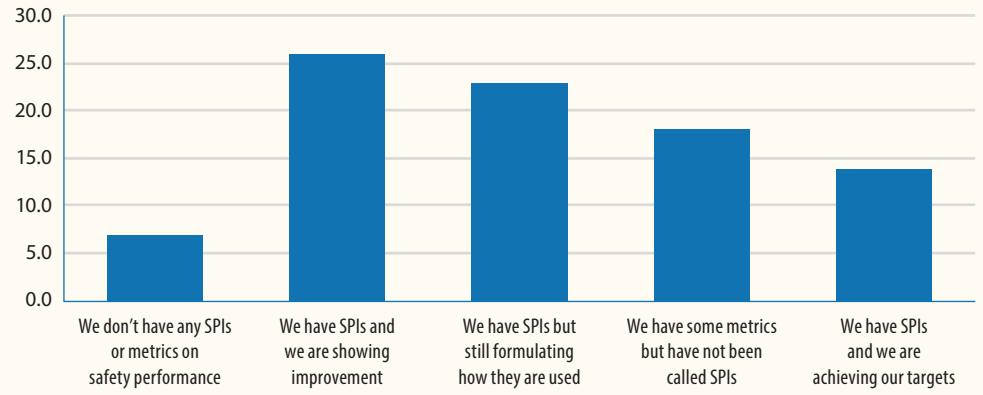
10. I Primarily Represent:



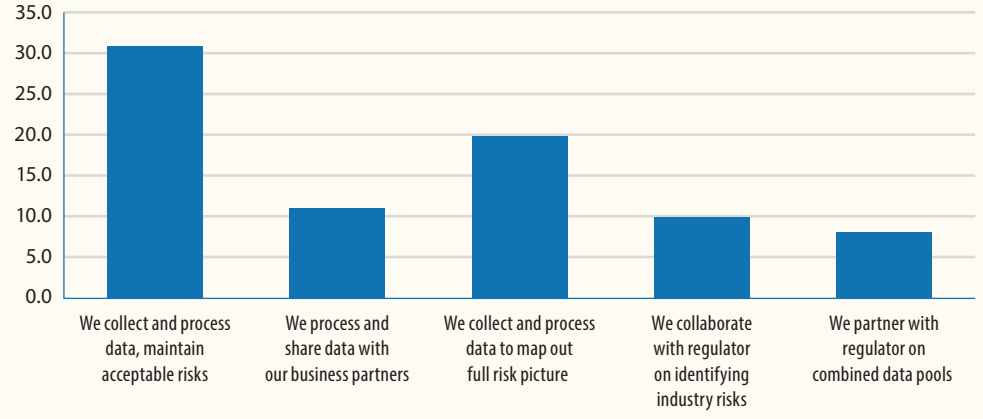
11. What Is the Status of SSP or SMS for My Organization?



12. How Would You Say the Safety Performance Indicators Are Working for Your Organization?



13. How Would You Characterize Your Experience Level With Data Collection and Processing?



Some of the responses indicate that much of the SDCPS work, as of 2016, was still in progress on SMS and SSPs to fully implement the ICAO Annex 19 requirements. At the same time, many airlines' risk-management advances in these regions seemed to be out ahead of the related advice/guidance and beyond the expectations from their regulators.

The results of our webinar provided confidence that the Foundation will be able to introduce more detailed GSIP information during further webinars. These webinars would support a deeper understanding of SDCPS practices.

Early Validations of GSIP

ICAO Regional Aviation Safety Groups

Throughout this project, Flight Safety Foundation has been coordinating with two of ICAO's five RASGs, comprising 40 Asia Pacific member states and 35 Pan America member states. At regularly scheduled RASG-APAC and RASG-PA meetings in 2016, the Foundation presented papers outlining the objectives and the status of the GSIP work while generating support for stakeholder participation in our workshops. Without exception, the responses of meeting attendees were supportive. The responses helped us add detailed GSIP guidance on how to effectively perform the risk management process within an SMS.

CAST, IATA, ASIAS, InfoShare

During a briefing to the August meeting of CAST, the Foundation announced that it would begin to separately introduce the GSIP framework and concepts to CAST members to allow more detailed review and discussion. This effort was meant to help validate our approach to the toolkit framework and concepts. We also began review and discussion with IATA's Safety Group in a visit on Sept. 12, 2016.

IATA has a unique global data sharing strategy in its FDX and Safety Trend Evaluation, Analysis and Data Exchange System (STEADES) programs. No other organization has an equivalent international approach to collecting and analyzing safety data. This approach is recognized within international commercial air transport as one of the leading examples of what the Foundation, in the *Information Sharing Toolkit*, calls a "highly advanced" intensity level.

IATA pointed out the need to make airline SMS programs account for the risks that come to their attention as operating-limit anomalies — i.e., significant flight parameter exceedances in flight data monitoring programs. IATA said that a mature ICAO-compliant SMS needs to be able to address cases in which the risks become evident as flight operations approach these limits. We also heard that some of these situations might become better known because of GSIP education, using intensity levels as the model of going beyond expectations for an ICAO-compliant SMS. Flight Safety Foundation agrees with this feedback, and we will explore this subject further in FY 2017 GSIP toolkit revisions.

The FAA's InfoShare meetings, conducted by its ASIAS program, also are recognized internationally in commercial aviation as a leading venue for conducting information sharing at a national level (with international outreach and partnerships). InfoShare also benefits GSIP as an example of one nation's airlines and the CAA jointly participating in new and productive study of current risks discovered or encountered by many different service providers. While airlines make the bulk of the InfoShare presentations, the semi-annual meetings provide a forum for manufacturers, the national accident investigation authority (National Transportation Safety Board) and the FAA to deliver presentations about conditions that

constitute significant risks and about stakeholders' post-analysis recommendations and/or actual experiences in implementing mitigation strategies.

We attempted to arrange a similar meeting with the Boeing Safety Office in Seattle, but a date could not be secured before the end of the GSIP Year 2 fiscal period on Sept. 30, 2016.

ICAO

Flight Safety Foundation representatives visited safety program officials at ICAO headquarters in Montreal during 2016 for coordination of GSIP efforts with guidance that may be introduced by its Safety Management Panel Working Group 3 and the Annex 19 Safety Information Protection Implementation Group.

The Foundation's representatives also met in 2016 with ICAO's integrated Safety Trend Analysis and Reporting System (iSTARS) coordinator, who is responsible for aviation safety and characteristics datasets maintained by iSTARS, a web-based system on the ICAO Secure Portal. iSTARS also provides web applications that enable authorized users to perform safety, efficiency and risk analyses.

ICAO asked the Foundation how the GSIP-proposed concept of intensity levels would apply to ICAO mandatory occurrence reports and to just culture adoption worldwide. ICAO officials said they realize that protection of mandatory occurrence reports is recommended in ICAO Annex 19, but they also believe that expanding legal protection to all mandatory reporting may not be more effective than just the protection of employee voluntary safety reports. Also, they said, the implementation of just culture is considered in much of the work of implementing basic ICAO-compliant protections. With this input, the Foundation is considering further revisions to the intensity level concept and applicability, and possibly recrafting the GSIP toolkit language about intensity levels, specifically how we intend the comparative "escalation" of SDCPS scope and sophistication to be understood when we speak about any intensity level.

Much of the FSF-ICAO work team effort was still in the beginning stages in FY 2016, and it was not clear enough — regarding the work products and deliverables — to know exactly how to shape our GSIP-related collaboration. During our visit, we made initial contacts and mutual commitments to share the work being developed in GSIP, and to participate in each other's related work.

Where GSIP Toolkits May Go

Webinars

Valuable feedback to Flight Safety Foundation from the FY 2016 webinars led us to conclude that our evolving GSIP toolkit content can be enhanced significantly — and cost effectively — by further engaging the known stakeholders and sharing development work through interactive webinars.

One likely content element to be covered in FY 2017 webinars, for example, is how to set up an SDCPS that fulfills the Annex 19 standards. This content element would give participants an idea of the data collection, data analysis, information sharing and information protection components of SDCPS for risk management within an organization. These become a baseline for implementation within an SMS or elements expected within most SSPs.

This webinar content would cover detailed examples of the data collection steps, the expected basic elements of a typical organization's SPIs, the related analytical data processing for probability-severity determinations on newly discovered hazards, the methods of sharing a summary of the risks internal to an SDCPS stakeholder organization and lines of accountability associated with such summaries, and, finally, the best practices to protect the derived safety information and individuals within an organization who provide voluntary safety reports.

Other envisioned content could explore advanced intensity levels with specific examples that elevate SDCPS beyond the organization into state, regional and global domains of information sharing and information protection.

Ultimately, we also expect to offer webinars that cover details of each GSIP intensity level across all components of an SDCPS.

SPI Exchanges

As we conducted the GSIP toolkit–focused workshops, we asked participants what SPIs they are using. Many had great interest in what other organizations are tracking. While some of these SPIs are the same, we expect that as the industry matures, service providers likely will track safety events and deficiencies during normal flight operations well upstream of today's events, deficiencies — and even warnings — are noticed.

For this reason, Flight Safety Foundation believes we can establish a de-identified method of sharing these performance metrics, including details of how these metrics are being captured and analyzed. With GSIP online discussion groups showing willingness to join in this general, open-survey approach to SPI exchange, we can also try to capture the perceived effectiveness of each SPI covered. The most effective SPIs logically would become discussion items, as noted.

Most service providers intent on improving their safety performance set up metrics that are best related to their key safety risks. While no single metric is perfect, there are lessons to be learned on why particular metrics were chosen and why some can have a greater influence on improving risk. We found in our workshops that many of these GSIP participants have SPIs and, to their credit, the SPIs are aligned with universally significant accident risk categories such as CFIT, LOC-I and MAC.

To significantly improve their safety performance, all service providers must monitor data streams that show them, for example, events in which an aircraft came close to a stall, to

another aircraft or to the terrain — in fact, probably closer than the normal operating procedures allow. Precise speeds and distances — whatever parameters the stakeholder considers critical — can sometimes be captured by the warning systems on board the aircraft. But it is up to each organization to decide, in this case, the speeds and distances that show the SPTs that must be improved.

Further Workshops

We have seen first-hand that time devoted to discussing robust risk management processes has its benefits. Such discussions can go well beyond the benefits typically experienced from a static safety-promotion website or a minimally interactive webinar. Whenever the Foundation succeeded in FY 2016 in having both a well-attended and a well-regarded GSIP workshop, the most rewarding part was bringing together key SDCPS stakeholders to discuss best methods of risk management.

Our preference for FY 2017 will be to target GSIP webinar and other invitations to these key stakeholders rather than to general lists of safety management contacts. While responses from participants in FY 2016 showed that the Foundation and its GSIP activities were well respected, our role serving both as the *sponsoring agent* responsible for organizing each event and as the *advocate* of certain practices a few times created confusion about our motives and our expectations of others. Going forward, we propose to utilize multiple sponsoring agents to help attract larger audiences of key stakeholders while avoiding factors that led to no-shows and to some participants with mismatched interest levels. (Serving as sponsoring agent simply should mean that the organization serves as a kind of host representative but does not serve as a funding source.)

Validations With Experts

Flight Safety Foundation regards several members of CAST as safety experts who come from service providers and other organizations that have highly advanced SMS processes. These experts have done specialized risk assessments and have established many data streams, from which they monitor SPIs and the effectiveness of SDCPS-derived risk mitigations.

CAAs also already have taken creative and novel approaches to increase technical knowledge and local awareness of risk. Moreover, they have explored many different approaches to current risk exposures, and they have monitored the approaches over time as mitigations have been implemented. In this validation context, the Foundation expects to be able to obtain reality-based but de-identified frontline scenarios and to confidently add them to the GSIP toolkits.

Conclusions

Key Issues

Flight Safety Foundation has concluded that for SDCPS to thrive, stakeholders in international commercial air transport must spread their knowledge of risk widely within their organizations and with as many other stakeholders as possible. The SMS at service providers and the SSPs at CAAs have to be assembled so that effective analyses of readily collected safety data drive their risk-management priorities. This holds true no matter what the organization's size or intensity level (i.e., its scope and sophistication). Results of the analyses also have to be clearly summarized and connected to the proposed priorities for risk mitigations.

Participants in the GSIP workshops concur on many aspects of SDCPS challenges. For each safety issue addressed, we agreed, stakeholders primarily must understand the "chain" of causality — the connections among threats, undesired aircraft states, defensive barriers, barrier failures and unwanted outcomes. Gaining this depth of understanding has only begun when they have completed basic familiarization with public safety information that explains the high-severity outcomes on record.

As stakeholders' SMS and SSPs mature, the stakeholders must dig deeper into known and potential causes of undesired aircraft states — or the equivalent metrics for non-airline service providers. This means analyzing the subtle and latent factors that, without successful intervention and recovery, may lead to a catastrophic outcome. Digging deeper also involves precisely determining the normalized frequency and rates of threats, and the effectiveness of defensive barriers.

Compliance with regulatory requirements has not diminished as a foundation of risk management for the industry. Aviation safety advocates, including CAAs and accident investigation authorities, still reinforce this foundation in the era of SMS because it is still important. But aviation safety professionals need to recognize the limitations of legacy regulatory compliance. Any audit, check or inspection is only a snapshot in time. Today, stakeholders must examine in great detail the effectiveness of compliance efforts and the effectiveness of their SDCPS.

In this context, the workload and demands on these Asia Pacific and Pan American CAAs have increased significantly. Some GSIP participants said states may be reaching the point where their regulators should shift their oversight focus to setting specific safety priorities for service providers, based on comprehensive safety data analysis and collaborative risk mitigation. This shift could reduce the need for the primary concentration to be on enforcement action — except in the few cases where a service provider proves incapable of complying and/or is unwilling to comply consistently. This shift of focus also sets a high expectation for every service provider to make its SMS as productive and effective as possible while making the CAA its partner.

The Foundation understands better today why GSIP workshop participants often told us that SDCPS resources are still needed in many areas of international commercial air transport operations and government oversight. Adequate resources enable an SMS or SSP to function effectively at any intensity level. The Foundation is positioned to respond to their call for real-world examples that will help them to fully implement data collection, data analysis and information sharing that drive effective risk management.

Finally, stakeholder collaboration and continuing education on contemporary safety theory proved to be more critical than we imagined. Theoretical and technological advances — reflected in SMS, flight data monitoring and hundreds of other capabilities — have launched this era of safety data–driven risk management. Therefore, almost any stakeholder, including many already performing well at the basic intensity level, can discover and break connections among causal factors well before an accident takes place. Closing gaps in education has special importance because so many organizations lack a full understanding of the processes involved. Flight Safety Foundation appreciates the FAA's support of GSIP work as one of the first steps in that direction.

Appendix A

Workshop Participant Survey

GSIP
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GSIP Workshop Participant Survey

Survey Instructions

Thank you for completing the GSIP Workshop Survey. In an effort to improve global aviation safety, please answer all applicable questions to the best of your ability. Should you have any questions while completing this survey, please ask one of the workshop moderators or refer to information from today's session.

Throughout this survey, many of the questions will ask you to respond on behalf of "your Organization". Please respond to all questions based on your experience within the Organization in which you work on a daily basis (e.g. Safety Department, Flight Ops, etc.).

Stakeholder Type

☐ Airline ☐ ANSP ☐ Manufacturer

☐ Airport ☐ Regulator ☐ Other: _____

Stakeholder Role / Job Description

Region

☐ Asia Pacific ☐ Middle East ☐ Western & Central Africa

☐ Eastern & Southern Africa ☐ South America ☐ North America, Central America, Caribbean

☐ Europe & North Atlantic

Country & Office Location

FSF Privacy Statement

Flight Safety Foundation recognizes the value of keeping organization and individual privacy within this research project, therefore:

1. All participant names will be considered privileged information. No participants will ever be mentioned by name in any of the published material about the project. Likewise these sources will be protected from disclosure.

2. All organization names will be considered privileged information. No organization name will be used or associated with specific inputs during GSIP conversations or correspondence without their express consent for the materials and products developed in this project.

3. All discussions on issues during our focus groups will be considered valuable for building future frameworks for protecting safety information. In those discussions, there may be information shared about special circumstances that have actually taken place. However, no performance or nonconformance to any industry standards will be described by attributing a violation to a specific country or organization in any of the published materials or in the summary materials prepared for interested stakeholders.

4. This project is not collecting any safety data and therefore cannot release safety data to organizations who believe their regulations compel a duty to act on safety issues.

GSIP Workshop, Day 1 Survey Instructions

Time has been allocated on the agenda for each participant to complete this survey. Below is a summary of those times and the applicable survey questions to be completed. During these times, the moderator will tell participants when to complete the survey. Should you have any questions, please don't hesitate to ask.

13:00 – 15:00 Toolkit Introduction

- Survey Cover Page
- SDCPS Questions (page 3)

15:30 – 17:00 Data Sources / Collection

- Runway Safety – Information Collection (page 4)
- Controlled Flight into Terrain – Information Collection (page 5)
- Aircraft Loss of Control (page 6)
- Mid-Air Collisions (MACs) and Near Mid-Air Collisions (NMACs) / Aircraft Proximity Events – Information Collection (page 7)
- Safety Audit & Compliance – Information Collection (pages 8 & 9)
- Maintenance Events – Information Collection (page 10)
- Other Safety Metrics – Information Collection (page 11)
- General Comments / Additional Space for Comments – Information Collection (pages 12 & 13)

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SDCPS Questions

1. My Organization collects the following information for Reportable Occurrences (select all that apply):
   - ☐ Factual Information
   - ☐ Direct Causes
   - ☐ Contributing Factors
   - ☐ Safety Recommendations
   - ☐ Not Applicable

2. My Organization collects the following information to support Safety Assurance activities (select all that apply):
   - ☐ Factual Information
   - ☐ Direct Causes
   - ☐ Contributing Factors
   - ☐ Safety Recommendations
   - ☐ Not Applicable

3. My Organization uses an Employee Voluntary Reporting Program to collect voluntary safety information:
   - ☐ True
   - ☐ False *(proceed to question 6)*
   - ☐ I Don't Know *(proceed to question 6)*

4. *If you responded "True" to question 3,* the following best describes the reporters participating in my Organization's Employee Voluntary Reporting Program (select all that apply):
   - ☐ Front Line Employees *(e.g. Pilots, Controllers, Airport Ops)*
   - ☐ Operations Support Employee *(e.g. Aircraft Maintenance, Air Traffic Maintenance, etc.)*
   - ☐ Supervisors & Managers
   - ☐ All Employees (100% participation)
   - ☐ I Don't Know

5. *If you responded "True" to question 3*, my Organization's Employee Voluntary Reporting Program allows for participants to report the following information (select all that apply):
   - ☐ Factual Information
   - ☐ Direct Causes
   - ☐ Contributing Factors
   - ☐ Safety Recommendations
   - ☐ Not Applicable

6. My Organization collects the following from Public Safety Information (check all that apply):
   - ☐ Factual Information
   - ☐ Direct Causes
   - ☐ Contributing Factors
   - ☐ Safety Recommendations
   - ☐ Not Applicable

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Runway Safety – Information Collection

1. My Organization collects runway safety information:

☐ True ☐ False *(proceed to Page 5)* ☐ I Don't Know *(proceed to Page 5)*

2. My Organization tracks runway safety metrics as a key performance indicator (KPI):

☐ True ☐ False ☐ I Don't Know

Please describe your runway safety key performance indicators:

3. My Organization collects the following runway safety information (check all that apply):

☐ Runway Incursions ☐ Runway Excursions ☐ Aborted Takeoffs

☐ Pilot Deviations ☐ Go-Arounds ☐ Pedestrian / Vehicle Non-Compliance Events

☐ Wake Turbulence Encounter ☐ Wildlife Strikes ☐ Infrastructure Damage

☐ Foreign Object Debris (FOD) Events ☐ I Don't Know

Please list other runway safety information collected by your Organization:

4. My Organization collects runway safety information from the following sources (check all that apply):

☐ Reportable Occurrences ☐ Safety Assurance Programs ☐ Employee Voluntary Reports

☐ Public Safety Information ☐ I Don't Know ☐ Not Applicable

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Controlled Flight into Terrain (CFIT) – Information Collection

1. My Organization collects information on the risk of CFIT:
   ☐ True ☐ False *(proceed to Page 6)* ☐ I Don't Know *(proceed to Page 6)*

2. My Organization tracks risk of CFIT metrics as a key performance indicator (KPI):
   ☐ True ☐ False ☐ I Don't Know

Please describe your risk of CFIT key performance indicators:

3. My Organization collects the following information on the risk of CFIT (check all that apply):

   ☐ EGPWS / GPWS Warnings ☐ FOQA / FDM ☐ MSAW Alerts
   ☐ I Don't Know ☐ Not Applicable

Please list other types of information your Organization collects regarding the risk of CFIT:

4. My Organization collects CFIT risk information from the following sources (check all that apply)

   ☐ Reportable Occurrences ☐ Safety Assurance Programs ☐ Employee Voluntary Reports
   ☐ Public Safety Information ☐ I Don't know ☐ Not Applicable

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Aircraft Loss of Control (LOC) – Information Collection

1. My Organization collects information on the risk of aircraft LOC:
   ☐ True ☐ False *(proceed to Page 7)* ☐ I Don't Know *(proceed to Page 7)*

2. My Organization tracks risk of aircraft LOC metrics as a key performance indicator (KPI):
   ☐ True ☐ False ☐ I Don't Know

Please describe your risk of aircraft LOC key performance indicators:

3. My Organization collects the following information on the risk of aircraft LOC (check all that apply):
   ☐ Aircraft System Malfunctions/Failures ☐ Environmental Factors *(e.g. Wake Turbulence Encounter)* ☐ Pilot Deviations
   ☐ Upset Recovery Events

Please list other types of information your Organization collects regarding the risk of aircraft LOC:

4. My Organization collects information on the risk of aircraft LOC from the following sources (check all that apply):
   ☐ Reportable Occurrences ☐ Safety Assurance Programs ☐ Employee Voluntary Reports
   ☐ Public Safety Information ☐ I Don't Know ☐ Not Applicable

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Mid-Air Collisions (MACs) and Near Mid-Air Collisions (NMACs) / Aircraft Proximity (AIRPROX) Events – Information Collection

1. My Organization collects information on MACs and NMACs / AIRPROX events:
   ☐ True ☐ False *(proceed to Page 8)* ☐ I Don't Know *(proceed to Page 8)*

2. My Organization tracks risk of MACs and NMACs / AIRPROX event metrics as a key performance indicator:
   ☐ True ☐ False ☐ I Don't Know

Please describe your risk of MACs and NMACs / AIRPROX event key performance indicators:

3. My Organization collects the following information on the operational risk of MACs and NMACs/AIRPROX events (check all that apply):
   ☐ TCAS RAs ☐ FOQA / FDM ☐ Conflict Alerts ☐ I Don't Know

Please list other types of information your Organization collects regarding the risk of MACs and NMACs/AIRPROX Events:

4. My Organization collects information on the risk of MACs and NMACs/AIRPROX Events from the following sources (check all that apply):

   ☐ Reportable Occurrences ☐ Safety Assurance Programs ☐ Employee Voluntary Reports
   ☐ Public Safety Information ☐ I don't know ☐ Not Applicable

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Safety Audits & Compliance – Information Collection

1. My Organization collects information to support the conduct and/or response to internal safety audit and compliance activities:

   ☐ True ☐ False *(proceed to question 4)* ☐ I Don't Know *(proceed to question 4)*

2. My Organization uses the following methods to collect and evaluate day-to-day operational performance:

   ☐ Flight Data (FDM) Information ☐ Line Operations Safety Audit (LOSA)

   ☐ Maintenance Error Decision Aid (MEDA) ☐ Normal Operations Safety Survey (NOSS)

   ☐ Other

   ☐ I Don't Know ☐ Not Applicable

Please describe other methods used by your Organization to support internal safety audit and compliance activities.

3. Please list the information your Organization collects and analyses to support the conduct and/or response to internal safety audit and compliance activities:

Please describe the information your Organization collects and analyses to support internal safety audit and compliance activities. Additionally, please include any relevant information on key performance indicators related to internal safety audits.

4. My Organization collects information to support the conduct and/or response to external safety audit and compliance activities:

   ☐ True ☐ False *(proceed to Page 10)* ☐ I Don't Know *(proceed to Page 10)*

5. My Organization utilizes the following resources to conduct external safety and compliance activities:

   ☐ ICAO (USAP-CMA) ☐ IATA (IOSA) ☐ Industry Consultant

   ☐ Other ☐ I Don't Know ☐ Not Applicable

Please describe other external or specialized audits that are conducted for your Organization:

6. Please list the information your Organization collects and analyses to support the conduct and/or response to external safety audit and compliance activities:

Please describe the information your Organization collects and analyses to support external safety audit and compliance activities. Additionally, please include any relevant information on key performance indicators related to external safety audits.

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Maintenance Events – Information Collection

1. My Organization collects information on maintenance events that impact safety and/or level of service:
   ☐ True ☐ False *(proceed to Page 11)* ☐ I Don't Know *(proceed to Page 11)*

2. My Organization tracks maintenance event metrics as a key performance indicator:
   ☐ True ☐ False ☐ I Don't Know

Please describe your maintenance event key performance indicators:

3. My Organization collects information on maintenance events from the following sources (check all that apply):
   ☐ Reportable Occurrences ☐ Safety Assurance Programs ☐ Employee Voluntary Reports
   ☐ Public Safety Information ☐ I Don't Know ☐ Not Applicable

Other Safety Metrics

Please identify additional KPIs that are collected and monitored by your Organization that have not been included in previous day 1 survey responses:

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Thank you for completing the Day 1 survey.

In the boxes below, please provide any additional feedback:

Please tell us how we can improve the GSIP workshop and toolkits:

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Additional Comments from Day 1

You may use this space for responses to survey questions. Please note the section and question number.

GSIP Workshop, Day 2 Survey Instructions

Time has been allocated on the agenda for each participant to complete this survey. Below is a summary of those times and the applicable survey questions to be completed. During these times, the moderator will tell participants when to complete the survey. Please reference your day 1 responses (as needed) for information consistency. Should you have any questions, please don't hesitate to ask.

09:00 – 10:00 Data Processing

- Runway Safety – Data Processing (page 15)
- Controlled Flight into Terrain – Data Processing (page 15)
- Aircraft Loss of Control – Data Processing (page 16)
- Mid-Air Collisions (MACs) and NMACs / Aircraft Proximity Events – Data Processing (page 16)
- Maintenance Events – Data Processing (page 17)

10:30 – 12:00 Information Sharing

- Runway Safety – Data Processing (page 18)
- Controlled Flight into Terrain – Data Processing (page 18 and 19)
- Aircraft Loss of Control – Data Processing (page 19)
- Mid-Air Collisions (MACs) and NMACs / Aircraft Proximity Events – Data Processing (page 20)
- Maintenance Events – Data Processing (page 20)
- Regulator Collaboration and Sharing of Information (page 21) – To *be completed by Regulators only*

13:00 – 15:00 Information Protections – Risk Management

- Information Protection (pages 22 - 24)

General Comments

- General Comments / Additional Space for Comments (pages 25 & 26)

Runway Safety Information – Data Processing

1. My Organization conducts the following types of runway safety data analyses (check all that apply):

☐ Frequency & Rate of Occurrence
☐ Frequency & Rate of Direct Causal Factors
☐ Frequency & Rate of Contributory Factors
☐ Linking Causal / Contributory Factors to Outcomes
☐ Geographical Hotspot Analysis
☐ Predictive Risk Analysis
☐ Safety Benefits Assessment
☐ Safety Benchmark Analysis
☐ I Don't Know
☐ Not Applicable

Please list other runway safety analyses conducted by your Organization:

Controlled Flight into Terrain (CFIT) – Data Processing

1. My Organization conducts the following types of CFIT risk data analyses (check all that apply):

☐ Frequency & Rate of Occurrence
☐ Frequency & Rate of Direct Causal Factors
☐ Frequency & Rate of Contributory Factors
☐ Linking Causal / Contributory Factors to Outcomes
☐ Geographical Hotspot Analysis
☐ Predictive Risk Analysis
☐ Safety Benefits Assessment
☐ Safety Benchmark Analysis
☐ I Don't Know
☐ Not Applicable

Please list other types of analyses your Organization conducts to identify and/or respond to the risk of CFIT:

Aircraft Loss of Control (LOC) – Data Processing

1. My Organization conducts the following types of analyses related to the risk of aircraft LOC (check all that apply):

☐ Frequency & Rate of Occurrence
☐ Frequency & Rate of Direct Causal Factors
☐ Frequency & Rate of Contributory Factors
☐ Linking Causal / Contributory Factors to Outcomes
☐ Geographical Hotspot Analysis
☐ Predictive Risk Analysis
☐ Safety Benefits Assessment
☐ Safety Benchmark Analysis
☐ I Don't Know
☐ Not Applicable

Please list other analyses conducted by your Organization to identify and/or respond to the risk of aircraft LOC:

Mid-Air Collisions (MACs) and Near Mid-Air Collisions (NMACs) / Aircraft Proximity (AIRPROX) Events – Data Processing

1. My Organization conducts the following types of analyses on MAC and NMAC / AIRPROX Event information (check all that apply):

☐ Frequency & Rate of Occurrence
☐ Frequency & Rate of Direct Causal Factors
☐ Frequency & Rate of Contributory Factors
☐ Linking Causal / Contributory Factors to Outcomes
☐ Geographical Hotspot Analysis
☐ Predictive Risk Analysis
☐ Safety Benefits Assessment
☐ Safety Benchmark Analysis
☐ I Don't Know
☐ Not Applicable

Please list other analyses conducted by your Organization to identify and/or respond to the risk of MACs and NMACs/AIRPROX:

Maintenance Events – Data Processing

1. My Organization conducts the following types of analyses on maintenance events that impact operational performance and safety (check all that apply):

☐ Frequency & Rate of Occurrence
☐ Frequency & Rate of Direct Causal Factors
☐ Frequency & Rate of Contributory Factors
☐ Linking Causal / Contributory Factors to Outcomes
☐ Geographical Hotspot Analysis
☐ Predictive Risk Analysis
☐ Safety Benefits Assessment
☐ Safety Benchmark Analysis
☐ I Don't Know
☐ Not Applicable

Please list other analyses conducted by your Organization to identify and/or respond to the risk of maintenance events that impact operational performance and safety:

Runway Safety Information – Information Sharing

1. My Organization coordinates runway safety information with the following domains (check all that apply)

☐Internal Coordination	☐Regulator	☐Airlines
☐ANSPs	☐Manufacturers	☐Airports
☐ Industry Groups	☐ I Don't Know	☐ Not Applicable

2. My Organization participates in the following runway safety collaboration and sharing activities (e.g. meetings, workshops, runway safety teams):

Please list all runway safety coordination activities that your Organization participates in:

Controlled Flight into Terrain (CFIT) – Information Sharing

1. My Organization coordinates CFIT risk information with the following domains (check all that apply)

☐Internal Coordination	☐Regulator	☐Airlines
☐ANSPs	☐Manufacturers	☐Airports
☐ Industry Groups	☐ I Don't Know	☐ Not Applicable

2. My Organization participates in the following CFIT risk collaboration and sharing activities (e.g. meetings, workshops, runway safety teams):

Please list all CFIT risk activities that your Organization participates in:

Aircraft Loss of Control (LOC) – Information Sharing

1. My Organization coordinates aircraft LOC risk information with the following domains (check all that apply):

☐Internal Coordination	☐Regulator	☐Airlines
☐ANSPs	☐Manufacturers	☐Airports
☐ Industry Groups	☐ I Don't Know	☐ Not Applicable

2. My Organization participates in the following aircraft LOC risk reduction collaboration and sharing activities (e.g. meetings, workshops, safety teams):

Please list all aircraft LOC risk reduction coordination activities that your organization participates in:

Mid-Air Collisions (MACs) and Near Mid-Air Collisions (NMACs) / Aircraft Proximity (AIRPROX) Events – Information Sharing

1. My Organization coordinates MAC and NMAC / AIRPROX Event information with the following domains (check all that apply):

☐Internal Coordination	☐Regulator	☐Airlines
☐ANSPs	☐Manufacturers	☐Airports
☐ Industry Groups	☐ I Don't Know	☐ Not Applicable

2. My Organization participates in the following MAC and NMAC / AIRPROX event risk reduction collaboration and sharing activities (e.g. meetings, workshops, safety teams):

Please list all MAC / NMAC / AIRPORX Event risk reduction activities that your organization participates in:

Maintenance Events – Information Sharing

1. My Organization coordinates maintenance event information with the following domains (check all that apply):

☐Internal Coordination	☐Regulator	☐Airlines
☐ANSPs	☐Manufacturers	☐Airports
☐ Industry Groups	☐ I Don't Know	☐ Not Applicable

2. My Organization participates in the following risk maintenance event collaboration and sharing activities (e.g. meetings, workshops, safety teams):

Please list all reduction activities that your Organization participates in:

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Regulator Collaboration and Sharing of Information

If you are not a Regulator, please proceed to Page 23.

1. My Organization collects the following information from:

Safety Information from Airlines
Reportable Occurrence Information ☐
Safety Assurance Information ☐
Employee Voluntary Safety Information ☐

Safety Information from ANSPs
Reportable Occurrence Information ☐
Safety Assurance Information ☐
Employee Voluntary Safety Information ☐

Safety Information from Airports
Reportable Occurrence Information ☐
Safety Assurance Information ☐
Employee Voluntary Safety Information ☐

Safety Information from Manufacturers
Reportable Occurrence Information ☐
Safety Assurance Information ☐
Employee Voluntary Safety Information ☐

Safety Information from Other Regulators
Reportable Occurrence Information ☐
Safety Assurance Information ☐
Employee Voluntary Safety Information ☐

General Information
Surveillance Data ☐
Audit Data ☐
Other ☐

Please list other types of data your Organization collects:

2. Please describe the direct feedback your Organization provides back to the domains providing data:

Information Protection

The following questions only apply to mandatory and voluntary reporting systems covered by ICAO Annex 19 – *Safety Management* ("Annex 19"), not data and information collected following accident and incident investigations (Annex 13).

Annex 19 protection applies to reported safety data and information to States in the State Safety Program ("SSP") and to Safety Management Systems ("SMS") of aviation service providers and operators.

1. What safety data and safety information reported or collected by your organization or country is protected?

☐ SCDPS Information ☐ Runway Safety Information ☐ CFIT Information

☐ Aircraft LOC Information ☐ MACs & NMACs Information ☐ AIRPROX Information

☐ Safety Audits & Compliance Information ☐ Maintenance Event Information ☐ I Don't Know

☐ Other Information: _____

Please explain and provide specifics:

2. When reporting to an organization in a SMS, how are individuals protected from employer's disciplinary actions or punishments?

☐ Law and Regulation ☐ Company Policy or Commitment ☐ Labor/Company agreements

☐ Memos of Understandings ☐ Education / Training programs ☐ Using Just Culture approach

☐ I Don't Know ☐ Other specific _____

Please explain and provide specifics:

3. When reporting to a State in a SSP, how are reporters of safety data and safety information, whether individuals or organizations, protected against enforcement actions, and administrative, civil and criminal proceedings?

☐ Law and Regulation ☐ Company Policy or Commitment ☐ Labor/Company agreements

☐ Memos of Understandings ☐ Education / Training programs ☐ Using Just Culture approach

☐ I Don't Know ☐ Other specific _____

Please explain and provide specifics:

4. What do you see as the major barriers to establishing further protections?

☐ Constitutional ☐ Cultural Resistance ☐ Financial Resources

☐ Government Transparency Laws ☐ Evidentiary Laws ☐ Criminal Laws

☐ Personal Resources ☐ Expertise & Knowledge ☐ I Don't Know

☐ Other specific _____

Please explain and provide specifics:

5. How would you assess the effectiveness of safety information protection in your country/organization?
   1- ☐ The protections are effective – the data/information and sources are protected for aviation safety purposes.
   2- ☐ Most data/information is protected, but some reported data/information is not protected (specify below).
   3- ☐ Most reported data/information is not protected (specify below).
   4- ☐ The current protections are unused or are unsupported by my organization/State.
   5- ☐ No protection framework and Just Culture exist to protect the data/information and sources.

Please explain and provide specifics:

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Thank you for completing the survey.

In the boxes below, please provide any additional feedback:

Please tell us how we can improve the GSIP workshop and toolkits:

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Day Two Additional Comments

You may use this space for responses to survey questions. Please note the section and question number.

Appendix B

Introductions to Toolkits

FLIGHT SAFETY FOUNDATION

GLOBAL SAFETY INFORMATION PROJECT

GSIP Toolkits Introduction

MARCH 2017

FLIGHT SAFETY FOUNDATION

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GSIP Toolkits Introduction

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.

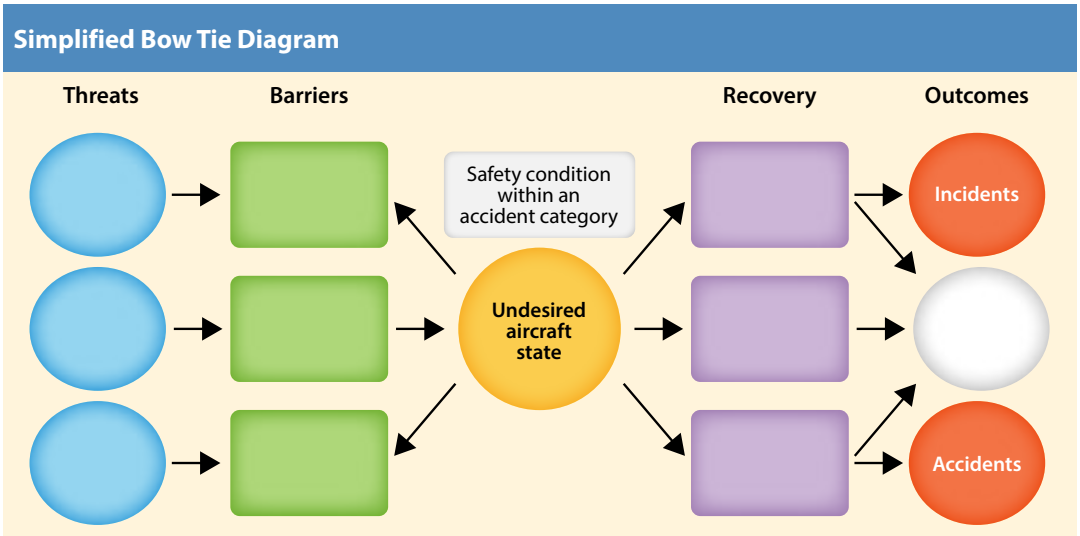

Figure 1

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.

Appendix C

Data Collection Toolkits

FLIGHT SAFETY FOUNDATION

GLOBAL SAFETY INFORMATION PROJECT

Data Collection Toolkit

MARCH 2017

FLIGHT SAFETY FOUNDATION

GLOBAL SAFETY INFORMATION PROJECT

Data Collection Toolkit

Welcome

Thanks for your interest in enhancing aviation safety data collection and processing systems (SDCPS). This toolkit offers insights recently gained by Flight Safety Foundation into typical data collection challenges and solutions among aviation service providers and their regulators in the Pan America and Asia and Pacific regions.

As noted in the *GSIP Toolkits Introduction,* research and development for the Global Safety Information Project (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 its compilation possible.

In civil aviation, as in many other global industries, the use of operational data to accelerate improvement of safety performance is growing rapidly. This pace can have inconsistent results. The frameworks we discuss here, therefore, are intended to help you objectively and confidently decide what types of data to collect within your safety management system (SMS, including SMSs within state safety programs), based on selected best practices and on new FSF proposals.

This toolkit urges you to consider the framework of a *bow-tie analysis* of your most probable risks — ideally combined with mathematical and statistical methods prior to making your data collection decisions. Moreover, we recommend mapping a strategy for the evolution of what we call your organization's relative *level of intensity* in risk management and, consequently, optimizing your organization's safety culture, capabilities and effectiveness.

A basic assumption linking this and three other GSIP toolkits is that, like other aviation stakeholders, your organization requires reliable streams of accurate data and information from which to identify, generate and prioritize risk mitigations. You cannot afford to wait, faced with fast-paced flight operations in dynamic environments, for results of an investigation into an accident, an incident or a precursor issue. You need to predict and to get ahead of the most probable threats.

Applying world-class knowledge of risks and countermeasures in flight operations — derived from accurate data collection, then analyzed and shared with proven methods — opens the path to improved safety performance using valid metrics. The GSIP toolkits show how such improvements to safety performance indicators (SPIs) can be the most likely outcome in the aviation domain where you take responsibility for acceptable levels of risk.

Toolkit Introduction

Our *Data Collection Toolkit*, partly based on input to Flight Safety Foundation from focus group participants and/or workshop participants, envisions and advocates continual risk-management enhancements as a priority as important as updating your crewmember training or procedures in flight operations.

Other toolkit aims are responding to SDCPS stakeholders' calls in several countries for guidelines on automated and voluntary data collection at all levels of an organization to enable trustworthy and meaningful data analysis; coping with extremely high data volumes; involving neutral third parties in the data collection process; and adhering to data collection standards while enabling details to be customized to reflect each organization's likely risks. Also desirable, they told us, is an enhanced common technical language for SDCPS across the globe so that any stakeholder can easily exchange dependable information on risks, current status on SPIs and other best practices internally and at the level of individual aviation service providers, safety domains, states, regions and the whole world.

Collecting risk data for SDCPS has become the norm in several parts of the Asia Pacific and Pan America regions, FSF GSIP researchers found. Participants in focus groups and workshops, however, raised concerns about how effectively some stakeholders derive benefits from the collected data.

As noted, the quantity, complexity and/or unsuitability of data sources reportedly has been overwhelming at times. Some participants voiced a desire for a high level of global standardization in SDCPS practices to help them decide how to achieve the right balance of quality and quantity of data collected. Others said they struggle with the best ways to optimize data collection for assessment of their most critical risks. No participants said they already have an ideal overall perspective of risk data or the risk assessments that need to be performed as a high priority.

This toolkit's frameworks have been influenced by GSIP participants' experience that collecting large amounts of data, while simpler than ever with current information processing technology, can be pointless if they lack an objective risk-management strategy, fail to select suitable data or lack quality standards, possibly leading to flawed conclusions. A researcher at one research session summarized, "It is unclear to participants how to prioritize the disparate data types and to know which data types add the most value. SDCPS — which can involve voluminous, scattered and sometimes confusing analyses and conclusions — is no small transition for the aviation industry."

The hazards and risks that affect each flight are dynamic and fast-paced, making it difficult for some safety professionals — for example, some of those representing charter/on-demand air carriers, business aviation and helicopter operators — to collect data that clearly will support risk management. Even relatively small organizations are expected to utilize data to objectively and routinely assess SPIs. Others say they feel the strongest pressure to adopt best practices in risk management when introducing new aircraft types, technologies and systems — before discovery of a significant unknown risk surprises them.

In this toolkit, we suggest that all data sources within the industry can be categorized into three main areas defined below: public safety information, reportable occurrences and safety program information. Each category can be used alone or with others at some times to focus your efforts in risk management.

The category title *public safety information* refers to the collection and analysis of publicly available information to improve a stakeholder's SDCPS capabilities. Additionally, the stakeholder may study this information to identify lessons learned from historical occurrences to improve future operations. Public safety information is available from many sources such as Airbus, Boeing, the International Civil Aviation Organization (ICAO), the International Air Transport Association, civil aviation authorities and accident investigation authorities.

Reportable occurrences include information in reports about an operational event or hazard that meets the criteria defined by the state and requires documentation and/or investigation. This information is obtained primarily from internal data produced by investigators or safety analysts or from participation in an investigative process. Reportable occurrence data is typically collected in response to a relevant category of aircraft accident (e.g., controlled flight into terrain [CFIT]), serious incident (e.g., runway incursion) or significant air proximity event.

Safety program information is the result of an aviation service provider's internally generated and managed safety programs aimed at improving operational safety. This includes safety assurance programs with ongoing auditing or inspections of operational processes, and employee voluntary safety reporting programs. The title recognizes that an organization also will make use of any risk data generated from its own accidents, incidents or mandatory reports as part of its own state safety program or SMS.

As covered in detail in the *GSIP Toolkits Introduction,* you ideally will recognize the data collection by your organization as occurring along an intensity continuum (see the matrix on page 6). You can apply this concept to perform a self-assessment of your airline's, air navigation service provider's, airframe/engine manufacturer's or other entity's risk-management practices in relation to intensity levels defined by GSIP.

- When we say your organization performs at the first (basic) level of intensity, we mean that you collect risk data primarily to understand the most probable and significant threats your organization faces, according to SMS principles. This essentially involves comparing SPIs inside your organization in light of standards and recommended practices published by ICAO in Annex 19, *Safety Management,* or more specifically under your state's Annex 19–compliant civil aviation regulations and related guidance. If you work for a commercial air carrier, you are bound to gather data related to key accident categories such as loss of control–in flight (LOC-I), runway excursion, runway incursion, CFIT and midair collision, for example, but these are determined by looking at the most recent five- to 10-year history for your industry sector and any key SPIs noted by the civil aviation authority.
- As a safety professional conducting risk management at a second (higher) level of intensity, you also collect risk data to understand your organization's most probable and significant threats in relation to the known probable (i.e., primary) causes of accidents and to known hazardous aircraft states. Your risk management extends to comparing your SPIs with aggregate rates or trends of local peer organizations, or an entire subsector, regional sector or worldwide sector of the civil aviation industry. These can be determined by examination of a bow-tie diagram–based breakdown of each of your most relevant data streams. For example, this could prompt you to extend your data collection to capture flight crew errors/failures in operational communication during taxiway navigation as a primary driver of runway incursions.
- At a third (higher) level of intensity, your data collection efforts support understanding of your organization's most significant safety events in relation to probable causes and contributing factors. This might mean, for example, that your data collection must be extended to compliance with the standard operating procedures specifically related to operational communication during taxiway navigation as a contributing factor in runway incursions.
- At GSIP's fourth (top tier) of intensity, you apply the most far-reaching risk-management practices. You collect data appropriate for understanding the most prominent risks at the global level. One preferred way to do this is to ensure that data streams you establish reflect accident categories of internationally respected authorities, such as the U.K. Civil Aviation Authority and its Significant Seven bow-tie analyses of fatal accident types throughout commercial air transport. This might mean you extend your data collection to all of your key pathways on bow-tie analysis within an accident category. You then understand where your operational system interfaces with other organizations and what those organizations have in terms of occurrence rates that you can expect to encounter across your operations.

As also noted in the *GSIP Toolkits Introduction* — regardless of your organization's relative level of intensity — you can apply simple mathematical and statistical techniques to "reverse engineer" an unknown variable within a bow-tie diagram–based analysis. For example, you can calculate, from the probability of the specific threat and the probability of a known unsafe outcome, how effective the existing risk barriers will be.

Key Insights and Considerations

Our GSIP research in 2015 and 2016 identified how data collection practices tend to reflect a given organization's level of data-collection intensity (i.e., its collection scope and sophistication) among the range

of possible SDCPS capabilities available. From these, Flight Safety Foundation concluded that no single data-collection tool or methodology appears to completely meet all the needs and desired capabilities described by states and aviation service providers. Moreover, changes and operational effects during the global scientific/technological evolution can alter any stakeholder's anticipated requirements (including knowledge and skills) for effective data collection, and introduce new circumstances of data collection.

We recommend that you consider pursuing a two-phase course of action, given uncertainties about your organization's future needs and priorities. Establish (or confirm) first that your SDCPS conforms to standards and recommended practices of Annex 19, paragraph 5.1. Then, watch for best practices — as this website is updated — in applying elements covered in this *Data Collection Toolkit*, especially lessons added from practical examples to enhance your safety data collection over time. This should include familiarity, as noted, with public safety information, especially detailed breakdowns of accident/incident rates from international sources.

If your SDCPS function at GSIP's first level of intensity, focus first on collecting relatively basic data and information on known and potential hazards within your operations, including numbers and rates of safety occurrences and outcomes. We highly recommend that your data streams include information closely aligned with the major accident categories for your industry sector that can be found in existing public safety information. For example, in the commercial airline sector, the top categories are LOC-I, CFIT and runway safety.

Your organization should decide, for this level, how many categories are relevant to your operation. Such data/information streams also typically include voluntary safety reporting from your frontline staff. Presumably, your data sources always will include results of any investigations conducted on specially flagged events using regulatory criteria specified by your state's civil aviation authority. For large organizations, your data streams may include at least one specific safety metric for each operational division (i.e., maintenance, ground, in-flight/cabin).

If your SMS already functions or is beginning to function at the second intensity level, you typically will need to add data sources enabling a deeper look into the main drivers of your SPIs, etc. Airlines at this level, for example, typically utilize flight data monitoring data to delve into the main causes of their previously investigated events/subjects, or events/subjects that have been detected through unacceptable risks discovered by safety reporting systems. For large organizations, the data being monitored might be the primary causes behind trends in their operational safety metric. For example, maintenance safety analysts may be monitoring how often recent overnight maintenance work may have contributed to an air turn-back or diversion.

If your organization manages risk at the third intensity level (i.e., with a deeper and relatively sophisticated understanding of underlying factors), you likely will want to collect data on events/situations considered possible contributors to safety events anywhere. This begins to reveal "softer" (i.e., subtle) connections between quality and safety programs. Data may be monitored on fatigue factors and how they connect to your primary safety data streams.

If your organization manages risk at the highest intensity level, that indicates that you are using a framework like a bow-tie diagram–based analysis to understand what data you have, which helps you to understand the frequency of threats, the effectiveness of your barriers, the frequency of all relevant undesired aircraft states, your recovery effectiveness. It also indicates that you are seeking data to understand how your performance can compare with other comparable operations in your industry sector. The urgency of building a complete risk picture may not diminish until you (and senior executives) understand what is happening — i.e., what is the industry SPI baseline — in addressing the same issues as comparable organizations.

Consider the following factors — derived from GSIP surveys, focus group sessions and workshop discussions — in choosing exactly which types of data you will collect routinely from *external* sources. Find other aviation service providers' outcomes data, reflecting their current collective experience in similar flight operating environments. Obtain public safety information. Collect data matching the industry-wide risk and outcomes that you specify, as well as the industry-wide risk of undesired aircraft states

that you specify. Most importantly for data relevance and accuracy, collect data reflecting unwanted outcomes that your organization is most likely to encounter in flight operations. Again, do that in light of bow-tie analyses that you perform at an early stage — alone or with industry safety partners.

Consider the following factors in choosing which data to collect routinely from internal sources. Data from voluntary safety reporting programs (such as the non-punitive, FAA-approved aviation safety action programs in the United States) — offering a view of the frontline of flight operations like yours — can help you answer the question "What looks safe or unsafe?"

Also, check out sources of de-identified auditing/assessment results (especially those reflecting process conformity and process effectiveness) for an entire aviation service provider or perhaps one of its departments. Obtain data derived during internal investigations of events or risk-management issues. Collect data that capture deviations from current standard operating procedures and other operating norms. Track direct inspection programs in flight deck and cabin operations (including line operations safety audits/assessments), maintenance and ramp services. If you are affiliated with an airline or business aviation operator, arrange access to the de-identified flight data monitoring data streams and analyses of the selected parameters.

Lastly, consider pursuing safety-related quality assurance data and any type of auditing data — whether the source is internal or external. Summaries of these data are probably the best known documents within each aviation service provider yet may be incompatible with your needs, depending on the other organization's types of operation.

Another focus of current data collection, GSIP participants said, is how best to gain understanding of issues from multiple simultaneous data streams. Such systems hold promise of enhancing understanding of risks and of correlating events to reveal the greatest risks.

Community Insights

Over time, plans call for our *Data Collection Toolkit* to add links (under this subtitle) to detailed examples of international best practices in data collection as they relate to successful risk analysis, information sharing and safety information protection.

Such stories and lessons learned are among the most beneficial ways of communicating this knowledge and illustrating concepts for practical benefit. Across our set of GSIP toolkits, plans also call for incorporating data analysis illustrations for subjects such as risks involving route networks, topography and airport design. Data visualization examples also are being curated to show the latest ways that event data, rates and correlations between one data stream and others enhance comprehension and inspire replication.

Guidance Resources

Again, regarding international expectations for safety data collection in civil aviation, first check ICAO's standards and recommend practices — starting with Annex 19, *Safety Management.*

GSIP researchers have found that normalized rates of occurrence for just about any risk-management topic have been produced. Often they are available to share with safety professionals as discussed in our *Information Sharing Toolkit*.

Opportunities to Share

From the outset of GSIP, Flight Safety Foundation has requested permission to publish brief de-identified narratives, articles and illustrations about safety data collection experiences from aviation safety professionals and organizations. We welcome you and fellow *Data Collection Toolkit* visitors to take advantage of this website to share with peers worldwide how you have turned data collection theories into best practices. Hundreds of GSIP participants and many others will appreciate the chance to learn from your experiences, and we will follow FAA-FSF confidentiality standards on vetting materials and protecting your privacy.

Global Safety Information Project (GSIP)

Overview Matrix Of Intensity Levels

Risk management is a tool for decision making and improving safety performance. As it is executed, additional learning continues to take place, which expands our knowledge on hazards and our horizons of influence. GSIP recognizes this ever-expanding growth of risk management and therefore incorporates a level of intensity across our toolkits. The following chart includes a simplified version of the different levels of intensity across all risk management safety activities.

	SMS Core Level	Expanded Level	Advanced Level	Industry Level
Data Collection	Data are collected to adequately monitor the normal hazards an organization may encounter and to support a functioning SMS.	Data are collected to understand both the hazards and exposure to operations with those hazards (e.g., *flight data acquisition systems).*	Data are collected to advance understanding of primary causes and contributing factors (e.g., *monitored data through LOSA).*	Data are collected to utilize and contribute to a larger industry understanding through bow tie organization of events (e.g., *data collection with industry partners).*
Data Analysis	Data are analyzed to determine acceptable risks. Safety performance indicators with current status against objectives.	Data are analyzed to understand all direct hazards and their impact on undesired outcomes. Multiple hazards are each examined for their influence on risk.	Data are analyzed to understand all potential direct and indirect hazards and their impact on undesired outcomes.	Data are analyzed to understand all industry impacts on safety. The math behind paths leading to and from an undesired state are well understood.
Information Sharing	Information sharing of performance results is comprehensive within an organization (e.g., within one organization).	Information sharing of performance and key areas of linked performance is performed among divisions or industry peers at detailed levels (e.g., ANSP to ANSP).	Information sharing is across the industry for key risks and mitigations. Generally this is through presenting detailed independent investigative work in the data (e.g., ANSP to airline).	Information is shared and managed across the industry for benchmarking capabilities and emerging conditions. Cooperative analysis is conducted (e.g., pooled data).
Information Protection	Individuals and organizations are protected against disciplinary, civil, administrative and criminal proceedings, except in case of gross negligence, willful misconduct or criminal intent.	The protection extends to certain mandatory safety reporting systems. In Annex 13, the protection extends to final reports and investigation personnel.	Further protection mechanisms may be in place to implement just culture principles and cross-industry support for strong safety reporting cultures.	Protection is formalized at the highest level between countries through memorandums of understanding or similar agreements.

ANSP = air navigation service provider; LOSA = line operations quality assurance; SMS = safety management system

Appendix D

Data Analysis Toolkits

FLIGHT SAFETY FOUNDATION

GLOBAL SAFETY INFORMATION PROJECT

Data Analysis Toolkit

MARCH 2017

FLIGHT SAFETY FOUNDATION

GLOBAL SAFETY INFORMATION PROJECT

Data Analysis Toolkit

Welcome

Thanks for your interest in enhancing aviation safety data collection and processing systems (SDCPS). This toolkit conveys knowledge gained by Flight Safety Foundation about data analysis practices (an element of *data processing*) among aviation service providers — such as airlines, aircraft maintenance and repair organizations, and air navigation service providers — and civil aviation authorities in two world regions. We see opportunities to further standardize the work of data analysts as they address the most critical accident categories in commercial air transport, business aviation and other industry sectors.

Aviation service providers, the largest group of stakeholders, ideally will progress from basic to advanced stages of data analysis, much as their organizations evolve through the intensity levels discussed in the companion *Data Collection Toolkit* prepared by the Foundation's Global Safety Information Project (GSIP).

Aviation industry data analysts, at a minimum, monitor safety performance indicators (SPIs), which focus on the highest risks that need to be addressed across your organization, and formally declare their risk levels according to a standardized risk matrix (i.e., probability versus severity). Typically, you will later identify the main drivers and obstacles to improving SPIs, trace events that have driven trends and identify primary causes from sources such as accident reports and report summaries.

At subsequent advanced levels, you will look outside your organization to address the influences of operating conditions seen elsewhere and/or to thoroughly study investigative findings and contributing factors. We encourage you and every stakeholder — including regulators — to derive the most actionable mitigation plans possible in order to avoid becoming so mired in high-level theory that you never take concrete action.

Some aviation industry data analysts focus on data metrics chosen because of a known close relationship of the metric to an undesired state (in the terminology of bow-tie analysis), such as an undesired aircraft state. An undesired aircraft state is a condition that, in the absence of an adequate response, may lead to an unwanted outcome such as triggering a special warning to the flight crew, exceeding an operational limit or contributing to fatalities, injuries and/or damage in an accident. You

will supplement these data metrics with others that "fill in the picture" of your most likely range of issues/situations leading to undesired aircraft states, all eventually leading to risk mitigations.

The Right Analysis

Participants in our focus groups and workshops raised concerns about challenges they face in performing the "right" analysis, one that accomplishes the stated goals. For example, flawed analytical practices sometimes degrade results — or worse, intentionally non-objective techniques produce predetermined (favorable) results.

They noted that aviation service providers also discover valid but unexpected results from a particular choice of analysis. For example, a single report can identify a new hazard (whereas many reports usually are required), and, at other times, a new trend emerges as the most significant hazard. Both situations should be anticipated and addressed in your safety management system (SMS) or the SMS of your state safety program (SSP). Ultimately, a data analyst must produce credible evidence of whether the risk of the particular outcome is acceptable (that is, whether to stop operations, require monitoring or allow flights or other aviation operations to continue).

In several states, representatives of airlines told us that sometimes they cannot be confident about the accuracy of data trends that regulatory authorities generate from airline data. This may introduce uncertainty as to which risk-analysis techniques work best when introducing new aircraft types, new technologies and systems.

Other challenges in achieving the right analysis are conflicts in terminology and taxonomies that interfere with data analysts properly classifying data or analytical results for comparability; effects from varying quality and quantity of data that are not considered adequately; and de-identification of data (which some call *filtering*) that protects source confidentiality to the extent of constraining or blocking analytical insights.

Other issues mentioned included insufficient data-mining capabilities (possibly limited by restrictions in public safety information); lack of scalable data analysis methods to enable industry-wide results to be applied by individual operators; and missed opportunities to collaboratively identify systemic hot spots. Flight data monitoring programs, despite strong endorsement by chief executive officers, have some of the most complex data parameters and the most difficult challenges for effective analysis, airlines said. While these programs have the potential to identify exceedances across a number of event sets, it takes extensive time and effort to customize these programs to an organization's operational norms, they said.

Other stakeholders described stark imbalances in which the *data collection* activities take precedence over *data analysis* capabilities. The GSIP researchers concluded in part, "The organization and analysis of a large volume of data can heavily consume both time and resources. This can make reaching accurate conclusions difficult. Financial and human resource limitations also impact data analysis. There are a limited number of SDCPS specialists [in some states] with adequate educational qualifications and applicable work experience."

We have highlighted concepts and best practices in this toolkit to help you make tactically sound choices about how to analyze data collected within your SMS, including risk management within your state safety program, based on information shared with GSIP researchers and on the FSF proposals.

Traditionally, inspectors and auditors looked for a system's absolute compliance with a regulatory requirement as the principal countermeasure to aviation threats and errors. Today, a major role of data analysis is to predict the effectiveness of barriers through analysis of data metrics. (The effectiveness of relying on regulatory compliance versus barrier effectiveness metrics has not been established.)

Toolkit Introduction

This *Data Analysis Toolkit*, partly based on input to the Foundation from participants in focus groups and workshops, responds to SDCPS stakeholders' requests for a harmonized taxonomy and

terminology for SDCPS across the globe so that every stakeholder can easily exchange replicable, real-world examples of SPIs, safety performance targets, bow-tie diagram–based analyses, and other best practices.

Analyzing safety data has become the norm among airlines in several parts of the Asia and Pacific and Pan America regions of the world, GSIP researchers found. Some GSIP participants said they strongly favor a high level of global standardization in SDCPS practices in data analysis, including related quality standards. Over time, we intend for the *Data Analysis Toolkit* to further explore existing best practices, especially how to consistently capture significant insights from flight data monitoring processes.

As explained in the *GSIP Toolkits Introduction*, some aviation safety professionals find it helpful to perform data analysis for their organization with awareness of the intensity level continuum (see the matrix on page 6). We likewise recommend self-assessments over time of your risk-management practices while keeping in mind the intensity levels defined for GSIP.

- As with each of our toolkits, GSIP proposes common terms to describe a progression in the intensity level of any SDCPS. If your organization is operating at the first level, you are routinely conducting basic-analysis activities to display your rate of occurrence on key SPIs against a specific target and against past performance levels. For example, if your organization has an SPI for resolution advisories from traffic-alert and collision avoidance systems (TCAS RAs), you regularly calculate performance in this area against your organization's current annual safety performance target for TCAS RAs.

  Your organization also continually conducts risk assessments on any newly discovered hazards. Each risk assessment indicates whether mitigations are required and, if so, which person or department is responsible for managing the risk and taking necessary mitigation actions. Organizations generally use an internally generated, but standardized, risk matrix to determine acceptable levels of risk, levels that require ongoing monitoring as risk mitigations continue, and levels that are unacceptable for operations until an effective mitigation is in place.

- If your organization is operating at the second (higher) intensity level, you calculate rates from other data that contribute to the top-level SPIs. At this level, your organization can track and plot performance based on the dependent conditions that create, for example, the TCAS RA events. TCAS RA events may be driven by hearback and readback types of air traffic controller–pilot clearance miscommunication. The appropriate analysis to be conducted in this situation would outline all the specific causes of TCAS RAs experienced throughout the reviewed period. The analysis can include examining hot spot areas overlaid on a navigational chart or airport diagram. It also can include basic breakouts (subfactors) of key situations that lead to a TCAS RA.

- If your organization is operating at the third intensity level, you generate more mathematical and statistical indicators of the effectiveness of some of your barriers to an undesired state through your safety assurance data. These may combine sources such as flight data monitoring, line operations safety audits/assessments and inspections. These efforts indicate where you will find specific weaknesses to be addressed in each set of barrier processes. Generally, it is a difficult task to make a complete determination of barrier effectiveness and to understand your degree of compliance with standard operating procedures prior to TCAS RA events. Statistical controls also can be applied to a number of barriers by establishing performance requirements to meet acceptable levels of undesired aircraft states.

- The fourth GSIP intensity level means that you understand, to the most complete extent in bowtie-analysis language, all the barriers and the recovery effectiveness — at the entire-industry scale and in cooperation with state, regional and global regulators and with the world community of aviation service providers. This may only be possible when your analysis is conducted in a collaborative method with all responsible stakeholders.

In some countries or regional groups, gathering industry results and publishing collective performance information from many participants gives the best sense of the risks to the commercial aviation industry, for example. Issues like TCAS RA hotspots can be understood to a much greater degree and lead to mitigation efforts that are based on a wide range of experiences.

Your starting point likely will be assuring that data analysis for your SDCPS occurs in accordance with standards and recommended practices published by the International Civil Aviation Organization (ICAO) in Annex 19, *Safety Management,* or more specifically under your state's Annex 19–compliant civil regulations and related guidance.

Key Insights and Considerations

As noted in the *GSIP Toolkits Introduction* — regardless of your organization's level of intensity — you can calculate and predict, from the probability of the specific threat and the probability of a known unsafe outcome, how effective your existing barriers will be.

That document strongly recommends taking advantage of the power of *bow-tie diagram* methodology in your SDCPS. This is an appropriate and readily understandable framework for analyzing data streams, and it is compatible with your data collection, data analysis, information sharing and information protection activities. In data analysis, this method is especially worth considering because of what the diagram reveals across the most prominent accident paths (i.e., links through a bow-tie analysis) that you study.

Studying bow-tie diagram connections (interrelationships) among threats, undesired aircraft states, barriers/barrier failures, recovery actions/recovery failures and outcomes on the diagram enables you to take a quantitative approach. That is, you calculate numerical scores accounting for severity and probability, avoiding problems of a more subjective/qualitative approach. Because mathematics and statistical probability can connect any accident path to any undesired outcome on a bow-tie diagram, you can readily determine the highest priorities for risk mitigation. The bow-tie diagram also provides a top-down look, giving you the best picture of key accident paths — and what further data and studies are necessary.

Adopting this method begins to generate a top-down look at your SMS, showing where you need to plan to have an audit/inspection, where you need to obtain safety performance feedback and data, and how you will manage the resulting risk register. For commercial air transport stakeholders, we noted in our *Data Collection Toolkit* that the U.K. Civil Aviation Authority has published template bow-tie diagrams for its Significant Seven accident categories (airborne conflict, controlled flight into terrain, airborne or post-impact fire, ground handling, loss of control, runway excursion and runway incursion). These bow-tie diagrams can serve as a data-analysis starting point for any aviation service provider or regulator studying these or other accident categories.

By determining which data streams are crucial to understanding your highest-risk issues, your own bow-tie diagrams will point you to the necessary data and analyses. You can start with the currently known, fatal accident risk numbers, then work back through accident/incident data, data from mandatory occurrence reporting, and eventually voluntary safety reporting data. This yields what you can expect to see in your actual risk and SPIs. In many ways, the data collection requirements may grow through iterative steps as your analysis strengthens.

In short, bow-tie diagrams provide preliminary understanding of the areas of analysis within your SMS (or the SMS of your SSP), including a deep look into key connections between your barrier effectiveness and undesired aircraft states. The diagram serves as an objective basis for refining data collection, enhancing audit and inspection programs, and calculating the overall barrier effectiveness in some accident paths.

From these diagrams, you can determine where additional collaborative work is indicated, encouraging stakeholders to come together to share and exchange data relevant to the specific diagram and accident paths. This is important because no individual stakeholder likely will be able to assume

responsibility for all threats, barriers and recovery actions. Watch for examples of fellow stakeholders' other best practices for data analysis in the *Data Analysis Toolkit* as this website is updated.

Community Insights

Over time, plans call for our *Data Analysis Toolkit* to add links (under this subtitle) to include detailed examples of international best practices in risk analysis, as well as references to information sharing and the importance of safety information protection.

Such stories and lessons learned ideally will incorporate data analysis illustrations for subjects such as assessing risks through airline self-assessments and external auditing. Data visualization examples also are being curated to show the latest ways that event data, rates and correlations between one data stream and others enhance comprehension and inspire replication.

Guidance Resources

Regarding international expectations for safety data analysis in civil aviation, as noted earlier, first check ICAO's standards and recommended practices — starting with Annex 19, *Safety Management.*

GSIP researchers find that normalized rates of occurrence have been produced for just about any risk management topic. Therefore, success in making valid comparisons during data analysis is increasingly likely. Often, the normalized rates are available to share with safety professionals as discussed in our *Information Sharing Toolkit*.

Opportunities to Share

From the outset of GSIP, Flight Safety Foundation has requested permission to publish brief de-identified narratives, articles and illustrations about safety data analysis experiences from aviation safety professionals and organizations. We welcome you and fellow Data Analysis Toolkit visitors to take advantage of this website to share with peers worldwide how you have turned generic data analysis techniques into best practices that fit your organization. Hundreds of GSIP participants and many others will appreciate the chance to learn from your experiences, and we will follow confidentiality standards recommended by the U.S. Federal Aviation Administration and Flight Safety Foundation on vetting materials and protecting your privacy.

Global Safety Information Project (GSIP)

Overview Matrix Of Intensity Levels

Risk management is a tool for decision making and improving safety performance. As it is executed, additional learning continues to take place, which expands our knowledge on hazards and our horizons of influence. GSIP recognizes this ever-expanding growth of risk management and therefore incorporates a level of intensity across our toolkits. The following chart includes a simplified version of the different levels of intensity across all risk management safety activities.

	SMS Core Level	Expanded Level	Advanced Level	Industry Level
Data Collection	Data are collected to adequately monitor the normal hazards an organization may encounter and to support a functioning SMS.	Data are collected to understand both the hazards and exposure to operations with those hazards (e.g., *flight data acquisition systems).*	Data are collected to advance understanding of primary causes and contributing factors (e.g., *monitored data through LOSA).*	Data are collected to utilize and contribute to a larger industry understanding through bow tie organization of events (e.g., *data collection with industry partners).*
Data Analysis	Data are analyzed to determine acceptable risks. Safety performance indicators with current status against objectives.	Data are analyzed to understand all direct hazards and their impact on undesired outcomes. Multiple hazards are each examined for their influence on risk.	Data are analyzed to understand all potential direct and indirect hazards and their impact on undesired outcomes.	Data are analyzed to understand all industry impacts on safety. The math behind paths leading to and from an undesired state are well understood.
Information Sharing	Information sharing of performance results is comprehensive within an organization (e.g., within one organization).	Information sharing of performance and key areas of linked performance is performed among divisions or industry peers at detailed levels (e.g., ANSP to ANSP).	Information sharing is across the industry for key risks and mitigations. Generally this is through presenting detailed independent investigative work in the data (e.g., ANSP to airline).	Information is shared and managed across the industry for benchmarking capabilities and emerging conditions. Cooperative analysis is conducted (e.g., pooled data).
Information Protection	Individuals and organizations are protected against disciplinary, civil, administrative and criminal proceedings, except in case of gross negligence, willful misconduct or criminal intent.	The protection extends to certain mandatory safety reporting systems. In Annex 13, the protection extends to final reports and investigation personnel.	Further protection mechanisms may be in place to implement just culture principles and cross-industry support for strong safety reporting cultures.	Protection is formalized at the highest level between countries through memorandums of understanding or similar agreements.

ANSP = air navigation service provider; LOSA = line operations quality assurance; SMS = safety management system

Appendix E

Information Collaboration Toolkits

FLIGHT SAFETY FOUNDATION

GLOBAL SAFETY INFORMATION PROJECT

Information Sharing Toolkit

MARCH 2017

FLIGHT SAFETY FOUNDATION

GLOBAL SAFETY INFORMATION PROJECT

Information Sharing Toolkit

Welcome

Thanks for your interest in enhancing aviation safety data collection and processing systems (SDCPS). Information sharing for risk management is now necessary and inevitable. Sharing amplifies what your safety management system (SMS) processes alone can achieve in the real-time risk mitigations of daily operations, and reaches far beyond SMS to longer-term, collaborative initiatives that increase your awareness of risks everywhere.

This toolkit — a product of the Global Safety Information Project (GSIP) — concentrates on best practices of civil aviation authorities and aviation service providers — such as airlines, airports, air navigation service providers (ANSPs) and aviation maintenance and repair organizations — in information sharing. Flight Safety Foundation studied these best practices in 2015–2016 within the Asia and Pacific and Pan America regions. We urge all aviation safety professionals to consider the leading methods of data-derived information sharing to accomplish your own goals and the world's common interest in risk management.

The Foundation first encourages strong SMS processes, then sees information sharing as a critical complementary process in an effective SDCPS. We expect that organizations like yours will continue to set annual objectives, such as specific measurable progress steps on safety performance indicators (SPIs), while collaborating with external counterparts to build robust information-sharing and comparative/benchmarking agreements, policies, procedures and technical platforms for analyzing risk data that will lead to effective mitigations of high-priority risks.

This toolkit also is part of the Foundation's effort to help the aviation industry make the most of SDCPS in the near future, bolstered by the strong safety information protection measures covered in GSIP's companion *Information Protection Toolkit*.

We also believe that beyond commercial air transport, certain underserved aviation industry sectors — for example, business aviation, charter/on-demand air carriers and helicopter operators — will benefit from information sharing and that existing practices likely will be translatable/adaptable by the other sectors without reinventing methods or safeguards.

Information sharing by aviation service providers has been increasing steadily within the two regions visited. Globally, subject matter experts say, the commercial aviation sector of the aviation industry could make significant strides by enhancing practical applications of the information sharing component of SDCPS. Aviation service providers already influence, and are influenced by, civil

aviation authorities, regional aviation safety groups, trade associations, manufacturers and other stakeholder organizations and sectors.

Updates of this toolkit will cover fundamental issues, challenges and solutions in information sharing to help you to identify high-value opportunities and to join initiatives well matched to your risk management priorities.

Toolkit Introduction

Information sharing is intended to give you a broader perspective on risk, especially to detect hazards that may not be visible through your normal data streams. This practice triggers questions such as: What information should be shared between our airports and our airline? What information should be shared between airlines? What information should be shared among air navigation service providers? What information or data should be contributed by aviation service providers and by regulators to an objective third party for purposes of wider influence and joint analysis efforts?

The International Civil Aviation Organization (ICAO) expects these stakeholders' risk-management opportunities to thrive using standards and recommended practices for information sharing. One relevant recommendation says, "If a State, in the analysis of the information contained in its database, identifies safety matters considered to be of interest to other States, that State should forward such safety information to them as soon as possible." ICAO also says, as part of another recommendation, "Each State should promote the establishment of safety information sharing networks." Similarly, ICAO's Global Aviation Safety Plan positions safety information sharing as a practice meant to expand progressively among states as SPIs evolve, terminology and taxonomies become harmonized and state safety programs meet SDCPS objectives.

The *Information Sharing Toolkit*, partly based on input from focus group participants and subsequent feedback to our proposals from workshop participants, is a response to the participants' strong interest in forming relationships in which peers can benefit from the experiences of others. Like the participants, you may be open to creating/joining processes and venues to boost awareness of real-world examples of aspects such as choosing and analyzing SPIs, setting safety performance targets, using bow-tie diagram–based analyses, and other best practices.

As summarized in the companion *GSIP Toolkits Introduction, Data Collection Toolkit* and *Data Analysis Toolkit,* whether and how you agree to provide and to receive data-derived information may depend on what GSIP proposals call the *intensity level* of your SDCPS at a particular time in relation to peers and to other like-minded stakeholders (see the matrix on page 6).

- As in all GSIP toolkits, this one describes evolution of the aviation industry through the intensity levels. We envision stakeholders self-ranking their GSIP intensity level beginning with the most basic capabilities of an SDCPS. At this first level, information is generally handled and shared by one department or a work group within the organization, and people are assigned to develop the risk mitigations/solutions made within that organization. An SMS will lack effectiveness if the SPIs and the analysis of metrics are not shared with the people who have the ability to directly influence performance.
- At the second (higher) intensity level, your organization may be sharing information for risk management/familiarization across multiple work groups within one organization, or between peer stakeholders. This sharing of both the performance and the improvement actions increases the influence those mitigations exert on other divisions and other organizations.

  If you can make a clear case for how your data analysis led to a specific mitigation that proved effective, other stakeholders are likely to adopt that practice or conduct a similar analysis of their operations. Sharing of such results often occurs at aviation safety conferences. Some safety professionals say these are the predominant venues where SMS risk-management interfaces occur. For example, one airline shares information on aircraft damage SPIs. That information also may be tracked by

several airports. At some point, these two aviation service providers also may exchange details of their results and actions related to their data analyses.

- At the third intensity level, stakeholders conduct data-derived information sharing across an entire organization, a geographic region or several sectors of the aviation industry to assure wide understanding of their methods and the implementation of related risk mitigations (e.g., peer to peer among stakeholders). This could be through structured or unstructured means. *Structured* refers to common definitions of performance calculations while *unstructured* means simply speaking to a specific risk study and explaining the results. At this level, any number of aviation service providers may share their SPI results and their stories of mitigation successes and remaining challenges.

  The SPIs can be from a defined, standardized formula that all stakeholders adhere to separately under their own analysis programs. This offers at least a preliminary baseline view of performance for many service providers. Most often, this kind of information sharing is done with specific arrangements and is strictly confidential under agreements between the parties.

- At the fourth intensity level, your organization shares data-derived information within a category of aviation service providers and with civil aviation authorities to understand more about priority risks in the industry using the most sophisticated methodology, datasets/samples and risk mitigations.

- Quite often, parties under these agreements contract with a specialized information technology service to take raw data from many stakeholder organizations and to assemble key performance metrics throughout the industry. This enables the greatest degree of consistency for safety performance calculations. The approach also provides the most sophisticated capability for service providers to examine performance against a standardized — so-called "blind" (unbiased) — benchmark.

  As a rule, this intensity level is possible only under strictest safety information protection agreements with equally strict governance and operating policies for its participants. At this level, key performance metrics — often those very close to inducing undesired aircraft states — can be fully examined. For example, data-derived information about loss of control–in flight precursors — such as aircraft overbank SPIs and approach-to-stall SPIs — can be understood by the industry across specific equipment and sectors of operation.

Key Insights and Considerations

As safety information sharing expands throughout the world, the analytical power of bow-tie diagram–based analyses likely will reveal trends and patterns that show up in nearly every accident category. By applying appropriate techniques summarized in our *Data Analysis Toolkit*, you can determine where additional collaborative work and information sharing are indicated. The bow-tie techniques encourage stakeholders to come together to contribute de-identified operational data relevant to the specific bow-tie diagram and accident paths. They also make clear how the involvement of multiple stakeholders makes it possible to collectively assume responsibility for all threats, barriers and recovery actions.

Watch for new examples of stakeholders' other best practices for information sharing as this website is updated.

Beliefs about safety information sharing can key off an assumption that if even more safety data were available for the stakeholder to analyze, the stakeholder automatically would be able to learn more. But we cannot count on scenarios in which such an increase in analytical power occurs immediately, or at all.

*I*nformation sharing so far has enabled stakeholders to accomplish or enhance SPIs and to review the following: SPI status against performance targets, actions for improved performance (to meet a target for an SPI), SPI status compared with other similar organizations and operations, pooling data

with others for structured analysis, structured information exchange of risk data with other organizations, sharing data via components of a bow-tie diagram–based analysis, publishing lessons learned from outcomes of mitigation efforts, sharing from regulator to aviation service provider, sharing among peer aviation service providers, and sharing among business partners or industry sectors.

Looking toward the near future, stakeholders participating in GSIP express the following needs and expectations: guidelines on who should manage data sharing and aggregated data analysis; guidelines on what data should be shared and in what formats; and industry-wide education on the purpose of data sharing, what resultant information is currently shared, and how the data and information are being analyzed. They also seek advanced techniques for aggregate-data analyses — including how to set safety baselines (benchmarks) and how to extend compatible data sharing technologies and processes across state boundaries.

In the Pan America region, for example, the Foundation learned that de-identified data and analytical results (safety information) are being shared within aviation service providers, operator-to-operator, ANSP-to-ANSP and operator-to-regulator. Information sharing occurs through meetings, forums, exchange programs, airline alliances and programs of civil aviation authorities.

Standards exist for information sharing that outlines the data types, trends and statistics required from stakeholder groups. Some regulators are collecting and analyzing shared data and holding conferences in which their expert feedback is provided regarding the results of various analyses. Feedback is also provided to organizations about current legislation, associated benefits and recommendations for risk mitigation in this context. Nevertheless, the civil aviation regulators tend to have limited access to the data being collected by operators because SMS is not fully implemented throughout Pan America, they said, and regulators have difficulty validating the data and information they receive during information sharing.

The degree to which civil aviation authorities support or conduct data sharing varies greatly within world regions, GSIP focus group participants said in 2015. Some regulators support data sharing via their own audits or inspections of aviation service providers and via ICAO assessments of state safety oversight, while other regulators either cannot or will not promote data sharing. The latter may involve safety culture issues or stakeholder concerns about punitive uses during regulatory oversight. Such local limitations often affect openness to information sharing beyond national or regional borders, they said.

Over time, plans call for our *Information Sharing Toolkit* to add links (under this subtitle) to include detailed examples of international best practices in data-driven collaboration, including references to critically important factors in safety information protection.

We hope that your stories, presented anonymously, along with lessons learned and testimonials on this website, will convey the success-factor details involved in information sharing. Examples of the data-visualization aspects of information sharing also are being curated to show the latest ways that aggregated event data, event rates and correlations of findings across data streams increase everyone's understanding and inspire replication.

Guidance Resources

Regarding international expectations for safety data sharing in civil aviation, first check ICAO's standards and recommended practices, starting with Annex 19, *Safety Management.*

Some of ICAO's most relevant requirements and guidance to states regarding safety information sharing also provide valuable background for aviation service providers. These are in Annex 13, *Aircraft Accident and Incident Investigation*, in Annex 19 and in the *Code of Conduct on the Sharing and Use of Safety Information* (see Appendix E). Sources of data encompass public safety data (such as official reports of accident investigations and annual compilations of accident types, numbers, rates and trends), reportable occurrences, and safety program information (such as employee voluntary safety reports).

Other sources of information about current and future information sharing practices are publications by the U.S. Federal Aviation Administration's (FAA's) Aviation Safety Information Analysis and Sharing (ASIAS) program. This is a prime example of a collaborative and confidential government-industry process designed to detect event probabilities that individual service providers could not detect by themselves. ASIAS has been designed to help stakeholders to think objectively about whether a risk discovered is acceptable or unacceptable (i.e., whether it requires new or enhanced mitigations). The process currently is being used, for example, to study events involving flight crews' flap misconfigurations for takeoff.

As one of the aviation industry's most-watched international programs, ASIAS has proved that it is possible to incentivize airlines to join very large and secure information exchanges that allow for continuous analysis, special studies and querying of data in a shared data pool (a massive network of networks). One benefit, as noted, has been that participants are exposed to new forms of data collection and analysis that otherwise would be invisible to individual organizations.

Opportunities to Share

From the outset of GSIP, Flight Safety Foundation has requested permission to curate and publish de-identified narratives about information sharing, drawing from experiences of other aviation safety organizations and professionals. We welcome you and fellow *Information Sharing Toolkit* website visitors to take advantage of this chance to advance and enrich the knowledge of your counterparts worldwide.

Others want to learn, for example, how you share/contribute de-identified, aggregated and other forms of information from flight data monitoring of routine operations, air traffic management safety data, aircraft maintenance and repair irregularities, internal accident/incident studies, audits/assessments, employee voluntary safety reporting systems and other confidential sources. Hundreds of GSIP participants and other individual stakeholders will appreciate the chance to learn from you and to share with you in return. GSIP will follow FAA-FSF confidentiality standards on vetting information if needed and protecting your privacy.

Global Safety Information Project (GSIP)

Overview Matrix Of Intensity Levels

Risk management is a tool for decision making and improving safety performance. As it is executed, additional learning continues to take place, which expands our knowledge on hazards and our horizons of influence. GSIP recognizes this ever-expanding growth of risk management and therefore incorporates a level of intensity across our toolkits. The following chart includes a simplified version of the different levels of intensity across all risk management safety activities.

	SMS Core Level	Expanded Level	Advanced Level	Industry Level
Data Collection	Data are collected to adequately monitor the normal hazards an organization may encounter and to support a functioning SMS.	Data are collected to understand both the hazards and exposure to operations with those hazards (e.g., *flight data acquisition systems).*	Data are collected to advance understanding of primary causes and contributing factors (e.g., *monitored data through LOSA).*	Data are collected to utilize and contribute to a larger industry understanding through bow tie organization of events (e.g., *data collection with industry partners).*
Data Analysis	Data are analyzed to determine acceptable risks. Safety performance indicators with current status against objectives.	Data are analyzed to understand all direct hazards and their impact on undesired outcomes. Multiple hazards are each examined for their influence on risk.	Data are analyzed to understand all potential direct and indirect hazards and their impact on undesired outcomes.	Data are analyzed to understand all industry impacts on safety. The math behind paths leading to and from an undesired state are well understood.
Information Sharing	Information sharing of performance results is comprehensive within an organization (e.g., within one organization).	Information sharing of performance and key areas of linked performance is performed among divisions or industry peers at detailed levels (e.g., ANSP to ANSP).	Information sharing is across the industry for key risks and mitigations. Generally this is through presenting detailed independent investigative work in the data (e.g., ANSP to airline).	Information is shared and managed across the industry for benchmarking capabilities and emerging conditions. Cooperative analysis is conducted (e.g., pooled data).
Information Protection	Individuals and organizations are protected against disciplinary, civil, administrative and criminal proceedings, except in case of gross negligence, willful misconduct or criminal intent.	The protection extends to certain mandatory safety reporting systems. In Annex 13, the protection extends to final reports and investigation personnel.	Further protection mechanisms may be in place to implement just culture principles and cross-industry support for strong safety reporting cultures.	Protection is formalized at the highest level between countries through memorandums of understanding or similar agreements.

ANSP = air navigation service provider; LOSA = line operations quality assurance; SMS = safety management system

Appendix F

Information Protection Toolkits

FLIGHT SAFETY FOUNDATION

GLOBAL SAFETY INFORMATION PROJECT

Information Protection Toolkit

MARCH 2017

FLIGHT SAFETY FOUNDATION

GLOBAL SAFETY INFORMATION PROJECT

Information Protection Toolkit

Welcome

Thank you for your interest in enhancing aviation safety information protection (SIP). The protection of safety data and safety information is critical to ensure that they remain available to your safety data collection and processing system (SDCPS), helping your organization to identify known and potential risks to flight operations and to effectively mitigate the risks.

This toolkit is a product of Flight Safety Foundation's Global Safety Information Project (GSIP) and primarily aims at providing all SDCPS stakeholders — at the regional, state, government agency and corporate levels — guidance on complying with existing and upcoming International Civil Aviation Organization (ICAO) standards and recommended practices (SARPs) for SIP.

The toolkit's website-based content <flightsafety.org/gsip> will also contain Foundation-developed best practices for SIP that are suitable for various service providers — such as aircraft operators in domestic and international commercial air transportation, approved maintenance and repair organizations providing services to operators, approved training organizations, organizations responsible for type design or manufacture of aircraft, air traffic service providers, and airport operators.

To briefly summarize our primary scope, ICAO's existing and upcoming SARPs provide stakeholders (i.e., service providers and civil aviation authorities [CAAs]) with principles of protection and principles of exception. They also require stakeholders to protect against the public disclosure of safety information; to have a competent authority that balances the interests of safety and the need for the proper administration of justice; and to apply appropriate safeguards to ensure safety information is protected.

With these requirements in mind, and with advice from international experts in the legal aspects of safety, the Foundation has analyzed SIP in the ICAO-defined Asia and Pacific Region and in the Pan America Region. Our analysis included studying the differences between current SIP practices and the ICAO SARPs, and developing this toolkit to assist stakeholders around the world with required and recommended SIP-implementation methods.

We believe that SIP should be implemented by the appropriate government organizations in your country and by the aviation organizations for which the government conducts regulatory oversight or has another type of authority. At the national level, the Foundation agrees with ICAO's recommendation that states must implement rules to provide a protection framework not only for CAAs and service providers but also for a very broad range of aviation stakeholders — including, for example, law

enforcement agencies and accident investigation authorities. Within organizations, policies should be in place to protect programs such as employee voluntary safety reporting and flight data monitoring.

Similar to the three SDCPS-focused toolkits on our website, our plan for this *Information Protection Toolkit* calls for increasingly advanced guidance and recommendations to states and service providers; capability to capture your feedback and to share feedback from other toolkit users with you; and a repository of stakeholders' de-identified SIP experiences and best practices.

Note that this toolkit, like the other GSIP toolkits, distinguishes the term *safety data* from the term safety information in a manner similar to the typical distinction in ICAO documents (i.e., aviation organizations typically collect safety data comprising discrete or irreducible elements such as numerical values and, by analytical processes, transform these data into valuable safety information). This toolkit addresses not only the protection of both safety data and safety information but also protection for the related sources, as provided in ICAO's principles of protection.

Based on international research and promotion by our experts in legal aspects of aviation safety — and on discussions and participant surveys in the two regions during FSF GSIP focus groups and toolkit-development workshops in 2015 and 2016, respectively — the Foundation became aware of various stakeholders' perspectives of SIP. Among these, we heard that information protection by CAAs, service providers and other aviation stakeholders remains a serious challenge today in many of the countries visited. We believe that addressing stakeholders' specific legal, regulatory, technical, cultural and practical impediments is essential because SIP is a key element of every SDCPS component: data collection, data analysis and information sharing.

Further updates to the *Information Protection Toolkit* are planned during 2017 to provide adaptable, interactive training modules that can help you — and can help fellow stakeholders who have different needs — to better understand and implement SIP. These modules will be able to be readily tailored to the whole range of potential users. This could extend from the smallest service provider responsible for implementing SIP as part of its safety management system (SMS) to a large CAA providing training and education to judicial and law enforcement authorities in the context of a state safety program (SSP).

To sum up, as noted in the *GSIP Toolkits Introduction,* our set of toolkits serves as an architecture to facilitate further communication. That is our first goal. This means the website enables us to link you to other programs and resources to help you gather practical concepts and implementation methods suitable for your organization such as guides for handling sensitive data, model regulations and legislation.

Our second goal is to interact appropriately with toolkit users as a trusted independent organization, capturing your experiences and questions for the benefit of a network of people facing common SIP issues. Your input about putting structures in place to protect safety data and safety information — and sharing your documented outcomes — holds promise of being extremely valuable.

Getting to Know ICAO SARPs for SIP

The *Information Protection Toolkit* will be refreshed as needed to help your aviation safety specialists, whether at a CAA, service provider or other concerned organization, to better understand which SIP practices fall under Annex 13, *Aircraft Accident and Incident Investigation,* and which fall under *Annex 19, Safety Management.* Each annex provides a separate, yet complementary, framework to protect safety data and safety information.

Annex 13 contains the SIP-related SARPs most relevant to aircraft accident and incident investigations, while Annex 19 contains the protection-related SARPs for a service provider's SDCPS and the specific SARP provisions related to the SSP of a country.

Specifically, as we add them, you will find synopses of the definition of SIP and the key elements of SIP, as well as SIP laws and regulations; policies; model advance arrangements and information safeguards; and education and training programs for CAAs, service providers, judicial authorities, government leaders and the global legal community. Our plans for 2017 also call for a periodically

updated SIP timeline, highlighting milestones such as ICAO's recognition of the need for SIP, and the development of the basic SIP framework as initially published in Annex 13 and Annex 19.

SIP Intensity Levels

In the *GSIP Toolkits Introduction* and in the three other GSIP toolkits, Flight Safety Foundation proposed intensity levels as a highly useful concept and terminology for every stakeholder to self-identify and to improve its SDCPS capabilities over time. We hope to settle by early 2017 on a similarly clear and simple way to categorize a stakeholder's capacity to employ SIP, to self-assess the differences among organizations in SIP-related sophistication and initiatives, and to openly discuss what is happening in the local, national, regional or global SIP domains over time.

Currently, we envision a set of SIP intensity levels requiring different descriptive narratives compared with those related to SDCPS. Based on FSF research and analysis of ICAO's SARPs, the observations of our collaborating experts in the legal aspects of aviation safety and discussions of the current SIP implementations in Asia Pacific and Pan America, we are proposing four intensity levels as follows:

- At the first intensity level, the typical service provider or CAA characterizes its sophistication and performance only in relation to adhering to all the SIP-related standards of Annex 19. This essentially means taking steps that help to protect aviation professionals against inappropriate uses of safety data and safety information that lead to disciplinary action by the employer, criminal prosecution, CAA certificate action or related punitive actions outside internationally recognized principles of just culture.
- At the second intensity level, the typical service provider or CAA characterizes itself as adhering to the same requirements as in the first intensity level, but additionally implements a policy and procedures that shield aviation professionals, such as protection from punitive actions based upon certain types of mandatory occurrence reporting of safety issues. The strongest argument for protection of some mandatory occurrence reports is that of resolution advisories from traffic-alert and collision avoidance systems (TCAS RAs) and warnings from terrain awareness and warning systems (including Enhanced Ground-Proximity Warning Systems [EGPWS]). There may be other comparable safety issues that are not always monitored, detected or recorded from outside the flight deck. Protection of safety information recorded automatically and consistent reporting by aviation professionals can encourage full reporting and lead to everyone's greater awareness of the existence of these events. Historically, the world's airlines have found underreported levels of TCAS RAs and EGPWS warnings in both their employee voluntary reporting programs and their mandatory occurrence reporting. SIP measures exceeding those at the first level may promote the awareness made possible by flight data monitoring programs. Information protection inherent in those programs typically has not extended to all the types of mandatory occurrence reporting where high volumes of reports are received and CAA investigations may lead to punitive action. (For SSPs, Annex 19 recommends similar protection of certain required safety reports.)
- If we reach a consensus about the need for a third intensity level, the typical CAA, and potentially a service provider, would characterize itself as adhering to the same requirements as in the first two intensity levels. In addition, the protections would apply to specific cases that would encourage global adoption of just culture principles. This would facilitate a CAA's recognition of situations in which the need to know about all safety events that occur, the need to maximize the benefits of SIP to fully understand the risks, and that safety outweighs any benefit of taking punitive action against aviation professionals based on this safety information.
- If we reach a consensus about the need for a fourth intensity level, the CAA would characterize itself as adhering to the same requirements and to similar recommendations as in the first three intensity levels. In addition, information protections would be designed to facilitate advance

arrangements and other agreements across state or regional boundaries. For example, assume that several states are collaborating on safety information sharing. They likely would characterize themselves as engaged in SIP activities at the fourth intensity level at a time when the knowledge gained from sharing rates of specific events drives them to adopt SIP practices that prohibit corporate disciplinary action, criminal prosecution or CAA certificate action by one state against individuals or organizations in other states.

A summary of all of these intensity levels along with the other SDCPS activities is provided on page 6 of this document.

Looking Forward

Potential sources of new toolkit content include feedback from FSF GSIP focus groups, workshops, webinars, and public and private discussions during our planning phase. Also valuable will be insights collected from SIP experts; participants in other related conferences and meetings; our extensive SIP research; our experts' 2015 review and analysis of Asia Pacific and Pan American states' level of SIP implementation; examples of the use of safety data and safety information in civil, criminal, administrative and disciplinary proceedings; and the FSF Legal Advisory Committee's (LAC's) efforts on SIP issues.

The LAC is a voluntary FSF committee established in June 2013 and is composed of globally diverse experts in the legal aspects of aviation safety, including representatives from manufacturers, labor unions, airlines, regulators, plaintiffs' and defense lawyers, and international organizations. The LAC will be an ongoing resource for potential future GSIP efforts.

Local SIP Best Practices

Complementing the main sections of the *Information Protection Toolkit* that cover ICAO-endorsed international practices, Flight Safety Foundation aims to address several "soft" aspects of SIP (i.e., best practices that service providers and CAAs find valuable, separately from state laws, ICAO SARPs and official guidance). We want to publicize relatively unknown, SIP-relevant best practices that have come to GSIP researchers' attention. We are motivated by the belief that strong safety culture (including strong employee voluntary safety reporting, for example) and the just culture principles noted above will be essential elements of SIP success.

Participants in GSIP focus groups and workshops told us that many effective practices in information protection are not based solely on state laws, CAA regulations, company policy or formal commitments among service providers. They come from other practices established over long periods with favorable results. The following examples of such practices, typically carried out to support a formal policy, would be worth covering in more detail:

- **De-identification —** Whether you process safety data with an advanced computer system or a rudimentary, non-technical method, it is worth the time of everyone involved to discuss exactly how each specific process must be performed. Knowing this level of detail can prevent protected information from inadvertently surfacing (i.e., causing harm by being revealed internally or to the public) at some time long after the initial employee voluntary safety report was received or the routine flight data were extracted from a flight data–recording system. Usually, the SIP process is straightforward and routine, a matter of checking that the content of key data fields has been de-identified. Other times, however, data that must be manually de-identified by the analyst are buried in dense or voluminous text, and you may need to perform additional extraction or summarization of raw data to ensure that the de-identification occurred.
- **Non-disclosure agreements —** Service providers routinely use these agreements to reduce the risk of disclosure to third parties of sensitive information. Often, the protected materials may be a program status or results that have been shared within internal discussions that are speculative/inconclusive in nature, or within preliminary group "brainstorming" about how to improve safety

performance when something in a policy or process fails to achieve the target rate of occurrence, for example.

- **Summarized information —** Recognize the characteristics of your audience and the implications of conducting a summary-type presentation of safety data or safety information for that audience. Stakeholders may inadvertently communicate information that immediately implies that some aspect of your organization's safety performance is the "worst ever," and thus obviously "unsafe," when in fact that conclusion is neither intended nor accurate. Ask yourself how special provisions, such as a clear introduction with caveats, and clear documentation of accurate conclusions, can prevent the audience from jumping to the wrong conclusion and misinforming others.
- **Handling identifiable information —** In some situations, a case can be made for an exception to the typical rule that all aviation safety-event information must be de-identified prior to disclosure outside a very small group of authorized data analysts. This could be seen as quite a "progressive decision" — but one made only when safety leaders, directors of safety, high level administrators and groups of aviation safety specialists make a strong commitment to focus solely on achieving a critical safety benefit and prohibiting disclosure of the identities of flights, flight crews, etc., and the assignment of blame to identified people. The importance of everyone adhering to such a commitment cannot be overstated because breaches can destroy an entire safety program that has been built upon a high degree of employee-management trust.

Your Opportunity to Share

From the outset of GSIP, Flight Safety Foundation has requested permission to curate and publish de-identified narratives about SIP, drawing from experiences of aviation safety organizations and professionals. We welcome you and fellow *Information Protection Toolkit* website visitors to take advantage of this chance to advance and enrich the knowledge of your counterparts worldwide.

Others want to learn, for example, how you implement SIP in flight operations — such as ensuring the protection of de-identified, aggregated and other forms of shared information from flight data monitoring of routine operations, air traffic management safety data, aircraft maintenance and repair irregularities, internal accident/incident studies, audits/assessments, employee voluntary safety reporting systems and other confidential sources. Hundreds of GSIP participants and other individual stakeholders will appreciate the chance to learn from you and to share with you in return. GSIP will follow U.S. Federal Aviation Administration and Flight Safety Foundation confidentiality standards on vetting information and protecting your privacy.

To demonstrate the value and importance of SIP, this toolkit will present SIP success stories. For example, this toolkit will discuss a legal example where safety information had been protected.

Ultimately, the *Information Protection Toolkit* will address all the issues that states, their CAAs and service providers should consider when implementing SIP. We welcome your feedback about this toolkit to help achieve one of the core objectives of GSIP — to improve the sharing and harmonization of safety information. Members of the GSIP team will respond and consider SIP ideas, best practices, lessons learned and applications in flight operations.

Global Safety Information Project (GSIP)

Overview Matrix Of Intensity Levels

Risk management is a tool for decision making and improving safety performance. As it is executed, additional learning continues to take place, which expands our knowledge on hazards and our horizons of influence. GSIP recognizes this ever-expanding growth of risk management and therefore incorporates a level of intensity across our toolkits. The following chart includes a simplified version of the different levels of intensity across all risk management safety activities.

	SMS Core Level	Expanded Level	Advanced Level	Industry Level
Data Collection	Data are collected to adequately monitor the normal hazards an organization may encounter and to support a functioning SMS.	Data are collected to understand both the hazards and exposure to operations with those hazards (e.g., *flight data acquisition systems).*	Data are collected to advance understanding of primary causes and contributing factors (e.g., *monitored data through LOSA).*	Data are collected to utilize and contribute to a larger industry understanding through bow tie organization of events (e.g., *data collection with industry partners).*
Data Analysis	Data are analyzed to determine acceptable risks. Safety performance indicators with current status against objectives.	Data are analyzed to understand all direct hazards and their impact on undesired outcomes. Multiple hazards are each examined for their influence on risk.	Data are analyzed to understand all potential direct and indirect hazards and their impact on undesired outcomes.	Data are analyzed to understand all industry impacts on safety. The math behind paths leading to and from an undesired state are well understood.
Information Sharing	Information sharing of performance results is comprehensive within an organization (e.g., within one organization).	Information sharing of performance and key areas of linked performance is performed among divisions or industry peers at detailed levels (e.g., ANSP to ANSP).	Information sharing is across the industry for key risks and mitigations. Generally this is through presenting detailed independent investigative work in the data (e.g., ANSP to airline).	Information is shared and managed across the industry for benchmarking capabilities and emerging conditions. Cooperative analysis is conducted (e.g., pooled data).
Information Protection	Individuals and organizations are protected against disciplinary, civil, administrative and criminal proceedings, except in case of gross negligence, willful misconduct or criminal intent.	The protection extends to certain mandatory safety reporting systems. In Annex 13, the protection extends to final reports and investigation personnel.	Further protection mechanisms may be in place to implement just culture principles and cross-industry support for strong safety reporting cultures.	Protection is formalized at the highest level between countries through memorandums of understanding or similar agreements.

ANSP = air navigation service provider; LOSA = line operations quality assurance; SMS = safety management system