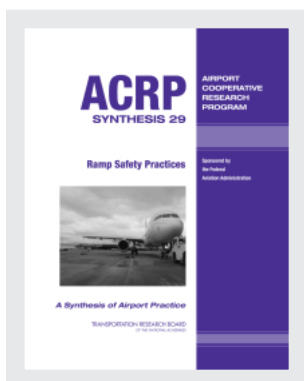


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AIRPORT COOPERATIVE RESEARCH PROGRAM

ACRP SYNTHESIS 29

Ramp Safety Practices

A Synthesis of Airport Practice

CONSULTANTS

JOANNE LANDRY
Landry Consultants LLC
Seattle, Washington
and
SHANE INGOLIA
University of Southern Illinois
Carbondale, Illinois

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AIRPORT COOPERATIVE RESEARCH PROGRAM

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Cover figure: Seattle–Tacoma International Airport (*Credit:* Landry Consultants LLC Photographic Catalog).

FOREWORD

Airport administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to the airport industry. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire airport community, the Airport Cooperative Research Program authorized the Transportation Research Board to undertake a continuing project. This project, ACRP Project 11-03, “Synthesis of Information Related to Airport Practices,” searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute an ACRP report series, *Synthesis of Airport Practice*.

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

PREFACE

*By Gail R. Staba
Senior Program Officer
Transportation
Research Board*

This synthesis study is intended to inform airport operators, ground handlers, and airlines about the current state of ground handling practices, focusing on safety measures and training.

Information used in this study was acquired through a review of the literature and surveys of airport operators, airlines, and ground service providers.

Joanne Landry, Landry Consultants LLC, Seattle, Washington, and Shane Ingolia, University of Southern Illinois, Carbondale, Illinois, collected and synthesized the information and wrote the report. The members of the topic panel are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

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Note: Many of the photographs, figures, and tables in this report have been converted from color to grayscale for printing. The electronic version of the report (posted on the Web at www.trb.org) retains the color versions.

RAMP SAFETY PRACTICES

SUMMARY An airport ramp is an area where aircraft, equipment, service providers, flight crews, and passengers converge. Coordination of multiple activities for flight arrivals and departures involving a variety of services is often complex, concurrent, and crowded. Efficient and rapid gate turns, which equate to cost savings for airlines, contribute to the hectic and demanding pace of ramp operations. Passenger guarantees for baggage claim services, flight on-time performance, and other promotional programs further increase the risk of ramp accidents and incidents. Owing to the level of aircraft activity, the complexity of work tasks, and the equipment used in servicing aircraft, ramp workers can face a variety of hazards. A 2000 analysis of accident rates in the airport industry by the Health and Safety Executive, an independent watchdog organization of work-related health, safety, and illness in the United Kingdom, identified that the accident rates for ground handling and airport workers exceed those of the construction industry and the agricultural sector.

Airports, airlines, and ground service providers (GSPs) participate in individual and collaborative roles to ensure the safe and efficient operations on the ramp. At this time, no formal U.S. regulatory requirement is in place for airport ramp oversight. Ramp operations are inherently dangerous because they include confined areas, rapid gate turns, various equipment interacting with the aircraft, weather conditions, and human factors such as fatigue and lack of situational awareness. Each airport manages the ramp area through lease and license agreements and has a degree of oversight through the enforcement of rules and regulations and safety violation or citation programs. Airports require airside driver training, but typically do not offer or require centralized safety awareness or ramp safety training to tenants or airport staff. A variety of industry guides and handbooks are available that provide operational and training information for ramp ground operations. Additionally, most airlines and GSPs have developed customized training curriculum for both classroom and on-the-job training programs as part of Title 14 Code of Federal Regulations (CFR) Part 121 requirements, yet accidents and incidents continue to occur.

The increasing number of accidents and incidents is further documented in the Airports Council International (ACI) Apron Safety Survey. From 2006 to 2007, the total number of accidents and incidents reported by 158 airports showed a 15% increase, or a total of 3,026 incidents and accidents in 2007 compared with 2,623 in 2006. Based on the total number of aircraft movements documented in 2007 (12,360,425), the rate of incidents and accidents per 1,000 movements would result in 0.245, or approximately one incident per 4,084 movements.

Correspondingly, the cost to air carriers from equipment damage and staff injuries is increasing each year. The Flight Safety Foundation has estimated that ground accidents cost as much as \$10 billion annually in direct and indirect costs such as loss of reputation, impacts to schedules and passengers, hiring and retraining new staff to replace injured individuals, insurance costs for staff and operations, repairs, parts, and staff time to complete and test repairs.

In 2004, the International Civil Aviation Organization responded to industry concerns about safe operating procedures on airport ramps by incorporating ramp safety into Annex 14

Aerodromes and its safety management system (SMS) requirement. The FAA addresses safe airport operations under 14 CFR Part 139. A Notice of Proposed Rule Making (NPRM), issued October 7, 2010, outlines the possibility of amending 14 CFR Part 139 to include SMS on non-movement areas such as ramps.

On February 1, 2011, the FAA issued an NPRM entitled Safety Enhancements Part 139, Certification of Airports. The NPRM states that “The FAA proposes to amend the airport certification standards in Part 139 and would establish minimum standards for training of personnel who access the airport non-movement area (ramp and apron) to help prevent accidents and incidents in that area.” The FAA further defines the basis of this proposed change by concluding that “non-movement area safety can be improved with increased training. Airport workers must be knowledgeable and aware of the various activities that take place in the non-movement area. This knowledge and awareness reduces confusion and carelessness . . .” Areas of training suggested include airport familiarization, markings, signs, ramp access procedures, high visibility clothing, cautious driving and speed awareness, foreign object damage, fire prevention, reporting accidents and incidents, aircraft right-of-way, propeller and jet intake hazards, and other airport-specific safety training items.

Airports, airlines, and GSPs face possible changes to the way the FAA and the aviation industry plan to manage the non-movement areas at U.S. airports. If the two NPRMs cited earlier provide insights into the future of ramp safety management, stakeholder integration and collaboration may become part of a formal and regulated national program.

As an area of interest and concern to the aviation industry this Ramp Safety Synthesis Study was conducted to identify and describe the current state of ground handling practices, focusing on safety measures used at airports. The target audience for this report is airport operators, airlines, and ground handlers. The approach for this study included both academic review and a survey instrument. Through the use of a set of three synthesis study surveys containing 25 to 26 questions each, this report presents individual and collective responses from airports, airlines, and GSPs. The surveys were designed to collect and review information on ramp safety operations, staff roles and responsibilities, safety training, audit and inspection programs, safety violation programs, and collaborative safety initiatives, such as foreign object debris programs. Of the 48 surveys distributed, 40 responses were received for a response rate of 83%. Additional information for this study was collected as part of a literature search and supplemented with airline, airport, and GSP program and training documentation. One representative each of the airline, airport, and GSP respondents was interviewed, by phone or in person, using an additional list of questions, to further investigate or clarify responses from the primary survey group.

As a summary of findings, the combined review, survey results, and interviews collected from this study provide a snapshot of the current ramp area safety issues, operations, and practices in the United States. Generally, the findings focused on the following key conclusions:

- Airport ramp areas are complex regardless of airport size or configuration.
- No comprehensive U.S. standards exist with regard to non-movement area ramp markings, ground operations, or safety training.
- Ramps are inherently dangerous (based on accident and incident data), but no data repository exists that presents a complete analysis of accident types, root causes, and trends to demonstrate mitigation successes (such as training).
- Airlines and GSPs surveyed typically individualize training programs to meet or exceed 14 CFR Part 121 and Occupational Safety and Health Administration regulatory requirements and introduce various levels of safety programs such as audits and inspections.
- Airports, airlines, and GSPs have various roles and responsibilities depending on airport contractual and operational agreements.
- Various FAA, industry, and technology safety initiatives are underway.

CHAPTER ONE

INTRODUCTION

BACKGROUND

In the United States, the ramp/apron area is typically managed by both airports and airlines. (*Note:* ramp and apron will be used interchangeably within this document.) The airport provides facilities for passenger and cargo access to air transportation such as gates, cargo hard stands, passenger loading bridges, and fueling systems to support aircraft servicing at the terminal. Airlines establish agreements with airports for gate usage and access to facilities. Ground service operations can be managed directly by airlines or outsourced to subcontractors. These ground operations occur in the ramp areas and include a variety of services, as listed in chapter two. Airport oversight of the ramp includes development and deployment of rules and regulations and airfield driving training programs to ensure staff, tenants, and service providers adhere to standards such as complying with speed limits, wearing personal protective equipment (PPE) such as safety vests, and properly disposing of hazardous waste.

Airlines and ground handlers require operational and safety training of all staff to support aircraft servicing, including use of ground service equipment (GSE) such as belt loaders, tugs, transporters, unit load devices, baggage carts, pallet loaders, and portable ground power units. Often, ground handlers require customized staff training that supports individual airline operations or procedures.

Airlines and GSPs comply with CFR 14 Part 121 training including the following:

Mandated Training

- Dangerous Goods
- Blast and Suction
- Ramp Safety—(operators typically combine ramp safety in the ramp basic training, which is not mandatory)
- Annual Recurrent
- Passengers with Disability.

Operational/Task Training (*Note:* The FAA inspects and audits the completion of Operational/Task Training considering it mandated by the operator and therefore resulting in ‘mandated training’).

- Ramp Safety—ramp markings, operation of motorized vehicles, approaching an aircraft.

- Aircraft Familiarization—typically specific to the aircraft type serviced at the specific airport location
 - Aircraft loading (weight and balance introduction)
 - Aircraft limitations (size of acceptable packages and floor weight)
 - Cargo compartment limitations (stacking height, bin webbing, etc.).
- Aircraft Servicing—lavatory and potable water servicing
 - Cabin service and cabin search (now mandated by the TSA).
- Receipt and Dispatch—marshaling of aircraft into the gate, chocking, off load and up load, push back, and disconnect.

Typically Mandated Training requires approximately 8 hours for ramp and cargo operation personnel. Operational/Task Training includes approximately 32 hours of classroom and on the job training (OJT). Most GSP and airlines have an extended period of OJT where a new employee works with another more experienced person before the new staff can begin operating equipment. Also airlines and GSPs comply with Occupational Safety and Health Administration (OSHA) required training for PPE, etc.

Airports, airlines, and ground handlers all function independently to support passenger and cargo operations through a variety of skills and services; however, in the United States no single standard or regulation exists that integrates these operations into a comprehensive ramp safety program. The FAA’s Title 14, Code of Federal Regulations (CFR), Part 139 requires safety measures such as lighting, pavement management, ice and snow removal, and foreign object debris (FOD) management for an airport operator’s ramp area. Currently, Part 139 does not mandate airport oversight of ramp operations.

Recently, the International Civil Aviation Organization (ICAO) conducted an audit of the FAA as an ICAO member state, and presented a Corrective Action Plan relating to the fact that the “FAA does not regulate apron management services at aerodromes.” The audit proposed the following corrective actions: “1) Initiate an Airport Cooperative Research study of best practices for managing ramp safety; 2) Form a Work Group with Airports, Air Traffic, Aviation Safety, and associations to study ramp safety; and 3) Review Work Group and research studies and determine next action” (ICAO 2007). These efforts are currently underway.

PROJECT OBJECTIVES

The objective of this synthesis project is to identify and describe the current state of ground handling practices focusing on safety and training measures used at airports. The target audience for this report is airport operators, airlines, and ground service providers (GSPs). The synthesis report provides a compilation of common practices.

STUDY ELEMENTS

The study approach for this project included:

- Investigating the available literature on ramp safety operations and training to assess the state of current practices in the United States.
- Reviewing past ramp safety surveys.
- Conducting new surveys and interviews of a range of commercial service and general aviation (GA) airports, airlines, and GSPs to determine current practices and gaps.
- Identifying duties and responsibilities of the various airports, airlines, and GSPs.
- Providing an overview of the airport, airline, and GSP roles in ground handling safety oversight.
- Presenting a discussion of current baseline and future trends [e.g., technology, safety management systems (SMS), International Air Transport Association (IATA) Safety Audit for Ground Operations (ISAGO), ramp towers, and changing business relationships such as airports offering ground services.]

LITERATURE AND DATA SEARCH

A considerable amount of literature exists for ground handling practices and operations both nationally and internationally. Most of the literature is directed at airline and GSP operations and includes a variety of manuals that provide guidance to and standards for ramp operations, markings, procedures, accident and incident reporting, and general safety practices. Many aviation organizations such as the Flight Safety Foundation (FSF), Airports Council International (ACI), National Safety Council, ICAO, and IATA produce documents and reports on current ramp operations, practices, trends, and activities. A number of these resources were used as a foundation for this study, are described throughout this document, and are presented in the References.

SURVEY

As part of the Ramp Safety Practices Synthesis study data collection process, three electronic synthesis study surveys were sent to airports, airlines, and GSPs. The surveys focused on existing safety practices including ramp oversight; management and individual responsibilities; ramp safety; staff initial

TABLE 1
SURVEY RESPONSES BY INDUSTRY TYPE

	Airport Reps.	Airline Reps.*	GSP Reps.	Total
Sent	33	7	8	48
Responses	29	7	4	40
% Total	87	100	50	83

*Note: Six airlines reported with two respondents from one airline representing different organizational positions. Reps. = representatives.

and refresher safety training; standardizations in safety training; safety violation practices including fines, safety audits, and inspections; and hazard reporting. A total of 48 surveys were distributed and 40 responses were collected, including 29 airports, 6 airlines/7 airline representatives, and 4 GSPs. Table 1 presents the total and percent responses by industry. The overall survey response rate result was 83%.

The range of airports responding to the survey included large (8), medium (7), small (6), non hub (4), and GA (4) as shown in Figure 1. Geographically, airports represented diverse areas across the nation including the states of Arkansas, Arizona, California, Florida, Georgia, Illinois, Indiana, Massachusetts, Maryland, Maine, Michigan, Missouri, Mississippi, North Carolina, North Dakota, Ohio, Oregon, Texas, Utah, and Washington State.

Airline respondents included representatives from large commercial and small regional air carriers including: (1) Air Wisconsin, (2) Alaska Airlines, (3) Continental Airlines—two replies, (4) Delta Airlines, (5) Horizon Air, and (6) United Airlines. Four GSPs completed the survey including representatives of Aircraft Service International Group, Delta Global Services, Gate Gourmet, and Menzies Aviation.

Survey respondents included vice presidents; directors; managers; risk, safety, and compliance officers; and operations and training staff. The diverse level of technical expertise and managerial positions from respondents is reflected

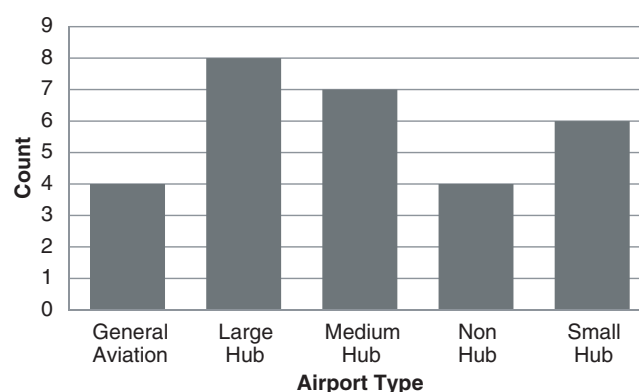


FIGURE 1 Total respondents by airport type. (Which category of airport do you represent?)

in the survey data; responses collected included insights from individuals affiliated with local, regional, and national organizations. A list of survey respondent titles from airports, airlines, and GSPs is presented here.

- Airfield Manager
- Airport Manager—Operations
- Airport Manager (2)
- Airport Operations
- Airport Safety Officer
- Assistant Aviation Director
- Assistant Director of Aviation
- Assistant Terminal Manager
- Compliance Officer
- Deputy Director Aviation Operations
- Director of Operations (4)
- Director of Safety Programs
- Director of Operations, Security & Environmental Compliance
- Director, Ground Safety
- Field Director
- Graduate Associate
- Ground Service Supervisor, Quality Assurance
- HSE & Training Supervisor
- International Regional Manager Safety & Regulatory Compliance
- Manager of Operations and Maintenance
- Manager Seattle Operations

- Manager, Airside Operations
- Manager, Occupational Safety
- Manager, Safety Compliance
- Operations Officer
- Operations Supervisor
- Regional Airport Safety and Security Officer
- Regional Director
- Risk Management (2)
- Senior Airfield Manager
- SMS Manager
- Superintendent Airport Operations
- System Manager, Safety & Compliance
- Vice President, NW Ground Handling
- Vice President, Safety, Security, and Compliance.

INTERVIEWS

One respondent from each of the three aviation industry groups was interviewed using an additional set of questions to further clarify and discuss survey answers. The interviewees included an Airfield Operations Manager from Seattle–Tacoma International Airport, a Safety and Regulatory Compliance Director from Delta Airlines Global Services, and a Field Director from Delta Airlines. Interviews were approximately 20 to 40 minutes in duration and were conducted in person or by phone. The questions and documented responses can be found in Appendix C.

CHAPTER TWO

RAMP OPERATIONS AND SAFETY

Chapter two presents foundational information collected from literature searches, synthesis study survey results, and interviews that relate to common practices used to manage ramp operations. Included are data from airports, airlines, and GSPs, and collaborative efforts discovered or documented as part of the study process such as FOD programs, safety meetings, violation and citation programs, and training initiatives.

RAMP OPERATIONS

Airport ramps are typically small, noisy, and congested areas where departing and arriving aircraft are serviced by ramp workers, including baggage handling, catering, and fueling personnel. Other staff present on ramps includes airport police and fire, emergency response and medic vehicles, FAA officials, airport operators, maintenance engineers, airline crew, and vendor and concessions personnel. The presence of a large number of people utilizing equipment in a relatively small area, often under considerable time pressure, creates an environment in which injuries and fatalities and aircraft and equipment damage can occur (Dillingham 2007). Typical activities involved with the operation and servicing of aircraft on the ramp include cleaning, catering, refueling, baggage and cargo handling, toilet and potable water servicing, maintenance, and transport of passengers and crew onto and off the aircraft (Health and Safety Executive 2000). According to *Airport Operations*, ramp service types can be divided into distinct areas as presented in the following list from *Airport Operations* (Ashford et al. 1996):

- Ramp services
- Supervision
- Marshaling
- Start-up
- Moving and towing aircraft
- Safety measures
- On-ramp aircraft services
- Repair of faults, fueling, wheel and tire check
- Ground power supply
- Deicing, cooling, and heating
- Toilet servicing, potable water, de-mineralized water
- Routine maintenance
- *Passenger loading

(*The referenced list by Ashford et al. did not include passenger loading, which was added to provide a more comprehensive list of typical ground services.)

- Non-routine maintenance
- Cleaning of cockpit windows, wings, nacelles, and cabin windows
- Onboard servicing
- Cleaning
- Catering
- In-flight entertainment
- Minor servicing of cabin fittings
- Alteration of seat configuration
- External ramp equipment
- Passenger steps
- Catering loaders
- Cargo loaders, mail and equipment loading.

A broad array of ground service contractual agreements exists including a large percentage of airlines that provide support to their own and other airlines, GSPs that are outsourced to multiple airlines and offer comprehensive above and below wing services, specialized services such as fueling and catering, and airports that offer ground support services to their airline customers. This mix of service arrangements can result in multiple providers operating at the same time at an airline arrival or departure gate.

OUTSOURCING TREND

As mentioned previously, approximately 50% of U.S. airlines continue to perform a portion of their ground handling support services, although it appears the trend of outsourcing is increasing, which suggests that airlines may be reducing costs by contracting out ground handling services. Typically, the cost savings for outsourcing are gained through leveraging staff and equipment across multiple airlines and by reducing labor rates inherent in airline organizations (Grossman 2010).

As part of the Ramp Safety Synthesis study, survey questions were submitted to airlines and ground handlers to collect information on ground service offerings. A limited number of responses were provided (four GSPs and six airlines, of which one airline included two respondents); however, as the survey data demonstrate in Table 2, airlines continue to provide in-house services, especially in aircraft, cargo/mail, passenger, and baggage handling; maintenance; and load control. The majority of airlines surveyed indicated that fueling is outsourced more often (7 to 0) than any other service listed in the survey. The two responses of “both” reflect an airline that provides in-house fueling at some locations and

TABLE 2
AIRLINE IN-HOUSE (S) AND OUTSOURCED (O) GROUND HANDLING SERVICES

	<i>Services Presented in Survey</i>	Aircraft Ground Movement	Aircraft Handling	Aircraft Maintenance	Baggage Handling	Cargo and Mail Handling	Catering	Fueling	Lav and Water	Load Control	None	Passenger Handling	<i>“Other” Provided by Respondents</i>	Small Package Handling	GSE Equipment Maintenance
*Respondents															
Airline 1 (Regional Airline)		O	S	O	S	O	O	O	S	S		S		S	
Airline 2		S	S	S	S	S	O	O	O	S		S			
Airline 3 (Regional Airline)		S	S	S	S	S	S	O	S	S		S			O
Airline 4		S	S	S	S	S	O	O	O	S		S			
Airline 5 (same Airline as 7)		S	S	S	S	S	both	both	S	S		S			
Airline 6		O	S	S	O	S	O	O	S	S		S			
Airline 7 (same Airline as 5)		S	S	S	S	S	both	both	S	S		S			
Total Count In-House (S)		5	7	6	6	6	1	0	5	7	0	7		1	0
Total Count Outsourced (O)		2	0	1	1	1	6	7	2	0	0	0		0	1

What types of ground support services does your airline provide? Select all that apply.”

“What types of ground support services does your airline outsource (other companies provide services to your airline)?

Select all that apply.”

S indicates in-house services, and O indicates outsourced services.

*Airports that provide ground services were not surveyed for this question.

outsources the operation at other airports. The next highest outsourced service was reported as catering (6 to 1), with one airline providing both in-house and outsourced catering and one airline providing only in-house catering. Generally airlines surveyed demonstrated that some ground services are retained in-house and others are outsourced; none of the airlines surveyed retain all ground services in-house nor do they offer all ground services to other airlines.

When asked “Does your Airline provide ground support services to other airline customers?” five of the seven airline representatives surveyed indicated “Yes.” The two airlines

that responded “No” are regional airlines, which may reflect certain operational limitations, although no additional survey comments were provided to confirm this assumption.

Of the four GSPs surveyed, one is a catering service and one a fueling company; the two remaining GSPs are large national and international GSPs offering a variety of ground support services. Despite the small size of the survey group, responses regarding service offerings were compiled and are presented in Table 3. As reflected in the survey responses, the caterer provides only catering services and the fueler primarily delivers fueling in addition to other services such as

TABLE 3
GROUND SERVICE PROVIDER SERVICES

	<i>Services Presented in Survey</i>	Aircraft Ground Movement	Aircraft Handling	Aircraft Maintenance	Baggage Handling	Cargo and Mail Handling	Catering	Fueling	Lav and Water	Load Control	None	Passenger Handling	<i>“Other” Provided by Respondents</i>	Deicing/Anti-icing	GA Services
Respondents															
GSP 1 (Caterer)							S								
GSP 2 (Multiple Services)		S	S	S	S	S		S	S	S		S			
GSP 3 (Fueler)								S						S	S
GSP 4 (Multiple Services)		S	S		S	S			S			S			
Total Count Services (S)		2	2	1	2	2	1	2	2	1		2		1	1

“What types of services does your company (GSP) provide? Select all that apply.”

S = Service.

de-icing and GA support for private and commercial aircraft for a fixed base operator (FBO). The two other GSPs offer similar services such as aircraft ground movement; aircraft, passenger, baggage, cargo, and mail handling; and lav and water. In some cases each GSP also provides load control and maintenance services. All four ground handlers responded to the survey question: “Does your company provide services to more than one airline customer?” with an affirmative answer “Yes—Nationally (at more than one airport) we provide services for multiple airlines.”

RAMP OVERSIGHT

According to the U.S. Government Accountability Office (GAO) report regarding Aviation Runway and Ramp Safety, the FAA’s oversight of ramp areas is provided indirectly through its certification of airlines and airports primarily through 14 CFR Parts 119, 121, 135, and 139. Safety at airports in the United States is a shared responsibility among the FAA, airlines, and airports. FAA air traffic controllers oversee activity in the movement areas—runways and taxiways—but airlines and airports provide primary safety oversight in the non-movement areas—ramps and gates (Dillingham 2007).

From the airports participating in the Ramp Safety Synthesis survey, the majority (25 of 29) responded “Yes” to having oversight or responsibility of the ramp area, 2 (1 large hub and 1 GA airport) replied “No,” and 2 replies indicated oversight of only common use, passenger loading bridges, and taxi lanes. Table 4 presents a count by airport type and ramp oversight responsibilities and Table 5 lists comments

TABLE 4
AIRPORT OVERSIGHT OF RAMP AREAS

Type	Yes	No	Only Common Use, PAX, or Taxi Lanes
General Aviation	3	1	0
Large Hub	7	1	1
Medium Hub	5	0	1
Non Hub	4	0	0
Small Hub	6	0	0
Count	25	2	2

“Does your airport have any oversight or responsibility of the ramp/apron area including exclusive use space, passenger loading bridges, or ramps?”
PAX = passenger.

from survey respondents regarding types of services. For the two airports that responded “No,” no additional comments were provided to clarify the answer. Comments included a variety of ramp oversight configurations such as shared responsibilities with airlines and oversight of GSE (typically passenger loading bridges) and gate management.

One of the challenges for standardization of the ramp area is the practice of airports leasing gates to airline tenants. Typically, tenants have the authority to manage the gate area in compliance with their company operations including markings, equipment type and use, and marshalling practices. Of the 29 airports replying to the synthesis survey, the largest percentage of gate operations (52%) included both common and exclusive gate use, with 24% indicating all common use, 10% all exclusive use, and 14% responding none or a single gate (all 4 GA airports). Survey comments included clarification that at large airports some of the gates are airline controlled and others are common use and managed by the

TABLE 5
COMMENTS ON AIRPORT OVERSIGHT OF RAMP AREAS

No.	Type	Response	Comment
1	General Aviation	Yes	The ramp area is owned and operated by the airport.
2	General Aviation	Yes	We control all ramps/aprons and assign users to specific areas.
3	General Aviation	No	No comment provided.
4	Large Hub	Yes	On the common use gates, the airport has contracted out the responsibility of sweeping/maintaining the cleanliness of the ramp from the terminal building to the tug road. In one of our terminals we also have oversight of the apron entering the ramp.
5	Large Hub	Yes	The airport oversees the ramp area, most jet bridges, FBO, taxi lanes, cargo locations, etc.
6	Large Hub	Yes	Airport maintains the ramps and provides daily sweeping of the ramps. Airport maintains airport-owned jet bridges.
7	Large Hub	No	No comment provided.
8	Medium Hub	Yes	Ramp areas at concourse gate parking are common use; gate leases include hold room and loading bridge use only.
9	Medium Hub	Yes	The airport is responsible for all jetways and FOD control on the ramp. Each airline is responsible for their respective ramp markings.
10	Medium Hub	Yes	Jet bridges are owned and maintained by the county airport system, but used by airline personnel for de-boarding and boarding.
11	Non Hub	Yes	Insomuch as it is our property and not exclusive use space. Air Traffic Control controls taxi and airlines manage the gate areas. We maintain the jet bridges.

Comments for: “Does your airport have any oversight or responsibility of the ramp/apron area including exclusive use space, passenger loading bridges, or ramps?”

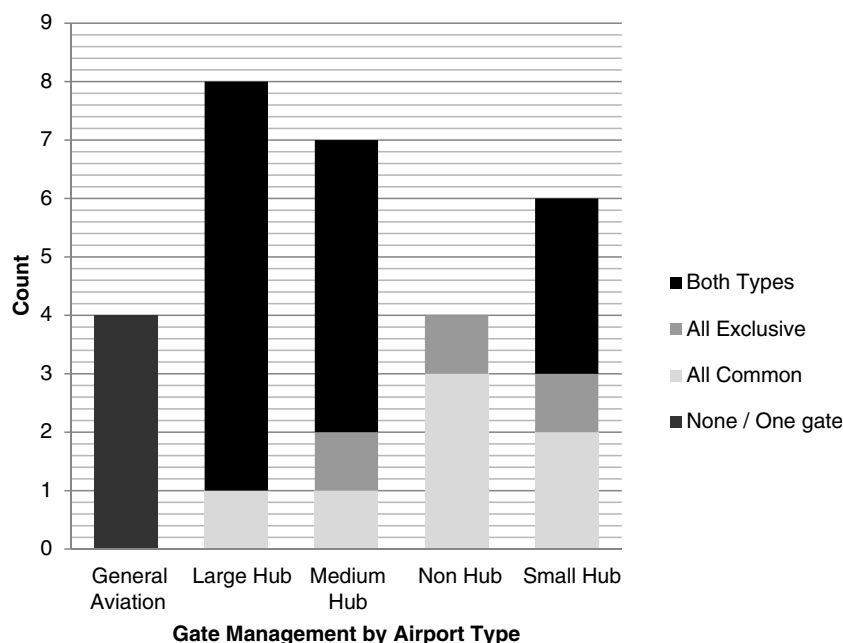


FIGURE 2 Airport gate oversight. (Does your airport manage gates through common use or exclusive use agreements?)

airport. Also, with regard to exclusive gate use, airport respondents indicated that airlines typically have preferential use but not necessarily exclusive use; exclusive use implies the airline has the sole authority to operate the gate, whereas preferential allows use of the gate by other air carriers if the preferred airline is not using the gate. See Figure 2 for a summary of responses by airport type.

With regard to gate and ramp oversight, airports were asked “Does your airport conduct safety inspections on the ramp or in the baggage make-up areas?” The majority (66%) replied “Yes,” 24% answered “No,” and 10% responded “Common use gates and baggage areas only.” Comments from respondents are presented in Table 6.

Airports were also surveyed as to whether ramp safety meetings occurred on a regular basis (Does your airport conduct regular ramp safety meetings with tenants?). Of the 29 airports that responded, 18 (62%) replied “Yes” and 11 (38%) replied “No.” Most of the airports responding “No” that submitted comments stated that the meetings are not regularly scheduled and other means and processes are in place to address ramp safety issues. Figure 3 presents responses by airport type and additional clarification through comments is included in Table 7.

Of the 18 airports replying “Yes” to regularly scheduled safety meetings, 13 selected “monthly” (72%), 3 replied “quarterly” (17%), and 2 responded “other” (11%). See Figure 4

TABLE 6
COMMENTS ON SAFETY INSPECTIONS RAMP AND BAGGAGE MAKE-UP AREAS

No.	Type	Comment
1	Medium Hub	We have increased our efforts in this area.
2	Medium Hub	Visual inspection of ramp areas. Bag make-up areas are currently transitioning from leased space (no operations inspections) to common use.
3	General Aviation	We hope to institute an auditing system for 2011—“Inspect What You Expect.”
4	General Aviation	Ramp only as part of our on-going self-inspection program
5	Large Hub	Airport operations inspect ramp areas every day, at least 3 times a day. Bag make-up areas are patrolled numerous times a day. Bag make-up areas are inspected at least once a day.
6	Non Hub	Our self-inspection program includes operations personnel monitoring the condition of the airfield (including the ramp area) at least once daily. However, no safety-specific checklist exists beyond the self-inspection checklist.
7	Large Hub	Constant surveillance by assigned airside staff as part of the Notice of Violation & Citation Program. We don’t do daily or shift documented inspection reports for those areas.
8	Small Hub	We inspect daily to ensure Part 139 standards are met.

Comments for: “Does your airport conduct safety inspections on the ramp or in the baggage make-up areas?”

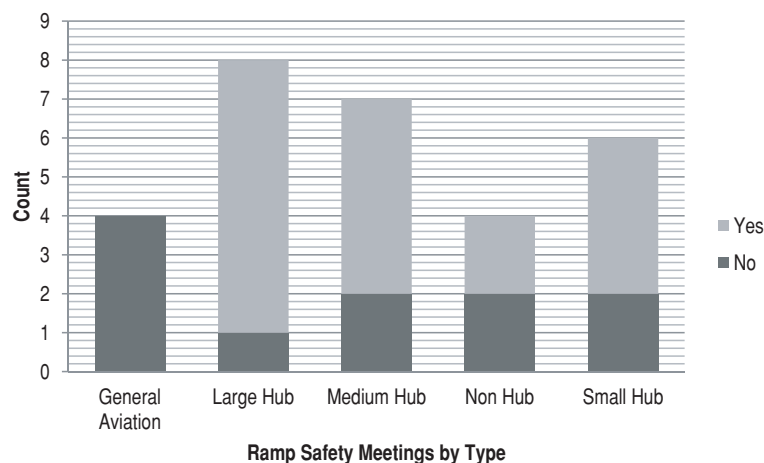


FIGURE 3 Ramp safety meetings. (Does your airport conduct regular ramp/apron safety meetings with tenants?)

TABLE 7
COMMENTS ON SCHEDULED RAMP SAFETY MEETINGS BY AIRPORT TYPE

No.	Type	Comment
1	General Aviation	We do expect to start safety meetings with tenant/vendors starting January 2011.
2	Large Hub	Meetings with the group the Aviation Safety Alliance; chaired by the airport operator.
3	Large Hub	Airport Action Safety Team meets with all the ramp/apron tenants.
4	Large Hub	Regular FOD prevention meetings
5	Large Hub	Monthly Airport/Tenant's Safety Committee meeting is scheduled.
6	Medium Hub	Monthly Tenant Safety Advisory Group facilitated by Airport Operations and Corporate Risk Management.
7	Medium Hub	Airport has a standing safety committee made up of airline tenants that meet monthly. Ramp/apron meetings are held solely by airlines.
8	Non Hub	Tenants are invited to airport safety meetings, as are all ramp departments.
9	Non Hub	We have regular contact with local station managers/supervisors. However, we do hold annual winter operation safety meetings with all tenants.
10	Non Hub	They are not always regular.
11	Small Hub	We have many monthly meetings with tenants, none specifically for ramp/apron safety. However, safety concerns and issues are addressed at each of them, as needed.
12	Small Hub	As an issue becomes apparent it is discussed at a monthly station manager meeting.

Comments for: "Does your airport conduct regular ramp/apron safety meetings with tenants?"

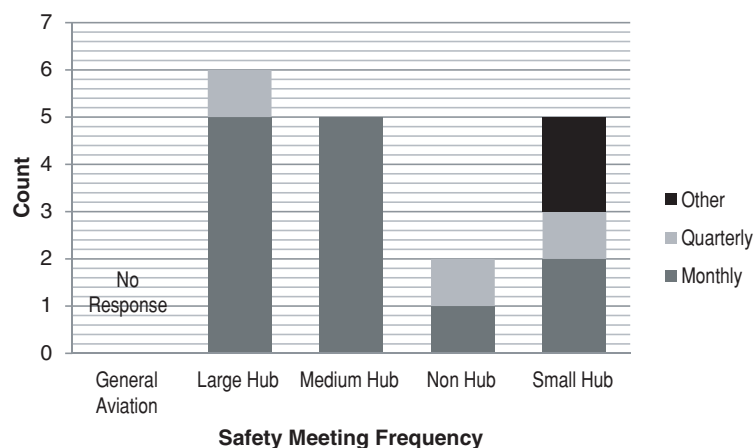


FIGURE 4 Safety meeting frequency. (If yes, how frequently are the ramp/apron safety meetings held?)

for responses by airport type. Comments regarding meeting format and frequency indicated that many airports consolidate safety meetings with other standing meetings such as station manager meetings and anticipate that in some cases meeting frequency will change from monthly to quarterly and that urgent issues will be resolved as needed.

Airports were surveyed regarding collaborative FOD programs with tenants to assess whether airlines and airports worked together on ramp safety initiatives. “Does your airport manage or collaborate with airlines and ground service providers to inspect for FOD on the ramp/apron?” Nearly all respondents (90%) replied “Yes” to the question. The 10% who answered “No” are GA and small hub airports with no commercial services. One of the GA airports commented that as part of the upcoming SMS implementation at his airport, a FOD program will be incorporated. Table 8 lists comments from airports regarding oversight and collaborative efforts of FOD programs.

GUIDES AND MANUALS

Despite the lack of a national ramp operations standard or regulation, numerous guides, handbooks, and manuals exist that provide assistance with ramp operations especially with regard to safety. A number of national and international organizations provide training in conjunction with ramp and safety documentation. Additionally, many offer magazines, online resources, and blogs that provide up-to-date information and evolving trends and tools. Table 9 provides a list of resources collected as part of this synthesis study; the list is not considered comprehensive and is intended to reflect readily available information regarding ramp operations, safety, and training in industry.

DATA SOURCES

Research relating to a comprehensive set of ramp safety accident and incident data was difficult to find; indeed, according to a report by the U.S. GAO on aviation runway and ramp safety, efforts to improve airport ramp safety are hindered by a lack of complete accident and incident data. Such data could help the FAA and aviation industry to understand the nature and extent of the problem as a first step to identifying what actions are needed to reduce ramp accidents and incidents. The GAO found no comprehensive nonfatal injury data on ramp accidents or incidents. According to the GAO report, the federal government has generally taken an indirect role overseeing ramp safety; airlines and airports typically control the ramp areas using their own policies and procedures. Meanwhile, some airlines and airports have initiated their own efforts to address ramp safety and aviation organizations have begun collecting ramp accident and incident data (Dillingham 2007).

In a 2002 Report to Congress regarding Injuries and Fatalities of Workers Struck by Vehicles on Airport Aprons, the FAA noted the difficulty of obtaining nonfatality data. “The lack of comprehensive nonfatal injury data makes it impossible to determine accurately the number and severity of nonfatal struck by injuries. The data suggest that airline industry workers actually sustain significantly fewer struck by injuries than workers in most other industries” (FAA 2002). Additionally, the FSF noted the limited amount of data available for its 2004 study of damage and injury on airport ramps (Vandel 2004). According to a *Flight International* article “Commercial aviation may be justifiably proud of its safety in the air, but its industrial injury record on the ground is one of the worst among all businesses. According to a recent study, the injury rate to employees of scheduled airlines is 3.5 times as bad as it is among miners, and the vast majority

TABLE 8
COMMENTS ON FOD COLLABORATION WITH AIRLINES AND GSPS

No.	Type	Comment
1	Large Hub	Regular FOD events and occasional inspections by Operations
2	Small Hub	We bring up this topic often in the monthly airline managers meeting.
3	Large Hub	The airport does FOD walks at least twice a year. The tenants also are required to keep their lease space and rented space clear of FOD. Some tenants are doing a weekly FOD walk in their area which helps out greatly.
4	Non Hub	Part of our driver/pedestrian training includes identification and disposal of various types of FOD.
5	Large Hub	Our major stakeholder airline manages its own FOD program in the terminals they occupy. The airport conducts ramp inspections including FOD pick-up twice a month at the common use gates in Terminal D. The major airline also has a FOD day once a year in which the airport board participates.
6	Large Hub	Assigned airside staff submits names of individuals observed conducting FOD inspections. At the monthly Partnership Meeting a drawing from the collected names is held and one individual is selected to receive a reward. Annually, the company that had the most monthly rewards receives a plaque from the airport.
7	Medium Hub	We conduct monthly runway FOD walks.
8	Non Hub	FOD control is a requirement of lease.

Comments for: “Does your airport manage or collaborate with airlines and GSPs to inspect for FOD on the ramp/apron?”

TABLE 9
INDUSTRY RAMP OPERATIONS AND SAFETY RESOURCES

Organization	Acronym	Handbooks, Guides, Standards	Website	Brief Description
Air Charter Safety Foundation	ACSF	ACSF Industry Audit Standard Operator Documents	http://www.acsf.aero/	Provides safety standards that cover aircraft ground handling and servicing. The intent of this standard is to raise the level of safety during ground operations by reviewing a ground operator's organization and management, manuals and related documentation, applicable training programs, contract ground handling, auditing, and quality assurance. The standards also focus on specific ground operator's programs including parking of aircraft, towing and taxiing of aircraft, fueling and servicing, baggage loading, and others.
Air Transport Association	ATA	<i>Recommended Guidelines for Preventing and Investigating Aircraft Ground Damage</i>	https://publications.airlines.org/	Multiple documents including those related to safety and ramp operations
Airports Council International	ACI	<i>Airside Safety Handbook and Apron Markings and Signs Handbook</i>	http://www.airports.org/cda/aci_common/display/main/aci_content07_banners.jsp?zn=aci&cp=1-6-5733_725_2	Provides airside managers with a comprehensive set of guidelines for safety and markings.
Australasian Aviation Ground Safety Council	AAGSC	Ground safety practices and training material	http://www.aagsc.org/rips.htm and http://www.aagsc.org/training.htm	AAGSC has developed both video and computer-based resources, including standard practices for ramp safety.
Boeing	Boeing	<i>Ramp Error Decision Aid (REDA) Users Guide</i>	http://www.atec.or.jp/SMS_WS_Boeing_REDA%20Users%20Guide.pdf (one of many sites providing this document)	Structured process used to investigate errors made by ramp personnel.
Civil Aviation Authority	CAA	CAP 642 Airside Safety Management	http://www.caa.co.uk/docs/33/Cap642.pdf	U.K. ramp safety operations and practices including risk analysis
Flight Safety Foundation	FSF	Ground Accident Prevention (GAP)	http://flightsafety.org/archives-and-resources	A set of e-tools on ramp operations and safety practices including but not limited to Ramp Operational Safety Procedures.
International Air Transport Association	IATA	IATA Safety Audit for Ground Operators (ISAGO) Airport Handling Manual (AHM)	http://www.iata.org/ps/certification/isago/Pages/index.aspx http://www.iata.org/ps/publications/Pages/ahm.aspx	Ground Services Audit program documentation including an audit checklist. Field reference publication containing recommended industry standards and procedures on airside safety; load control; baggage, cargo, and mail handling; aircraft movement control; aircraft loading; and departure control systems.
International Civil Aviation Organization	ICAO	Annexes <i>Safety Management Manual (SMM)</i>	http://store1.icao.int/mainpage.ch2 (costs vary by document) http://www.icao.int/anb/safetymmanagement/DOC_9859_FULL_EN.pdf (publication is free)	A variety of documents including Annex 14 for Aerodrome operations and Annex 13 for accident incident investigation.
National Air Transportation Association	NATA	Safety 1st and Fueling	http://www.nata.aero/web/page/557/sectionid/557/pagelevel/1/module/toggle/interior.aspx	Program promotes safety for ground operations that provides a number of training programs and best management practices to enhance safety for general aviation service providers.
Occupational Safety and Health Administration Voluntary Protection Program	OSHA VPP	Safety management program	http://www.osha.gov/dcspp/vpp/	VPP sets performance-based criteria for a managed safety and health system, invites sites to apply, and then assesses applicants against these criteria.
U.S. National Safety Council	NSC	<i>Aviation Ground Operations Safety Handbook</i>	http://shop.nsc.org/Aviation-Ground-Operation-Safety-Handbook-6th-Ed-P1753.aspx	The handbook sets forth the guidelines for safely accomplishing most ground operations associated with aircraft and applicable to aviation ground operations.

VPP = Voluntary Protection Program.

of airline workers' injuries occur on the airside of airports" (Learmount 2005).

The U.S. GAO reviewed ramp fatality data from 2001 through 2006 from FAA, OSHA, and the NTSB, and found that these agencies had investigated 29 fatal ramp accidents during that time. The majority of the fatalities in these accidents were ground workers (17). The results of the GAO survey indicated that the action FAA, OSHA, airport, or airlines could take with the greatest potential for preventing ramp accidents was promoting a safety culture in the ramp area (Dillingham 2007).

Chamberlin et al. (1996) examined 182 ramp operation incident reports from the U.S. Aviation Safety Reporting System for the period 1984–1994 and found that incidents on the ramps tend to occur more for arriving flights than for departing flights, more so at the parking area than at the entry/exit points to the ramp, and that there are fewer incidents or accidents when more ground crew were present. They went on to suggest a number of actions that could be taken to mitigate accidents, such as providing better training of marshallers and wingwalkers to include scenario-based training, maintaining highly visible pavement markings, and establishing and enforcing vehicle speed limits on the ramp.

Additionally, in a recent study, FSF discovered that the largest proportion—43%—of ramp accidents happen in the “gate stop” area. Next is the gate entry and exit area with 39%, and the remaining 18% happen between the gate entry/exit and the runway. There are far more incidents involving damage to stationary aircraft than to moving ones, and even more incidents—in simple numbers rather than value—are “equipment-to-equipment” damage (Learmount 2005).

ACI surveys its members on an annual basis to document and produce the *ACI Survey on Apron Incidents/Accidents*. In the most recent survey, which was conducted in 2007, the total number of respondents reflected 158 airports, representing only a portion of U.S. airport accident and incident statistics. Data from the 2006/2007 report were compiled and published in 2009 and are presented in Tables 10 and 11. In Table 10, the rate is based on accidents and incidents per 1,000 departures.

Based on ACI member airports worldwide reporting to ACI in the annual *Survey of Apron Incidents and Accidents*, the following category percentages (assessed from the total data collected) of damage were determined for the time period 2006–2007: equipment to equipment damage (45.3%); equipment to property damage (24.6%); damage to stationary aircraft by apron equipment (22.2%); damage to moving aircraft (6.7%); and property or equipment damage by jet blast (1.2%). Total injuries to personnel on the ramp for the year 2007 was 251 (1 fatal; 35 severe; 215 minor), whereas injuries to passengers totaled 222 (0 fatal; 25 severe; 197 minor).

Comparison of 2006 and 2007 ACI Data

The total number of incidents and accidents reported in 2007, 3,026, was a 15% increase from the 2,623 recorded in 2006. The number of aircraft movements documented in the ACI survey increased by one million. This resulted in a higher rate of incidents and accidents per 1,000 movements from 0.230 in 2006 to 0.245 in 2007. The rate of incidents and accidents involving aircraft increased from 0.073 in 2006 to 0.078 in 2007; similarly, the rate of incidents and accidents not involving aircraft increased from 0.157 to 0.167. The rate of injury to personnel and passengers decreased in 2007 to 0.038, a 13% decrease from 2006 when the rate was 0.043.

TABLE 10
ACI RAMP INCIDENT AND ACCIDENT DATA

CAUSES OF INCIDENTS AND ACCIDENTS (I&A) (2007)

Number of participating airports: 158

Number of aircraft movements: 12,360,425

Incidents and Accidents	Number	% Total	Rate
I&A involving aircraft	966	31.92	0.078
I&A involving equipment and property	2,060	68.08	0.167
Total	3,026	100.0	0.245
Incidents and Accidents Involving Aircraft			
Damage to stationary aircraft by equipment	725	75.05	0.059
Damage to moving aircraft	241	24.95	0.019
Total	966	100.0	0.078
Incidents and Accidents Involving Equipment and Property			
Caused by jet blast	27	1.31	0.002
Equipment to equipment damage	1,393	67.62	0.113
Equipment to property damage	640	31.07	0.052
Total	2,060	100.0	0.167
Injuries			
Fatal	1	0.21	0.000
Severe	60	12.68	0.005
Minor	412	87.10	0.033
Total	473	100.0	0.038

Source: ACI Survey on Apron Incidents/Accidents (2009).

TABLE 11
ACI CATEGORIES OF INCIDENTS AND ACCIDENTS

CATEGORIES OF INCIDENTS AND ACCIDENTS (2007)		
Causes of Apron Incidents and Accidents	No.	% Total
A. Damage to Stationary Aircraft by Apron Equipment		
Passenger handling equipment	188	
Aircraft loading equipment	294	
Aircraft servicing equipment	136	
Others	107	
Total A	725	23.96%
B. Damage to Moving Aircraft		
Another aircraft (taxiing)	6	
Jet blast	7	
Aircraft marshaller/follow me/Visual Docking Guidance System	2	
Aircraft maneuvering (towing/push back)	46	
Fixed objects	10	
Parked apron equipment	21	
Foreign object damage (FOD)	77	
Other	72	
Total B	241	7.96%
C. Property or Equipment Damage from Jet Blast		
Total C	27	0.89%
D. Equipment to Equipment Damage		
Total D	1,393	46.03%
E. Equipment to Property Damage		
Total E	640	21.15%
G. Injuries to Personnel or Passengers		
Injuries to personnel (1 fatal; 35 severe; 215 minor)	251	
Injuries to passengers (0 fatal; 25 severe; 197 minor)	222	
Total G	473	

Source: ACI Survey on Apron Incidents/Accidents (2009).

The majority of injuries (251) were to personnel (53%), but 222 (47%) were to passengers.

Grabowski et al. (2005) examined NTSB data on airport ground crew injuries and fatalities involving aircraft of commuter air carriers and major airlines for the period 1983–2004. During the 22-year study period, the NTSB recorded 80 ground crew accidents involving landing, taxiing, or standing commercial airline aircraft. Vehicular collisions with an aircraft made up 43% of the accidents, 34% were caused by moving aircraft equipment such as propellers or nose gear, and 11% resulted from jet blasts or fires. Grabowski concluded that intervention programs for airport ground personnel should emphasize the safe operation of the aircraft equipment and ground vehicles and that some of the injuries to ground crew members might be avoided through improved design of commonly used equipment (Grabowski et al. 2005).

ACCIDENT AND INCIDENT FACTORS

Lu et al. (2005) analyzed 189 accident and incident reports from 14 CFR Part 121 scheduled operations for the period between January 1999 and May 2004, and identified ground crew operations as the second leading factor of accidents. The factors leading to ground crew error were identified as:

1. Poor situational awareness (clearance, airstair/jet bridge/vehicle operations),

2. Ineffective communication (tug/truck/beltloader driver–pilots–wingwalkers),
3. Lack of supervision/quality assurance,
4. Ramp agents' ignorance of safety criteria,
5. Physical fatigue, and
6. Personal health and medication (Lu et al. 2005).

Wenner and Drury (2000) conducted an analysis of 130 ground damage incident reports from major air carriers covering the period from January 1992 through April 1995. The analysis of ground damage incidents in their study showed that there are relatively few factors that contribute to most ground damage incidents. They suggest that by introducing a small number of interventions a large number of ground damage incidents can be prevented. Results of the analyses also indicated that simply using the “blame-and-train” approach to preventing ground damage is ineffective, because ground damage incidents are often caused, at least in part, by latent failures in the system. These latent failures cannot be eliminated without making changes in the system further upstream than the mechanics or even the first line supervisors. Changes must be initiated by upper levels of management and must become integrated into the existing maintenance system (Wenner and Drury 2000).

The type of incidents and accidents in the Wenner and Drury analysis fell into the following categories:

- Tools or materials contact aircraft,
- Work stand contacts aircraft,

- Ground equipment is driven into aircraft,
- Unmanned equipment rolls into aircraft,
- Hangar doors closed onto aircraft,
- Position of aircraft component changes,
- Center of gravity shifts,
- Aircraft rolls forward/backward,
- Towing vehicle strikes aircraft,
- Aircraft is not properly configured for towing,
- Aircraft contacts object/equipment, and
- Aircraft contacts moveable object/equipment (Wenner and Drury 2000).

A source of error that can result in an accident or incident is a failure to properly cooperate and coordinate activities during aircraft operations. The Health and Safety Executive of the United Kingdom points to three key elements that must be accomplished to help reduce the risk of accident, incident, or injury on the ramp:

1. Ensure cooperation and coordination among employees;
2. Proper control of the various operators; and
3. The proper assessment and control of the risks individuals are exposed to.

Examples of these three key aspects are:

- The establishment of an Airside Safety Committee;
- The establishment and enforcement of airport rules and agreements;
- The proper design of the ramp layout to accommodate the different types of operation and levels of activity; and
- Utilizing various safety recommendations from regulators, aircraft manufacturers, and industry trade groups (Health and Safety Executive 2000).

SAFETY CULTURE

A number of articles point toward the need for a proper safety culture or safety climate to exist within an organization to reduce accidents. Cabrera et al. (1997) suggested that safety climate can be an optimum indicator in evaluating SMSs as well as change-oriented programs. Safety attitude of management, efficient performance feedback, well-designed and developed motivation strategies, the existence of an adequate decision process, company philosophy toward safety as a priority, optimum upward and downward communication, and a good reporting system have been identified since the early 1990s as being components of a safe organization. Company policies toward safety, emphasis on training or general safety strategies, and risk perception are several of the identified dimensions that promote a safe organizational operating environment. Work motivation is one of the more powerful psychosocial processes that can have a positive impact on promoting safe behaviors (Cabrera et al. 1997). Hayward (1997) noted that airline ramp employees at a large airport base may be very different in terms of their sub-cultural attitudinal and behavioral norms from those at a regional airport, even though they work in the same industry, for the same carrier, in the same job category.

In an interview with Ground Support Worldwide, Delta's former Director of Safety and Ground Support, Jim Swartz, identified six drivers of safety on airport aprons that have to be balanced:

1. Financial or business piece,
2. Customer service element,
3. The regulatory driver (EPA, FAA, NTSB, DOT, NFPA, OSHA),
4. The work process,
5. Innovation/technology applied to the business, and
6. Moral leadership (Garetson 2008).

Piotrowicz et al. (2002) determined that the most effective approach to ramp human factors skills assessment is behavioral assessment, as compared with cognitive assessment. One suggestion made to improve ramp safety is to include lost-time injury rates in a manager's performance assessment. Although lost-time injuries are not considered an accurate barometer of safety on a ramp, making a ramp manager or supervisor accountable for safety performance better ensures a focus on safe operations, as compared with being evaluated on on-time performance (CASA 2002).

Ek and Akelsson (2007) studied the safety culture of a ground handling company at a Swedish airport and came away with these suggestions for improvement: (1) provide anonymous distribution of anomaly reporting forms, (2) provide education in the area of human error, (3) provide education about the importance of having a safety culture with continuous improvement, and (4) perform proactive risk analyses.

COSTS OF ACCIDENTS AND INCIDENTS

The FSF has estimated that ground accidents worldwide cost air carriers \$10 billion annually. These accidents affect airport operations and result in personnel injuries and damage to aircraft, facilities, and ground-support equipment. IATA estimated that the annual cost of ground damage accidents in 2008 was \$4 billion for the airline industry and \$1 billion for corporate aircraft operations; a total of 17% of all accidents in 2008 (Werfelman 2009).

A recent U.S. survey showed that the average direct cost of a ramp damage incident for narrow-body aircraft is U.S. \$75,000, and that indirect costs can reach \$230,000 for a narrow-body and \$425,000 for wide-body aircraft (CASA 2002). Activities in the ramp area can also affect the safety of air crew and passengers once they leave the ramp area. Undetected aircraft damage from ramp activities can cause in-flight emergencies; for example, in December 2005 an Alaska Airlines MD-80 that had departed from Seattle en route to Burbank, California, experienced a sudden cabin depressurization. After the aircraft safely returned to Seattle, it was discovered that a ramp vehicle had punctured the aircraft fuselage, but the incident had not been reported (Sullivan and Allison 2005).

In a study conducted by Boeing Commercial Airplanes Group and cited by CASA (2002), for typical targets for “ramp rash” the average direct costs of repair or replacement are presented in Table 12.

Ramp accidents are a high-cost item for airlines and airports in personnel injuries and death, and in damage to equipment. A FSF review of ramp operations suggested a lack of overall consistency in standards, operating practices, and management as early as 1993. The review goes on to recommend safety audits and voluntary, confidential, and nonpunitive safety reporting systems as being actions to pursue for safe operations (Enders 1993).

TABLE 12
TYPICAL “RAMP RASH” COSTS

Repair/Replacement Part	Costs
Elevator assembly	\$264,708
Inboard flap assembly	\$224,872
Leading edge slat assembly	\$52,863
Wingtip assembly	\$28,872
Outboard flap assembly	\$255,845
Inlet cowl	\$329,203
Main entry door	\$171,220
Radome	\$19,712
Cargo door	\$58,327
Aileron and tab assembly	\$183,545

Source: Boeing Commercial Airplanes Group, CASA (2002).

CHAPTER THREE

CURRENT PRACTICES IN RAMP SAFETY

This chapter focuses specifically on existing safety training practices including type and duration of training, recurring training, and frequency and re-training procedures for safety violations or infractions.

GENERAL

In a 1997 study by *GSE Today*, 35% of respondents (ramp operation managers around the world) reported that reasons for ramp accidents included inadequate training and inexperienced crews (Prill 1999). The *GSE Today* survey also indicated that these inadequacies in training and experience resulted from inconsistency in standards, operating practices, and management that can be overcome through initial and recurrent training programs for employees.

As part of this Ramp Safety Synthesis study, airports, airlines, and GSPs were asked a variety of questions regarding training formats, frequency, and strategies as part of the survey questionnaire. Based on the results of the survey, 37.9% of airport respondents indicated they require airside safety training for tenants [not including Air Operations Area (AOA) or Airport Movement Area (AMA) driving]. One hundred percent of reporting airlines and GSPs responded that all ground support staff are required to participate in safety training. Although the study findings may not provide a large representative sample, survey results may offer a baseline for analyzing the type of training required by the typical aviation organizations. See Figure 5 for a breakdown of training requirements by airport type and Table 13 for comments collected from the survey outlining airside safety requirements from airport respondents. Most of the airport-required training relates to driving programs, FOD, construction, passenger loading bridges, and pedestrian safety including use of PPE (safety vests).

Safety training that personnel receive is directly related to company policy and the day-to-day responsibilities of each individual. Variation on training is a result of airport, airline, GSP, FBO, and tenant policy and is typically subject to change dependent on job-specific duties. Supplementary or specialized instruction for ground operations such as de-icing, aircraft towing and pushback, and marshalling is required to ensure that techniques, equipment, and safety operations are consistently maintained. The most common required training is fuel service, which is audited to verify that operators are meeting

FAA 14 CFR section 139.321 (e)(1) requirements. A further breakdown of safety training based on airport type is provided in Table 14 and airport associated comments are presented in Table 15. Many of these training courses are delivered by general orientation sessions and video, classroom, and on-the-job training formats. An overview of training approaches is provided in Table 16 to demonstrate how personnel are trained on each required element.

TRAINING REQUIREMENTS

The ground service area is a complex network of vehicles and individuals operating together to accomplish the same underlying goal. This goal however may be vulnerable, with loosely defined ramp procedures, poor communication, and disparity within ramp practices. Parallel safety training among airports, airlines, and GSPs helps close the gap in errors by the ground crew. The following paragraphs outline the training requirements that airports, airlines, and GSPs provided as current practices.

Airports

The complexities within training begin with the type of instruction that airports must offer to a variety of constituents. Tables 14, 15, and 16 in the previous section outline the variation in training requirements for ground handlers at airports. Training is directly influenced by the type of service delivered at airports. Training components may include, but are not limited to, general orientation, hands-on (supervised), video training, classroom training, on-line training, and rules and regulations review. Of the surveyed airports, all agreed that it is important that a mixture of these practices be utilized to provide training to tenants. Redundancy in fueling training is the most commonly reported practice that airports have employed. According the results of the survey, 36% of respondents combine both airport and tenant safety training.

Recurrent or refresher training can be delivered after specific periods of time have passed to promote safety standards and make changes in safety practices. The always changing landscapes of airport ramp areas introduce hazards that cannot always be recognized by initial training alone. In a study conducted by Prill (1999), 45% of respondents stated that a lack of motivation and knowledge among crew members were the primary reasons for ramp accidents. To ensure thorough

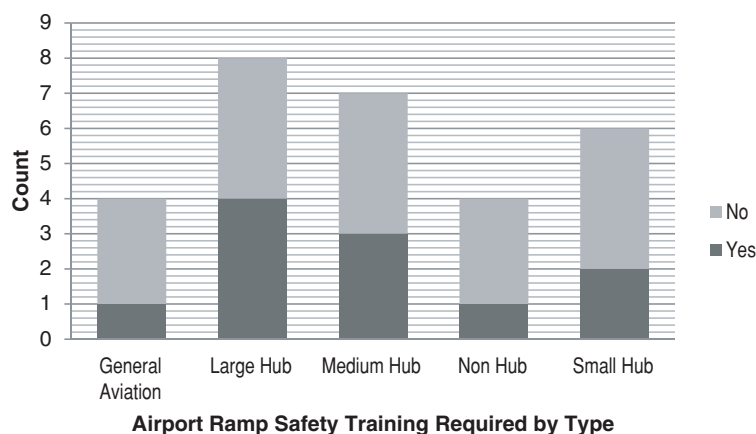


FIGURE 5 Airport ramp safety training required. [Does your airport require airside safety training for tenants (not including AOA or AMA driving)?]

TABLE 13
AIRPORT RAMP SAFETY TRAINING COMMENTS

Type	Response	Comment
General Aviation	No	Staff is required to complete general safety training as an organization and specific safety training based on their job requirements.
Large Hub	No	Basic safety training is part of driver training. Also, airport tenants expected to provide ramp safety training to employees.
Large Hub	No	Cal OSHA requires safety training and tenants are held to their own internal policies and procedures as well as compliance with Cal OSHA requirements.
Large Hub	No	We hope to develop this as a separate training module to our existing AOA/AMA driving class under our on-going SMS implementation plan.
Medium Hub	No	The airport requires tenants to have a safety program and to follow the airport's rules and regulations. The airport requires contractors to go through safety training prior to starting a job. FOD is required safety training for tenants. Safety vest requirements are trained to tenants.
Medium Hub	Yes	Under SMS we will
Non Hub	No	Atlanta Fire Department requires training for fuelers.
Non Hub	No	Everyone with AOA access receives Driver/Pedestrian Training to obtain airport access.
Small Hub	No	Required—Only related to fueling—receiving, handling, and dispensing. Airport does offer an optional class for Aircraft Maintenance Technicians who are involved with towing aircraft.
Small Hub	No	We only require airside safety training for those with ramp or movement area drivers privileges. Tenants often have required safety training for their employees who work around aircraft.
Small Hub	No	Only for jet bridge operations.

Comments for: "Does your airport require airside safety training for tenants (not including AOA or AMA driving)?"

TABLE 14
SAFETY TRAINING REQUIRED OF GSPS (BY AIRPORTS)

Airport Type	None	Fueling	Baggage Handling	A/C Handling and Loading	A/C Ground Movement	Passenger Handling	A/C Maintenance	Lav and Water	Catering	Cargo and Mail Handling	A/C Load Control	Other Services
General Aviation	1	3	0	0	1	0	0	0	0	0	0	0
Large Hub	2	5	2	2	2	1	1	1	1	0	0	2
Medium Hub	0	4	2	2	2	1	1	3	2	2	0	0
Non Hub	0	4	2	2	2	2	2	2	1	2	1	1
Small Hub	1	4	4	4	4	3	2	4	2	2	3	1
Total Count	4	20	10	10	11	7	6	10	6	6	4	4

"What types of service providers at your airport are required to have safety training?"

TABLE 15
AIRPORT TRAINING REQUIREMENTS FOR GROUND HANDLER COMMENTS

Type	Comment
General Aviation	All general aviation line services including fueling, marshalling, and towing
General Aviation	The airport provides for all of the listed service except A/C maintenance and catering. We do have our own internal safety training for these functions.
Large Hub	All companies are required to have safety training programs. Fueling is one that the airport ensures is done by train the trainer and by conducting audits. In general the tenants train their own employees on the rules of the company and what is best practice for the industry. Safety vests is another aspect of required safety training for all people who work on the airfield; vests are to be worn when 15 feet or more from the building.
Medium Hub	We do not control what the air carriers do in terms of training. We do know that air carriers conduct training with their employees and contractors for the abovementioned. Since we do provide fueling and lav/water services, safety training is required for those services.
Medium Hub	Any safety training provided is the responsibility of the tenant company.
Medium Hub	No safety training is governed by the airport authority for these types of services. Safety training is per individual company policy.
Non Hub	Bangor Airport is the FBO for the airport and provides all ground services so airport employees perform the above services and receive airport safety training.
Non Hub	NATA Safety 1st Program is used by the airport FBOs and meets FAA Part 139 requirements. Specific safety training for airlines, ground handlers, and aircraft maintenance is provided by each carrier separately.
Non Hub	Anyone with a badge must have security and airport safety training. The airport only requires fuelers to have job-specific training.

Comments for: "What types of service providers at your airport are required to have safety training? Select all that apply."

understanding of responsibilities, recurrent training programs that aimed to reduce complacency might be used.

As outlined in the results of the participating airports in this study, 62.1% do not require airside refresher safety training for tenants (18 of 29 participants). Just over 24% (7 of 29 participants) of survey respondents stated that they are currently engaged in refresher training during annual recurrent fueling examinations and access control badge renewal processes. If recurrent training is practiced, it is delivered by either the airport or the tenant 66.7% of the time. Annual recurrent training is the most common timeframe for refresher courses and is used 58.3% of the time.

According to the results of this synthesis survey, 85.2% (23 of 27 airport respondents) believe that additional safety training would benefit their airport, its tenants, and GSPs (two airport respondents skipped this question). A common suggestion from the survey respondents was to control training variables by relying on airline safety training programs, but enhance outcomes with monthly safety meetings to address key issues. The major gap within the current state of enhanced safety training is that a high rate of respondents understands the benefits of increased training, but only 57.1% (16 of 28 participants) are planning to increase the amount of safety training. In contrast, 28.6% of respondents stated they had no plans in the foreseeable future to increase the amount of safety training.

TABLE 16
SERVICE PROVIDERS AND SAFETY TRAINING REQUIREMENTS (BY AIRPORTS)

Training Types	All Service Providers	Fueling	Baggage Handling	A/C Handling and Loading	A/C Ground Movement	Passenger Handling	A/C Maintenance	Lav and Water	Catering	Cargo and Mail Handling	A/C Load Control
General Orientation	9	12	5	4	4	3	0	4	1	1	2
Hands-on/Supervised	3	11	5	4	4	4	0	4	1	1	2
Video Training	4	11	2	2	2	2	1	2	1	0	1
Classroom Training	2	10	4	3	3	2	1	2	1	0	1
On-line Training	2	8	2	3	3	2	1	1	0	0	1
Rules and Regulations Review	7	13	2	3	3	2	1	2	0	0	0
Other	2	1	0	0	0	0	0	0	0	0	0
Total Count	29	66	20	19	19	15	4	15	4	2	7

"If yes, what type of safety training is required? Are training requirements different by service? Select all that apply."

Airlines

As previously mentioned, all seven reporting airlines (two respondents from one airline) require all ground support staff to participate in safety training. In addition, six of the seven respondents require the same safety training for contracted company staff providing ground support services. The remaining airline elaborated on its training requirements by stating that all training is not the same, but standard training covers all Part 121 regulatory requirements. Furthermore, any required OSHA training and development is the responsibility of the vendor and is stated in the contract.

Depicted in Figure 6 are the types of safety training practices required by airlines. Specific training ranges from every individual receiving a general safety orientation to only half of airline personnel receiving training in push back and communication practices. The airlines reported using both on-the-job and instructional training delivery methods to promote the most thorough guidance as possible.

The amount of time dedicated to training varies from respondent to respondent. Three of the six responding airlines reported that their duration period for training was three or more days. Each of the two categories, one day or less and one to two days, had one respondent each. All reporting airlines also required refresher training for ground services. The common practice within respondents was initial safety training upon hire, with annual recurrent training on the anniversary of employment (five of seven respondents). Training is conducted twice a year or every two years for the remaining two airlines, with each option having one response. Every participating airline provides the same level of ground handling safety training at all locations.

To further facilitate consistent safe operations, all seven of the participating airlines audit their safety training require-

ments to identify gaps and trends to be addressed in future training. Part of identifying these hazards is increasing training. Based on the results, five of the seven responding airlines believe that additional safety training would benefit airline ground handling services. As with airport respondents, only three of the surveyed airlines are planning to increase the amount of safety training to personnel and/or GSPs. The other four airlines responded that they have no plans to increase safety training or that it does not apply because safety is a daily expectation.

Ground Service Providers

Without examining statistics and previous studies, a common misconception within the industry is that there is an even distribution of incidents during arrivals and departures. It is important to note that 58% of the time incidents occur during aircraft arrival and 35% during departure (Chamberlin et al. n.d.). Standardized procedures may account for this disparity; however, training aimed at overcoming inconsistency has proven useful. Four GSPs participated in this synthesis study. All four stated they train 100% of employees on general safety, OSHA standards, ramp operations, and airfield driving. Only two of the participating agencies went on to say they required training in push back operations, marshalling, communication, and “other” (other was explained by participants as aircraft servicing and transportation of dangerous goods). Training was conducted using a mixture of classroom and on-the-job instruction by all four respondents. Figure 7 illustrates the required training elements used by GSPs.

All four GSPs stated that they conduct in-house training to control variables and external training gaps. The minimum training duration provided to employees was two to three days (one of four reporting GSPs), whereas the remaining three GSPs answered three or more days. One survey participant

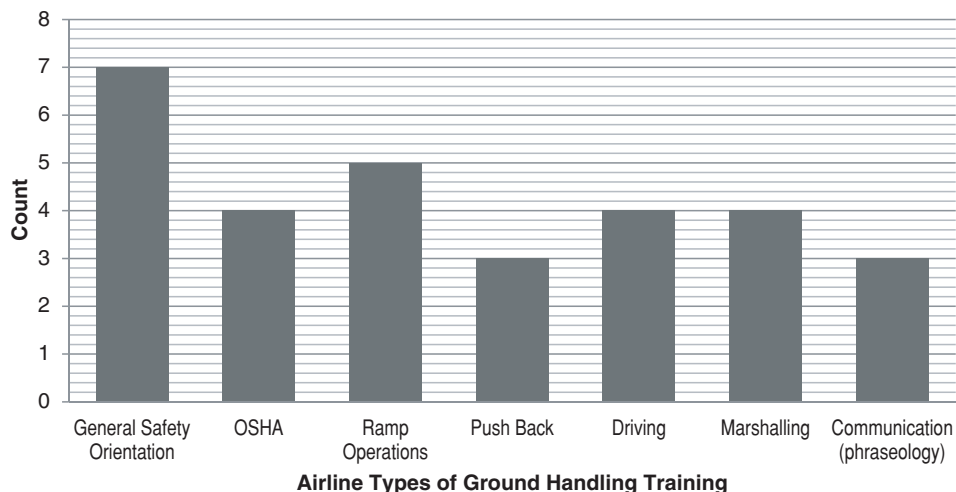


FIGURE 6 Airlines ground handling safety training. (If yes, what type of safety training is required? Select all that apply.)



FIGURE 7 GSP safety training. (If yes, what types of safety training are required? Select all that apply.)

provided further insight into its training duration requirements: “We have a 30-day classroom training program in CSR Certification for our drivers that operate front-loads, then they participate in a ramp experimental component working with an experienced mentor. The trainee is monitored and assessed three times during training and must be certified by a manager before release for full duty.”

Another major practice executed by the participants was standardized training at all locations. Requirements are set within company policy and carried out in initial and refresher training courses. To combat changes made in training requirements, all four respondents reported they require safety refresher training. Refresher training is provided annually by three of the respondents and biannually by one. Based on the survey results, the refresher training courses were conducted by airports 25% of the time, by the GSPs 50% of the time, and by both airport and GSPs the remaining 25% of the time.

To further maximize the results of their training, all four of the respondents stated they audit the programs and measure outcomes against procedures. This practice helps identify gaps within the training program and provides the necessary information for management to shape training requirements. In doing so, two of the GSPs identify the benefit of additional

safety training, whereas one believes its current training procedures are adequate. No matter the perceived benefit, none of the participating providers have plans to increase the amount of training given to their employees.

STANDARDIZED SAFETY TRAINING PROGRAM

The survey contained a uniform question asking if the participants would be interested in a standardized safety training program. A total of 39 answers by airports, airlines, and GSPs were given to the choices of “Yes,” “No,” and “Other.” A combined rate from all reporting survey participants indicated that 74.4% of respondents would like to see a standardized safety training program, whereas 7.7% are against such a practice. The remaining 17.9% were “Other” and stated various reasons why such a practice may or may not work at every location. Comments regarding the standardization included airport uniqueness, inclusion of specific features that are commonly omitted from standardized material, specific training requirements, the amount and type of training is a corporate decision, and consistency of IATA processes and procedures vary depending on clientele therefore training may vary. Depicted in Tables 17 and 18 are the responses and comments from all participants on standardized safety training.

TABLE 17
STANDARDIZED TRAINING

Respondent	Total Surveyed	Yes	No	Other	No Reply
Airport	29	24	1	4	0
Airline	7	3	1	2	1
GSP	4	2	1	1	0
Total Count	40	29	3	7	1

“Would you like to see a standardized safety training program used by airports, airlines, and ground service providers, similar to the NATA fuel service training program?”

TABLE 18
STANDARDIZED TRAINING COMMENTS

Type	Response	Comment
General Aviation	No	No comment provided
General Aviation	Other	No comment provided
General Aviation	Other	No comment provided
General Aviation	Other	Like to develop more airport-specific training, but industry standard training provides for great supplemental material, such as the American Association of Airport Executives/ANTN series.
Large Hub	Other	This would be a significant improvement, especially if this training was automated and easily accessible.
GSP	No	There is too much variation for an overall generic training program.
GSP	Other	I am not sure if that is possible as not every one of our customers is consistent with processes and procedures, so training is different by client and location.
Airline	Yes	Simply because of the close proximity of our work to some of the other airlines operating at our location
Airline	Other	It depends upon the program and the specific requirements. If every aircraft were the same and all of the equipment was the same and the airlines and the airport authorities could mutually agree on those procedures involved, the answer would be yes.
Airline	Other	Corporate decision

Comments for “Would you like to see a standardized safety training program used by airports, airlines, and ground service providers, similar to the NATA fuel service training program?”

EXAMPLES OF STANDARDIZED SAFETY TRAINING

A number of organizations provide literature and training modules to promote safe ramp operations. They include IATA, FSF, ACI, National Air Transportation Association (NATA), Air Charter Safety Foundation, and Australasian Aviation Ground Safety Council (AAGSC). As previously presented, a commonplace activity to gauge what type of training is warranted begins with program auditing. Many of the participants stated they currently audit their safety training program to identify gaps in training procedures. Two examples of common safety training practices are the safety audit for ground operations (ISAGO) developed by IATA and the Ground Accident Prevention (GAP) program developed by the FSF.

ISAGO

The implementation of ISAGO aims to improve safety and cut airline costs by drastically reducing ground accidents and injuries. Refer to chapter six for additional information regarding the ISAGO program.

Flight Safety Foundation

The FSF launched the GAP program in 2003 to address the increasing number and cost of ramp incidents and accidents on airport ramps and adjacent taxiways, and during the movement

of aircraft into and out of hangars (retrieved from FSF.org 2011). GAP contains a number of electronic and online training modules and is built on considerable work conducted by the ACI, AAGSC, European Regions Airline Association, IATA, ICAO, NATA, National Business Aviation Association, Regional Airline Association, and other organizations.

One part of the GAP program is a three-part video on towing corporate/business aircraft that provides best practices for the safe use of aircraft-tow vehicles, safely towing aircraft, and general ramp safety.

FSF Ramp Operational Safety Procedures is a standard operating procedures (SOPs) template that includes industry best practices and guidelines for a wide range of ramp procedures. The document is intended to assist ramp supervisors in the development or improvement of their organizations’ written SOPs. The template is presented in Microsoft Word format (doc) to facilitate customization by the user, including revision, deletion, and addition of information as necessary to tailor the document to the organization’s ramp activities. The *FSF Ramp Operational Safety Procedures* template is a product of the GAP program that includes industry best practices and guidelines for a wide range of ramp procedures and is intended to assist individual users in the development of unique written SOPs. According to the FSF, the guidelines presented in the document are not intended to supersede government regulations or to replace manufacturers’ or operators’ policies, practices, or requirements.

CHAPTER FOUR

DUTIES, ROLES, RESPONSIBILITIES, AND OVERSIGHT

This chapter identifies both the key roles and the responsibilities proposed by the literature review and information collected from the participant surveys and interviews.

A common issue is present in both the relevant literature provided for this study and the responses from participants from the survey. This issue is the loosely defined duties, roles, and responsibilities that are currently in place for personnel from airports, airlines, and GSPs. As previously mentioned, safety at U.S. airports is a shared responsibility among the FAA, airlines, and airports, but commonly accepted duties that promote a unified safety culture are severely lacking. Cabrera et al. (1997) suggested that safety climates can be an optimum indicator in evaluating SMSs as well as change-oriented programs. Safety attitude of management, efficient performance feedback, well-designed and developed motivation strategies, the existence of an adequate decision-making process, company philosophy toward safety as a priority, optimum upward and downward communication, and good reporting systems have all been identified from the early 1990s onward as being components of a safe organization (Cabrera et al. 1997). Company policies toward safety, emphasis on training or general safety strategies, and risk perception are several of the identified dimensions that aide personnel in promoting a safe organizational operating environment

Based on the synthesis survey, 86.2% of airports are responsible for the oversight and responsibility of the ramp/apron area, which includes exclusive use space, jet bridges, and ramps; however, only 62.1% conduct regular ramp/apron safety meetings with tenants. Of the airports that conduct ramp safety meetings, 66.7% are monthly, 23.8% are quarterly and 9.5% are conducted as needed. Gaps in management oversight may establish a reactive means to ramp safety instead of proactive mitigation. To promote cohesion in the administration of safety practices, 65.5% of surveyed airports conduct safety inspections on the ramp or in the baggage make-up areas. Another 10.3% inspect common use gates and baggage areas, leaving 24.1% not inspecting any of the identified areas. Many responsibilities in the non-movement area were cited as airline and GSP areas of responsibility.

To promote knowledge on current safety situations and concerns, management utilizes a variety of practices through-

out multiple levels in the organization. Both airlines and GSPs answered survey questions pertaining to who within the organization was responsible for safety information dissemination at the national and local level. Responses ranged from vice presidents and CEOs at the national level to ground service supervisors, union safety representatives, and station safety managers/supervisors at the local level. No matter the title or rank, each stakeholder used multiple methods to inform staff of safety concerns. These methods included audit findings, reports, onsite visits, Line Operations Safety Audits, daily briefings, bulletins, e-mails and review boards. The methods used by airlines and GSPs when providing notice to staff of safety concerns are presented in Figures 8 and 9.

To further promote the investment to safety as an organizational duty, management divides hazard reporting responsibilities across the entire workforce. This collaboration of duties helps build a safety culture by increasing staff awareness and by spreading the responsibility for incident identification among all participants. By engaging in nonpunitive safety reporting, the integrity of the reporting system can be maximized. Based on the survey, five airlines and all four GSPs engage in nonpunitive reporting practices. The remaining two airline respondents reported that they depended on the type of safety violation. Implementing this type of reporting system generates trust in the individuals providing the information to promote frequent reporting of hazards, incidents, accidents, errors, and near misses.

Participants in the survey reported on several practices used to promote safety oversight. Providing access to multiple techniques encourages reporting and further removes the reluctance to submit information. A visual depiction of the reporting options given to airline and GSP personnel to promote their role in hazard reporting is provided in Figures 10 and 11. All respondents noted that the most common form of reporting was directly to a manager or lead personnel. Common suggestions from participants outlined that no matter the system used most, it is important for management to train and educate personnel on their roles and responsibilities pertaining to safety oversight and hazard reporting. Approaching safety oversight with reporting practices as outlined previously reduces the total number of accidents and incidents by decreasing the rate of safety deficiencies on the ramp (FSF 2011).

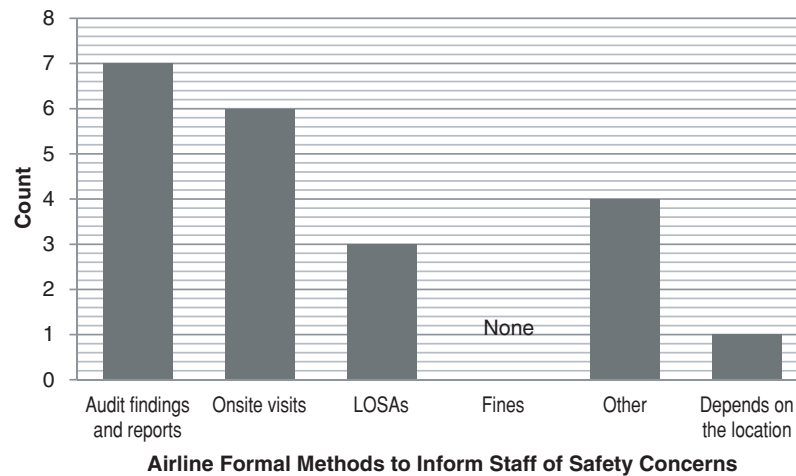


FIGURE 8 Airline methods to inform safety concerns. [What formal method does your (Airline) company use to provide notice to inform staff of safety concerns? Select all that apply.] LOSAs = Line Operations Safety Audits.

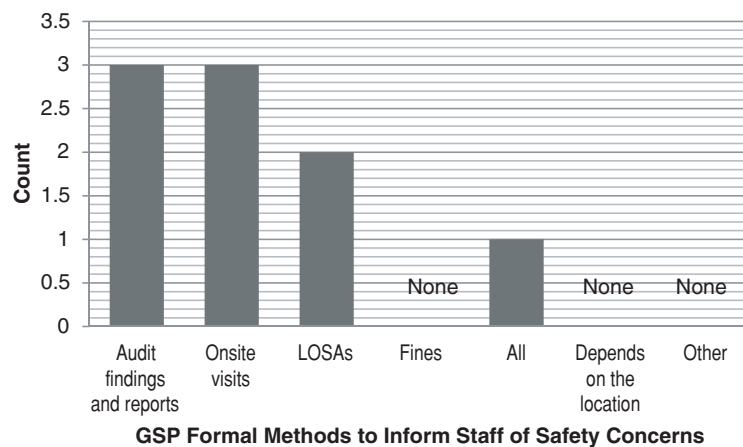


FIGURE 9 Safety Concerns. [“What formal method does your (GSP) company use to provide notice to inform staff of safety concerns?”]

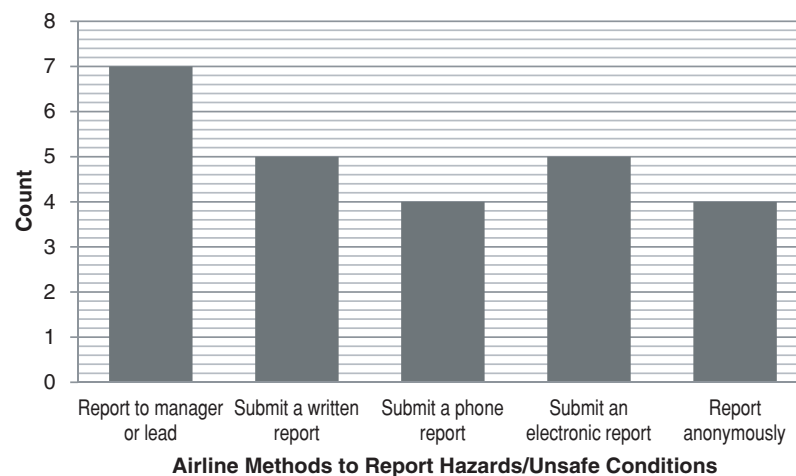


FIGURE 10 Airline methods to report hazards/unsafe conditions. [How do staff (Airline) report hazards or unsafe work conditions? Select all that apply.]

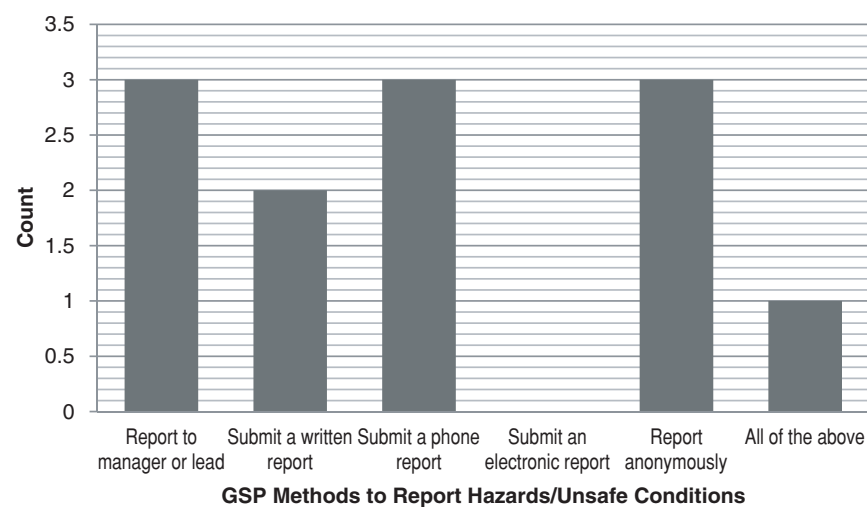


FIGURE 11 GSP methods to report hazards/unsafe conditions. [How do staff (GSP) report hazards or unsafe work conditions? Select all that apply.]

CHAPTER FIVE

TRENDS AND INDUSTRY REPORTS

This chapter provides suggestions for revised ground safety practices from industry studies addressing processes and procedures, standards, certifications, PPE, management oversight, and data collection and reporting. Suggestions included increased coordination among airports, airlines, and GSPs through committees, meetings, and champions. A compilation of suggestions is presented from two industry resources [Airport Operations Safety Panel (AOSP) and ACI] and a summary is provided to consolidate the findings.

INDUSTRY SUGGESTIONS

In a 2004 report on the Safety of Airport Operations, *Reducing Accidents and Improving Safety on the Ramp* by the AOSP, the panel provided a set of recommendations to enhance safety on the ramp. The panel was comprised of industry representatives to “raise industry awareness on the current state of airport operations safety” (AOSP 2004). The report states that

The aviation industry has entered a period of significant transition. Airlines are making progress in returning to profitability but serious financial hurdles remain. Cost cutting and preservation of capital has never been more important. Airlines are actively pursuing a new business model that calls for outsourcing non-core businesses. Airport managers are confronted with a new business model that requires active involvement on the ramp.

The AOSP panel recommendations included the following two items for improved safety of ramp operations:

1. Adopt a set of minimum standards for ramp operations, which is championed by airports. According to John Goglia, AOSP panel chairman, “The model should be that the airport take control and dictate a set of procedures. The common dominator for this issue (standards) is the airport. . . . It is in the airport’s best interest to monitor the activity on the ramp; they have the final liability.”
2. Adopt standardized licensing, training, and certification for safe vehicle operation on the ramp for ramp operators. Ramp personnel driving tankers, deicing equipment, and push back tugs do not require special permits or certifications as are mandated off of airport facilities. The panel recommends that airports

require equivalent training and certification as do other industries (AOSP 2004).

In the 2007 ACI annual survey on Apron Incidents and Accidents, member airports were asked to provide suggestions for enhancing safety on aprons. ACI members offered a variety of actions including forming committees, providing training, developing communication and promotion programs, conducting audits, establishing standards, and enforcing safety through various means. The following list presents suggestions from the ACI members surveyed in 2007 and reported in 2009. The suggestions are compiled into logical groups such as committees, promotion and training, standards, data management, and operational improvements. Duplications of items are included to demonstrate more than one response from the ACI members surveyed (ACI 2009).

Safety Committees

- Establish an Apron Safety Committee.
- Establish an Apron Safety Committee with representatives of the airport community.
- Hold safety committee meetings twice a year with the ground handling provider’s representatives, the local airport authorities, and the public authorities.
- Hold specific committee meetings whenever necessary.

Promotion and Training

- Conduct ground safety seminars on a regular basis.
- Provide continuous training and monitoring activities in apron areas.
- Distribute safety-related information in different languages, or where possible use pictograms.
- Hold regular airside safety campaigns.
- Identify minimum training standards for airside drivers.
- Organize an apron safety week for enhanced awareness.
- Prominently display posters on apron safety.
- Publish an airport safety bulletin.
- Regular training of personnel in apron safety.
- Conduct safety awareness classes.
- Display safety slogans; for example, “be clever—be careful,” “taking off with safety” at numerous locations.

- Provide specific apron safety training for contractors and vendors with apron driving authority.
- Provide training on apron rules and regulations for members of the airport community.

Data Management and Reporting

- Develop an effective and efficient apron accident and incident reporting system.
- Collect, analyze, and review incidents and accident data on a regular basis.
- Receive up-to-date information, data, and procedures pertaining to apron safety management by joining the ACI Operational Safety Sub-committee.

Operational Improvements

- Provide follow me services as and when required.
- Undertake daily FOD patrols with a sweeper truck.
- Develop a program of regular apron cleaning and airport community FOD walks.

Standards, Policies, Controls, and Audits

- Introduce color-coded permit systems for access to specific areas.
- Provide daily, weekly, monthly, and annual random auditing of GSE.
- Develop policies for apron management and vehicle parking.
- Ensure that all airside workers wear high visibility reflective clothing.
- Harmonize full-scale airport emergency plan exercise with the apron safety plan.
- Have a progressive enforcement policy in place for non-compliance with traffic directives, possibly resulting in permanently taking away driving privileges.
- Identify minimum maintenance standards for all airside vehicles.
- Introduce wildlife hazard control unit.
- Perform regular safety audits of aircraft turnarounds.
- Implement a SMS.
- Use protective and reflective gear for all airside personnel.
- Monitor vehicular movement.
- Send warning letters pertaining to careless behavior to the ground handling provider's representatives.

STUDY FINDINGS AND INDUSTRY SUGGESTIONS

This section provides an overview of the earlier industry suggestions with regard to the study findings and is organized by topics presented in the previous section: (1) Safety Commit-

tees, (2) Promotion and Training, (3) Data Management and Reporting, (4) Operational Improvements, and (5) Standards, Policies, Controls, Audits.

Safety Committees

Research and Survey Findings

The 29 airports responding to the synthesis study survey indicated that to some degree meetings relating to ramp safety take place with airline and GSP tenants on either a monthly or quarterly basis. Meetings are either coordinated by airports or limited to airlines. Some respondents indicated that issues are resolved at meetings that are not specifically designated as ramp safety meetings (such as station manager meetings) and others reported that safety concerns are addressed as they are identified. A representative of a non hub airport commented that with regard to safety at the airport:

The Airport Operations Managers communicate with Airline Station Managers and Supervisors almost daily about ongoing operations at the airport. Furthermore, if a problem does arise, we simply talk with the Airline Station Managers and Supervisors. The Airport is small enough that we maintain open lines of communication between all parties. If irregular activity is noticed, it is communicated and dealt with on the spot.

Industry Suggestions

According to ACI's 2007 survey of members regarding improvements to ramp safety, the addition of safety meetings was listed a number of times as a potential safety program enhancement. Safety meetings are a means to discuss concerns and to inform airport and tenants of operational changes or to report on the status of identified hazards and mitigations. OSHA's Voluntary Protection Program recommends safety meetings as an important aspect of its program. Airport safety construction programs require safety meetings for contractors. ICAO's Annex 14 requires safety meetings for aerodromes under the SMS program.

Promotion and Training

Research and Survey Findings

All airlines and GSPs surveyed in this synthesis study provide a variety of training to staff depending on roles and responsibilities, including both classroom and on-the-job training ranging in duration from 1 to 3 or more days. Training focuses on carrier operations and is not consistent across providers; however, survey respondents indicated in various

comments that training either met or exceeded airline and OSHA requirements. Airports require a range of training and certification requirements based on the type of service (fueling, for example, requires certification). Approximately 60% of the airlines and GSPs surveyed as part of this synthesis study regarding standardized training responded that they would see value in the program as long as the standardization allowed for flexibility to support site-specific differences. Additionally, 85% of airport respondents believe that additional training would benefit airports and tenants alike. Airlines and GSPs typically require refresher training and audit their training programs. When airports were asked “Does your airport review tenant safety training programs as part of the lease or license agreement?” 83% responded “No” and 17% “Yes.” Typical airport oversight of training programs is limited to AOA and AMA driving and various airport comments indicated that airlines and GSPs were accountable and responsible for staff training and that the airport’s role in advising tenants on their training programs was negligible.

Industry Suggestions

Both AOSP and ACI suggest that training is an important aspect of ramp safety. Prill (1999) indicated that one-third of ramp operations managers consider inadequate training to be a contributing factor in ramp accidents and is the result of a lack of motivation and knowledge. Chamberlin et al. (1996) suggested that a number of actions could be taken to mitigate accidents such as provide better training of marshallers and wingwalkers to include scenario-based training. Cabrera et al. (1997) reported that company policies toward safety, emphasis on training or general safety strategies, and risk perception are several of the identified dimensions that promote a safe organizational operating environment. One GA survey respondent commented that

We had a full-time position for a safety/training person for the 2009/10 Budget, however the city instituted a hiring freeze and we lost the position. So the responsibility had to fall back on someone who already had many hats to wear. We are hoping to try for the position again in the 2011/12 Budget year. We feel that to have an effective safety program you really need a full time individual.

Data Management and Reporting

Research and Survey Findings

Today, apart from surveys conducted by industry aviation organizations such as ACI, there is no centralized database of accident, incident, or near miss data from which to trend potential hazards and hazardous operations on the ramp. Typically,

each airline or GSP collects and reports internally on trends. Rarely, unless accidents occur between carriers or result in airport facility damage, are accidents and incidents centrally documented by airport management. The FAA, NTSB, and OSHA collect data separately when investigating accidents, incidents, and fatalities and, as reported by the GAO, the lack of data on accidents and incidents limits the industry’s ability to understand inherent risks in ramp operations.

Industry Suggestions

In the U.S. GAO report on ramp safety, the GAO is recommending that the FAA take several measures to enhance runway and ramp safety including “improving data collection on runway overruns and ramp accidents” and that “a lack of complete accident data and standards for ground handling hinders the effort to understand the nature, extent, and cost of accidents and to improve safety” (Dillingham 2007). The ability to collect industry data on ramp accidents and incidents would require significant collaboration among airlines, GSPs, and airports. Public disclosure of accident and incident data could serve as a deterrent unless the FAA is able to protect the information through legislative measures.

Operational Improvements

Research and Survey Findings

Of the 29 airports surveyed in this synthesis study, 90% responded “Yes” to the question “Does your airport manage or collaborate with airlines and ground service providers to inspect for FOD on the ramp/apron?” Only 10% of the airports surveyed indicated “No.” General comments included that FOD management by tenants is a lease requirement and that airports conduct movement area FOD walks while tenants address FOD on the ramp areas. FOD is traditionally one of the key areas where tenants and airports work together on safety initiatives. Many airports and tenants provide prizes and other incentives for tenants and staff to manage FOD.

Industry Suggestions

Two suggestions from the ACI membership survey indicated FOD management as a possible operational improvement. Most airports participate in or have oversight of FOD programs both on the ramp and the movement areas. The FAA requires FOD management through Part 121 for airlines and Part 139 for airports; FOD is a shared responsibility that crosses typical airline and airport ramp oversight that allows for coordinated and collaborative joint efforts. The collaboration that is present in FOD programs could serve as a model for future training and ramp oversight and safety program management.

Standards, Policies, Controls, Audits

Research and Survey Findings

Most airlines and GSPs conduct internal safety and training audits. Airports rarely conduct tenant audits or inspections unless accidents or incidents occur. Airports typically restrict inspections to the movement area as a requirement of Part 139. When asked if airports conduct safety inspections on the ramp or in the baggage make-up areas, 66% responded “Yes,” 24% replied “No,” and 10% indicated inspections only occur in common use areas. Airport comments included an increase in ramp safety inspections and a non hub airport reported that “Our self inspection program includes operations personnel monitoring the condition of the airfield (including the ramp area) at least once daily. However, no safety specific checklist exists beyond the self inspection checklist.”

Airports surveyed were also asked “Does your airport require an external audit of ground service providers through

programs such as the IATA Safety Audit for Ground Operations (ISAGO) or Insurance agencies?” The majority (86%) replied “No,” with 10% replying “Yes” and 3% indicating “Other,” with the comment that if an audit occurred the respondent was not aware of it. One of the airports commented that the safety inspection was conducted by its insurance company.

Industry Suggestions

A variety of suggestions from the ACI survey group recommended audits, policies, standards, monitoring, and the implementation of SMS as possible ramp improvements for safety. John Goglia, AOSP panel chairman suggests that airports take on the role of ramp management and monitoring. Airport oversight of the ramp through safety meetings, audits, and inspections provide a centralized coordination point for documenting and reporting on safety issues.

CHAPTER SIX

FUTURE TRENDS

Current emerging and future trends gleaned from literature and industry research are included in this chapter. Areas discussed include technologies such as the FAA's Next Generation Air Transportation System (NextGen) program and surface radar and multilateration systems; SMSs and the FAA Notice of Proposed Rulemaking (NPRM) for SMSs; the FAA's recent NPRM regarding Safety Enhancements for Part 139 Certification of Airports; the ISAGO program; use of ramp towers to control aircraft in gate areas; and changing business relationships such as airports managing ground services.

TECHNOLOGIES

NextGen

NextGen is a comprehensive program led by the FAA that will modernize the National Airspace System (NAS) through new technologies, processes, and collaborations. The project is scheduled to be completed by 2025 and is currently underway.

According to the FAA, many NextGen operational capabilities will make the NAS safer. The Automatic Dependent Surveillance-Broadcast (ADS-B) will provide safety improvements on the ground and advances in tracking operations on airport surfaces will make runway incursions less likely. Also, integrating Airport Surface Detection Equipment-Model X (ASDE-X) surface radar coverage with ADS-B surveillance of aircraft and ground vehicles will increase situational awareness.

As mentioned previously, one of the NextGen initiatives is to leverage the existing ASDE-X system, installed at approximately 32 airports across the country, to extend coverage to the ramp areas through a software tool called "Surface Management." ASDE-X is a ground radar system that allows FAA air traffic controllers to see real-time positions and identification information of aircraft and vehicles on the airport surface. By extending the Surface Management System to the ramp areas, the air traffic controllers and airport operators are able to track aircraft and vehicles from the movement area into the ramp area and to the gate. In 2009, the John F. Kennedy International Airport (JFK), FAA, and Port Authority of New York and New Jersey extended ASDE-X coverage into JFK ramp areas to provide surface surveillance data. The data are shared by the FAA, airport, and airlines to provide a comprehensive view of the airports operations.

Surface Radars/Multilateration/ADS-B

A number of commercial products exist that provide software and hardware solutions to identify, track, or guide aircraft and/or vehicles on the ground. These products offer visual and electronic alerts to airside operations using radar and transponder technologies such as multilateration or ADS-B. Multilateration is "the process of locating an object by accurately computing the time difference of arrival (TDOA) of a signal emitted from that object to three or more receivers using satellite and radars" (Wikipedia 2010).

ADS-B uses Global Positioning System signals along with aircraft avionics to transmit the aircraft's location to ground receivers. The ground receivers then transmit that information to controller screens and cockpit displays on aircraft equipped with ADS-B avionics. The ADS-B technology can also be used on vehicles in a similar manner (Takemoto and Jones 2010).

The companies listed in Table 19 are currently using these products to provide airports, airlines, and the FAA with solutions to track aircraft and vehicles on the ramp for efficiency and safety. Some of the software features include recording and playing back events for investigational purposes, setting electronic boundaries to restrict vehicles from unauthorized areas, monitoring vehicle speeds, creating proximity alerts, and providing enhanced visual aids for Surface Movement Guidance and Control System low-visibility conditions.

RAMP TOWERS

Ramp towers are often managed by airlines, outsourced to third-party companies, or in some cases operated by airport or county/city staff such as at Denver International. Ramp towers are typically responsible for aircraft movements conducted in the non-movement or ramp area. Ramp tower controllers assist with traffic sequencing, separation, pushback, gate arrivals and departures, and coordination with the FAA's Air Traffic Control Tower ground controller.

Ramp tower structures vary widely and can include control tower-like facilities such as the US Airways Terminal One Ramp Control Tower at Philadelphia International Airport, which offers a 207-foot view of the ramp and gate areas. Other ramp towers are operated from terminal rooms with window views of the ramp and gate areas.

TABLE 19
SURFACE MANAGEMENT SYSTEM PRODUCTS

Company	Product(s)	Website	Brief Description
Advanced Aviation Technology Ltd.	DSMR-800	http://www.aatl.net/products/radar.htm	Surface movement radars using millimetric radars for tracking surface movement operations including runway/taxiway incursion detection, critical area penetration monitoring, and conflict alerts
ID Systems	AvRamp® SafeNav™	http://www.id-systems.com/industry-solutions/aviation/	Wireless Vehicle Management System and Airport Vehicle Navigation and Runway Incursion Avoidance System products that manage airside vehicle tracking and situational awareness
PASSUR Aerospace	Portal™ inSight™ OPSnet™ FlightPerform™	http://www.passur.com/products-for-airports.htm	A variety of products for airport operations including airspace activity, arrival and departure rates, real-time runway configurations, vectors, miles-in-trail, detailed flight trajectory and traffic flows, and NOTAMS/Field Condition Reporting
Safegate Group	Safedock	http://www.safegate.com/home/safegate-solutions/the-safegate-solutions/docking-gs	System that provides aircraft guidance on the ground through the use of an electronic docking system that guides pilots into gate areas by aircraft equipment type
Sensis Corporation	Airport Surface Detection Equipment, Model X (ASDE-X) Aerobahn®	http://sensis.com/products-by-solution.php	Various real-time FAA and commercial surface management system products using a multilateration (MLAT) surveillance infrastructure to manage movement and non-movement areas through visual identification of aircraft and vehicles, including recording and replay features for accident/incident investigations
SRA International Inc./ERA	MSS—MLAT and ADS-B Surveillance Squad—Vehicle Tracking	http://www.sra.com/air-traffic-management/solutions/index.php	Hardware and software aircraft tracking system using multilateration (MLAT) for surface management and control. Ground vehicle tracking using ADS-B broadcasting for Advanced Surface Movement Guidance and Control Systems.

Source: See web link for each product.

NOTAM = Notice to Airmen; ADS-B = Automatic Dependent Surveillance-Broadcast.

Ramp towers are typically installed to increase efficiencies and safety through communication with pilots and oversight of the ramp and gate areas. Using radio communication and visual tools such as video cameras and surface management software provides an additional level of aircraft separation and control on the ramp. Although limited industry data exist to reflect a decrease in ramp incidents and accidents through the installation of ramp towers, a report by the U.S. GAO on Aviation Runway and Ramp Safety indicates that when asking experts to provide their views on safety-related industry efforts, they suggested that the most effective ones were being taken mainly by airlines; for example, by setting safety targets and using ramp towers. Of 15 U.S. GAO survey respondents, 2 experts indicated that airports' use of ramp towers was "very or extremely effective in addressing ramp accidents, and 3 stated that airlines' use of ramp towers was very effective. One expert said that ramp towers improve operational safety but that all operations are still not completely visible" (Dillingham 2007).

Research conducted online and through industry organization information resulted in a partial list of ramp tower operations at U.S. airports and is presented in Table 20. The list is intended to demonstrate the variety and diversity of ramp tower operators, not to serve as a comprehensive list of all ramp tower operations in the United States.

SAFETY MANAGEMENT SYSTEMS

On October 7, 2010, the FAA released a NPRM through the *Federal Register*, Vol. 75, No. 194 (Docket No. FAA-2010-0997; Notice No. 10-14 RIN 2120-AJ38) entitled "Safety Management System for Certificated Airports." The NPRM proposed that all CFR 14 Part 139 certificated airports establish a SMS "for its entire airfield environment (including movement and non-movement areas) to improve safety at airports hosting air carrier operations" (*Federal Register* 2010a).

TABLE 20
PARTIAL LIST OF RAMP TOWER OPERATIONS IN THE UNITED STATES

Airport Name	Airport	Operated by
Chicago–O'Hare	ORD	Signature, United
Cleveland Hopkins International	CLE	Continental
Dallas Fort Worth	DFW	American
Denver International	DIA	City and County of Denver, United
Detroit Metro	DTW	Northwest, Delta
John F. Kennedy International	JFK	Airport Operated, JetBlue,
LaGuardia	LGA	American, United, Delta, US Airways
Los Angeles International	LAX	United, Delta, American, Alaska
Miami International	MIA	American Airlines
Philadelphia International	PHL	Airport Operated, US Airways,
San Francisco International	SFO	Airport Group International (AGI)
Seattle–Tacoma International	SEA	Robinson Aviation Inc. (RVA)

Source: Internet research and airport website information.

The FAA further stated that “the proposal extends the scope of Part 139 by including the non-movement areas, but the FAA has concluded that ensuring safety in air transportation requires that an SMS applies to any place that affects safety during aircraft operations” (*Federal Register* 2010b).

According to the FAA’s Advisory Circular 150/5200-37, “Introduction to Safety Management Systems for Airport Operators,” an SMS is defined as “The formal, top-down business-like approach to managing safety risk. It includes systematic procedures, practices, and policies for the management of safety (including safety risk management, safety policy, safety assurance, and safety promotion)” (FAA 2007b).

An SMS can be further defined as including the following program elements:

- 1—Safety Policy
 - Formal Policy
 - Management and Staff Roles and Responsibilities
 - Program Objectives and Goals.
- 2—Safety Risk Management
 - Hazard Identification
 - Safety Risk Assessments
 - Safety Risk Mitigation, Monitoring, and Reporting.
- 3—Safety Assurance
 - Quality Control—self-inspections
 - Quality Assurance—program audits/evaluations.
- 4—Safety Promotion
 - Training and Orientation
 - Data and Reporting/Communication
 - Safety Culture.

The proposed changes to CFR 14 Part 139 certificated airports regarding SMS could change the management of the ramp area by formalizing the airport’s responsibility for the non-movement area; however, the NPRM does not reflect the final rulemaking. The future SMS program, which will be finalized after review of industry, airport operators, and pub-

lic comments, may or may not include the proposed changes to ramp oversight.

On February 1, 2011, the FAA released a NPRM through the *Federal Register*, Vol. 76, No. 21 (Docket No. FAA-2010-0247; Notice No. 11-01 RIN 2120-AJ70) entitled “Safety Enhancement Part 139, Certification of Airports.” The NPRM proposes that all CFR 14 Part 139 certificated airports “establish minimum standards for training of personnel who access the airport non-movement area (ramp and apron) to help prevent accidents and incidents in that area.” The NPRM provides guidance on program development, type and frequency of training, and reporting. As mentioned for the SMS rule, the training NPRM does not reflect the final rulemaking and possible changes resulting from public and industry comments could alter the current proposed requirements (*Federal Register* 2010b).

ISAGO

IATA launched the IATA Safety Audit for Ground Operations (ISAGO) program in February 2008 to provide standardized auditing for GSPs. The program is designed much like the IATA Operational Safety Audit program for airlines. A successful audit results in the GSP company name displayed on an IATA website registry, which allows airlines and airports to assess the company’s ability to meet ISAGO standards. ISAGO proposes that the audit function may offer safer ground operations and improved quality standards through participation in the program. As of January 2011, only one GSP located in the United States [Seattle–Tacoma International Airport (Sea-Tac)] is listed on the registry (a total of 61 are presented on the ISAGO website). The majority of ISAGO-registered companies are located in Europe, Asia, Africa, the Middle East, and South America. Sea-Tac is requiring all GSPs to complete audits by the end of 2011 to provide services at the airport. ISAGO may assist airports with the standardization and management of GSPs through their audit program; however, with few U.S. airports and GSPs participating at this time, the program may have difficulty gaining momentum.

AIRPORT MANAGEMENT OF GROUND SERVICES

In April 2006, the Aviation Ground Services Association (AGSA) was formally launched through the AAAE. The group's focus was to support airports that were developing and managing ground handling services. In an interview with *Airport Business Magazine*, Bruce E. Carter, AGSA Committee Chair stated that "For airports, the primary focus is on maintaining and attracting air service. As airports are being pushed to find new ways of operating and generating revenue—led by the carriers' emphasis on cost reduction—some are looking at getting into the into-plane refueling and/or other airline services" (Infanger 2006).

Approximately 50 airports and service companies comprised the AGSA organization from 2006 through 2008. In 2008, the group disbanded for a variety of reasons, although multiple airports continue to provide ground services. For example, the Columbus Regional Airport Authority oversees the operations of the Port Columbus, Rickenbacker, and Bolton Field airports. One of the airport services is management of ground services. The airport's primary goal in taking over the ground services was to maintain support for their existing carriers, especially for fueling, cargo handling, and ground handling. The prior service provider was unable to continue providing services owing to financial constraints and the airport took over the services. According to Charlie Goodwin, Director, Airport Operations Columbus Regional

TABLE 21
FORMER AGSA COMMITTEE AIRPORTS
AND SERVICE ORGANIZATIONS

Airport	City/State
Castle Airport	Atwater, CA
Chattanooga Metro Airport Authority Chattanooga Metropolitan Airport	Chattanooga, TN
Columbus Regional Airport Authority Bolton Field Airport	Columbus, OH
Fort Wayne International Airport	Fort Wayne, IN
Globe Composite Solutions, Ltd.	Rockland, MA
Gulfport–Biloxi International Airport	Gulfport, MS
Hartsfield–Jackson Atlanta International Airport	Atlanta, GA
Lexington Blue Grass Airport	Lexington, KY
Metropolitan Nashville Airport Authority Nashville International Airport–BNA	Nashville, TN
Middle Tennessee State University	Murfreesboro, TN
Quad City International Airport	Moline, IL
Sedalia Memorial Airport	Sedalia, MO
SITA	Trinidad and Tobago, West Indies
Springfield/Branson National Airport	Springfield, MO
Trillion Aviation	Austin, TX

Source: AAAE—http://www.aaae.org/about_aaa/aaae_committees/aga.

Airport Authority, most airports that take on ground support services engage in the activities to support carrier activities and to maintain continuity in services. A list of former AGSA committee representative airports and service organizations is provided for reference in Table 21.

CHAPTER SEVEN

CONCLUSIONS

The combined review, survey results, and interviews provide a snapshot of the current ramp area safety issues, operations, and practices in the United States. Generally, the findings focus on the following key conclusions:

- Airport ramp areas are complex regardless of airport size or configuration.
- No comprehensive U.S. standards exist with regard to non-movement area ramp markings, ground operations, or safety training.
- Ramps are inherently dangerous (based on the limited accident and incident data that are currently available), but no data repository exists that presents a complete analysis of accident types, root causes, and trends to demonstrate mitigation successes (such as training).
- Airlines and ground service providers (GSPs) surveyed typically individualize training programs to meet or exceed Code of Federal Regulations Part 121 and Occupational Safety and Health Administration (OSHA) regulatory requirements and introduce various levels of safety programs such as audits and inspections.
- Airports, airlines, and GSPs have various roles and responsibilities depending on airport contractual and operational agreements.
- Various FAA, industry, and technology safety initiatives are underway.

SURVEY FINDINGS

Of the airports, airlines, and GSPs surveyed and interviewed, all respondents were aware of ramp concerns with regard to safety. This knowledge indicates that ramp safety is not a new topic; some of the earliest research reviewed was initiated in the early 1990s.

Based on the synthesis study survey, no distinct safety management trends or practices emerged with regard to airport size, location, or management oversight. Many of the airports have introduced ramp safety programs through both informal and structured committees and meetings, ramp inspection and collaborative foreign object debris/damage programs, citation and education initiatives, and safety training. Some of the small and non hub airports indicated through survey comments that their safety relationship with tenants occurred informally through well-established communication practices and regular onsite presence. General aviation airport representatives found the synthesis survey challenging because of their noncommer-

cial, nongate airport operations. General aviation ramp oversight is geared toward private pilot, charter, and small corporate operations with a strong fixed-base operator role in ramp and aviation management, including fueling and catering services. Additionally, some large hub airports have multiple and complex tenant relationships depending on lease agreements and gate and ramp management, including ramp towers operated by airlines and third-party providers.

Among the 10 airlines and GSPs participating in the synthesis survey, respondents provided consistent replies with regard to safety operations, training, and reporting. All airlines and GSPs surveyed focus on comprehensive training programs that either meet or exceed OSHA safety or 14 CFR Part 121 training requirements. Nationally and locally, airlines and GSPs reported various methods such as safety briefings, peer reviews, audits, and inspections to promote general safety awareness and compliance. Airlines and GSPs invest significant time and expense to staff training and therefore when staff self-report infractions, the errors, incidents, or accidents are typically resolved through re-training efforts or additional supervision.

RAMP OPERATIONS

Industry can point to a number of reasons for the increase in ramp accidents and incidents, such as outsourcing staff; higher volumes of flights; increased congestion in the ramp area; larger aircraft; fewer airport operations staff; and cost-cutting measures with regard to training, equipment, and staff supervision. Measures to mitigate these changes have included, for some, increased training, safety promotional programs, re-training as a means to correct hazardous behaviors, nonpunitive reporting, open communication, and safety committees.

Today there is no clear single ownership and supervision of the ramp area. Tenants lease gates, passenger loading bridges, equipment staging areas, etc., in a variety of agreements and configurations. Airports surveyed indicated that both common use and leased gates typically make up their airport facility configurations. In a few cases, airports manage all their gate areas; in others, an airport's only oversight is of common use gates. This complexity and diversity can lead to a lack of clear management of the ramp area. In addition, no U.S. standards or regulatory requirements exist for airport ramp markings, signage, or operations. Each air carrier manages operations to their company guidelines; these guidelines are often used as a foundation

for safety and operational training. Some lease agreements allow for air carriers to use unique markings at the gate areas; this practice assists with pilot and ground service crew familiarity at the gate. Because one size does not fit all, the challenge relating to ramp management is difficult to resolve. Each aviation partner faces various safety and operational hurdles, and even with collaboration, communication, and standardization, the ramp will remain complex and congested.

RAMP SAFETY TRAINING

Because no national or centralized incident and accident data repository exists, it is unclear whether changes to ramp programs such as increased training or improved situational awareness result in reduced incidents and accidents. Nonetheless, based on the synthesis surveys and the review conducted, additional training has been identified as a means to reduce accidents and incidents on the ramp. Surveyed airlines and GSPs presented additional or repeat training as one of the first mitigations required for safety violators.

The FAA's recent Notice of Proposed Rule Making (NPRM) regarding airport oversight of ramp training (as part of an airport's Part 139 certification program) may introduce new opportunities for centralized training and trending of training information; however, the challenges facing small airports to design, deploy, and manage recordkeeping requirements for such programs may be prohibitive.

DATA COLLECTION AND REPORTING

With regard to data collection and reporting, the challenge to airports, airlines, and GSPs is to develop a method to share safety data in a useful and purposeful way. Although the Airports Council International (ACI) Apron Accident Survey compiles information from approximately 150 airport members, this airport-centric accident and incident information is limited. Rarely do air carriers or GSPs report internal accidents and incidents to airports. To understand the cause and effect of training, human factors, and types of training, a centralized database would greatly improve the ability to trend and track best practices. However, this goal could be difficult given current airport/airline relationships, public disclosure laws, and the competitive business of ground operations.

ROLES AND RESPONSIBILITIES

Airports, airlines, and GSPs support aviation businesses through a collection of processes, training, and operations, yet at this time very few of these collective operations are shared. Most of those airports responding to the synthesis survey indicated that relationships with tenants are typically managed through lease and license agreements, rules and regulations, safety violations and citations programs, and both formal and informal safety committee meetings. Sixty-two percent of

the surveyed airports indicated that some form of regular safety meetings exist within their airport/tenant operations. A variety of formats and frequencies exist, but airports consistently responded that safety meetings focus on resolving identified safety concerns. As a consistent practice, safety meetings appear to be a means to bridge airport, airline, and GSP responsibilities at least with regard to resolving safety hazards and associated risks.

CURRENT GAPS

Two identified gaps based on the synthesis study results include the lack of mandatory safety committees with integrated aviation partner roles and the introduction of ramp standards for markings, operations, and associated operator certifications. Both the Airport Operations Safety Panel (AOSP) and ACI member surveys indicate that safety meetings can be vehicles to enhanced communication and resolution of safety issues. Formal safety reporting and review is recommended as part of the Safety Management System (SMS) and required in OSHA's Voluntary Protection Program. If SMS programs are introduced and ultimately mandated by the FAA for all regulated aviation operations (such as airports and airlines), safety meetings would be expected as part of the SMS program. The AOSP panel and ACI members also recommend that ramp oversight be delegated to each airport and that ramp standards, audits, certifications, and enforcement policies be implemented and managed by airport operators. Airport staffing and budgetary challenges associated with these proposed suggestions are not addressed in the survey results.

FUTURE TRENDS

As the FAA's NextGen initiatives and other technical advancements continue to improve aviation technologies, airports may benefit from solutions such as ground surface radars, Automatic Dependent Surveillance-Broadcast, and collaborative data sharing. Aircraft movements on the ramp area including near misses and incursion data can assist airports and airlines with jointly mitigating facility or operational constraints. Airports' roles in offering ground support services are a future trend that may improve the integration of airport and ramp operation functions. The opportunity for an airport operator to understand challenges faced by GSPs may assist in bridging gaps for improved collaboration and efficiencies.

During the course of this ramp safety synthesis study and survey effort, two NPRMs were introduced by the FAA. Each of the NPRMs proposes new regulatory programs to provide additional oversight of the ramp area. Docket No. FAA-2010-0997 introduces the SMS as a required airport program and Docket No. FAA-2010-0247 proposes an airport non-movement area training program. Depending on the final rulemaking outcome, these NPRMs could change the current structure of airport ramp operations, especially with regard to the airport's roles and responsibilities in ramp safety and oversight.

GLOSSARY OF TERMS

Above wing: Ground support services such as cabin cleaning and catering that take place above the wing.

Accident: FAA System Safety Definition: An unplanned fortuitous event that results in harm; i.e., loss, fatality, injury, system loss. The specific type and level of harm must be defined; the worst case severity that can be expected as the result of the specific event under study. Various contributory hazards can result in a single accident.

Aircraft accident: An occurrence associated with the operation of an aircraft, which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft suffers substantial damage.

Aircraft damage: Any damage or adverse condition that affects the structural strength, performance, or flight characteristics of an aircraft or causes a delay in flight operations owing to repairs.

Aircraft operation: Operation of an aircraft with the intent of flight.

Air Operations Area (AOA): Any area of an airport used or intended to be used for landing, takeoff, or surface maneuvering of aircraft. An air operations area includes such paved areas or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiways, or apron.

Airport Movement Area (AMA): Controlled by the FAA's Air Traffic organization; typically runways and taxiways.

Airside: All activities that take place on the movement and non-movement areas of an airport (as compared with terminal or landside).

Apron: The part of an airport, other than the maneuvering area intended to accommodate the loading and unloading of passengers and cargo; the refueling, servicing, maintenance, and parking of aircraft; and any movement of aircraft, vehicles, and pedestrians necessary for such purposes. Vehicles, aircraft, and people using the apron are referred to as apron traffic. Apron is typically used in Europe and in the United States it is referred to as the "Ramp."

ASDE-X: Airport Surface Detection Equipment, Model X (ASDE-X) is a sophisticated, airport surface detection technology. ASDE-X integrates data from a variety of sources, including radars and aircraft transponders, to give controllers a more reliable view of airport operations. Controllers in the tower see the aircraft on a continuously updated color display map and are able to spot potential collisions. ASDE-X capabilities will be added to many of the sites that already

have AMASS (Airport Movement Area Safety System), as well as other busy airports. ASDE-X enables air traffic controllers to detect potential runway conflicts by providing detailed coverage of movement on runways and taxiways. By collecting data from a variety of sources, ASDE-X is able to track vehicles and aircraft on the airport movement area and obtain identification information from aircraft transponders.

Aviation Safety Reporting System (ASRS): A voluntary program administered by NASA that receives, processes, and analyzes reports of unsafe occurrences and hazardous situations that are voluntarily submitted by pilots, air traffic controllers, and others. Information collected by the ASRS is used to identify hazards and safety discrepancies in the National Airspace System. It is also used to formulate policy and to strengthen the foundation of aviation human factors safety research.

Below wing: Ground support services such as fueling, baggage handling, etc., that take place below the wing.

Causes: Actions, omissions, events, conditions, or a combination thereof that lead to the accident or incident; also, events that result in a hazard or failure. Causes can occur by themselves or in combinations.

Circle of safety: At the gate or parking location, painted lines resembling an enlarged outline of an aircraft typically define the circle of safety.

Common use or shared-use gates: Airlines share the use of gates in coordination with airport management and other air carriers providing services at the airport.

Effect: The potential outcome or harm of the hazard if it occurs in the defined system state.

Equipment damage: Any damage or adverse condition that limits or prevents the use of mobile aircraft handling equipment or requires repairs.

Exclusive use gates: Airlines lease airport gates for only their use. Typically, airports use preferential use gates at which airlines have preferred use, but if the airline is not using the gate, other airlines can access the gate.

Facility damage: Any damage or adverse condition that limits or prevents the use of a fixed aircraft handling facility or requires repairs.

Finding: A condition, supported by objective evidence, which demonstrates nonconformance with a specific standard.

Foreign object debris/damage (FOD): Any object that does not belong in or near airplanes and, as a result, can injure airport or airline personnel and damage airplanes. Airports, airlines, and airport tenants can reduce this cost

by taking steps to prevent airport FOD. FOD encompasses a wide range of material, including loose hardware, pavement fragments, catering supplies, building materials, rocks, pieces of luggage, and even wildlife.

Ground incident: An occurrence not associated with the operation of an aircraft, causing injury that does not require professional medical attention, or minor damage to an aircraft or other equipment.

Ground operations: The department, company, or vendor responsible for all ground (ramp) operations.

Ground Service Equipment (GSE): The support equipment found at an airport, usually on the ramp or the servicing area by the terminal. This equipment is used to service the aircraft between flights. As its name implies, GSE is there to support the operations of aircraft on the ground. The functions that this equipment plays generally involve ground power operations, aircraft mobility, and loading operations (for both cargo and passengers).

Ground Service Provider (GSP): Ground crew members include:

- Airframe and power plant technicians
- Avionics technicians
- Baggage handlers
- Rampers (ramp workers)
- Gate agents
- Ticket agents
- Passenger service agents (such as airline lounge employees)
- Flight dispatchers.

Hazard: Any real or potential condition that can cause injury, illness, or death to people; damage to or loss of a system, equipment, or property; or damage to the environment. A hazard is a condition that is a prerequisite to an accident or incident.

Human factors: Human factors involves gathering information about human abilities, limitations, and other characteristics and applying it to tools, machines, systems, tasks, jobs, and environments to produce safe, comfortable, and effective human use. In aviation, human factors is the study and application to better understand how humans can most safely and efficiently be integrated with the technology. That understanding is then translated into design, training, policies, or procedures to help humans perform better.

Incident: “An occurrence other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations.”

Injury: Any condition that requires medical assistance, including first aid.

Injury (fatal): Any injury that results in death within 30 days of the incident/accident.

Investigation: A process conducted for the purpose of accident or incident prevention that includes the gathering and analysis of information; the drawing of conclusions, including the determination of causes and, when appropriate, the making of safety recommendations.

Jet bridge: A passenger loading bridge (also termed loading bridge, aerobridge/airbridge, jetway, passenger walkway, or passenger boarding bridge) is an enclosed, movable connector that extends from an airport terminal gate to an airplane, allowing passengers to board and disembark without having to go outside. Depending on building design, sill heights, fueling positions, and operational requirements it may be fixed or movable, swinging radially or extending in length.

Movement area: The runways, taxiways, and other areas of an airport that are used for taxiing or hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and aircraft parking areas (14 CFR 139.3).

NextGen: Next Generation Air Transportation System is an FAA initiative to overhaul the national airspace system to make air travel more convenient and dependable, while ensuring that flights are as safe, secure, and hassle-free as possible.

Non-movement area: The non-movement area consists of aircraft gates, the terminal, cargo facilities, hardstands, taxi lanes, the perimeter roads, and the vehicle drive lanes. This area is also referred to as the ramp, apron, or tarmac. Both aircraft and ground vehicles move on the non-movement area.

Obstacle free zone: The obstacle-free zone is a three-dimensional volume of airspace set up to protect aircraft transitioning to and from the runway.

Passenger loading bridge: See Jet bridge

Personal protective equipment (PPE): Equipment for protecting the eyes, face, head, ears, extremities, protective clothing, respiratory devices, and protective shields.

Preferential use gates: See Exclusive use gates.

Property damage: Any damage or adverse condition that limits or prevents the use of a structure or building or that requires repairs.

Ramp: see Apron.

Risk: The composite of predicted severity and likelihood of the potential effect of a hazard in the worst credible system state. Types of risk include:

- a. *Identified risk:* That risk that has been determined to exist using analytical tools. The time and costs of analysis efforts, the quality of the risk management program, and the state of the technology involved affect the amount of risk that can be identified.
- b. *Unidentified risk:* That risk that has not yet been identified. Some risk is not identifiable or measurable, but is no less important. Mishap investigations may reveal some previously unidentified risks.
- c. *Total risk:* The sum of identified and unidentified risk. Ideally, identified risk will comprise the larger portion of the two.
- d. *Acceptable risk:* The part of identified risk that is allowed to persist after controls are applied. Risk can be determined acceptable when further efforts to reduce it would cause degradation of the probability of success of the operation, or when a point of diminishing returns has been reached.

- e. *Unacceptable risk*: The portion of identified risk that cannot be tolerated, but must be either eliminated or controlled.
- f. *Residual risk*: The remaining safety risk that exists after all control techniques have been implemented or exhausted, and all controls have been verified. Only verified controls can be used for the assessment of residual-safety risk.

Root Cause Analysis: A systematic approach to identifying, investigating, categorizing, and eliminating the root causes of safety-related incidents.

Safety: A condition in which the risk of harm or damage is limited to an acceptable level.

Safety Management System (SMS): A formal, top-down business-like approach to managing safety risk. It includes systematic procedures, practices, and policies for the man-

agement of safety. It also includes safety risk management, safety policy, safety assurance, and safety promotion.

Tarmac: see Apron.

Unit load devices (ULDs): Standardized cargo container to enable individual pieces of cargo to be assembled into a standard-size unit to facilitate efficient loading and unloading of aircraft having compatible handling and restraint systems. ULDs are primarily used on wide body aircraft.

Work-related injury or illness: An injury or illness that is caused by an event or exposure in the work environment that either caused or contributed to the resulting condition or significantly aggravated a pre-existing injury or illness. Work relatedness is presumed for injuries and illnesses resulting from events or exposures occurring in the work environment.

ACRONYMS

AAGSC:	Australasian Aviation Ground Safety Council	GAP:	Ground Accident Prevention
ACI:	Airports Council International	GSE:	Ground Service Equipment
ADS-B:	Automatic Dependent Surveillance-Broadcast	GSP:	Ground Service Provider
AMA:	Airport Movement Area	IATA:	International Air Transport Association
AOA:	Air Operations Area	ICAO:	International Civil Aviation Organization
AOSP:	Airport Operations Safety Panel	ISAGO:	IATA Safety Audit for Ground Operations
ASDE-X:	Airport Surface Detection Equipment, Model X	MLAT:	Multilateration
CAA:	Civil Aviation Authority	NAS:	National Airspace System
FOD:	Foreign object debris/damage	NextGen:	Next Generation Air Transportation System
FSF:	Flight Safety Foundation	NPRM:	Notice of Proposed Rulemaking
GA:	General aviation	OSHA:	Occupational Safety & Health Administration
GAO:	Government Accountability Office	PPE:	Personal protective equipment
		SMS:	Safety Management System

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APPENDIX A

Web Surveys

ACRP Airport Ground Handling Practices—Airport Survey

Thank you for participating in the following Transportation Research Board (TRB) synthesis project study. The purpose of this survey is to collect relevant information regarding Airport Ground Handling Practices from an Airport perspective. The survey contains questions about current ground handling practices and staff training at your Airport. If a question does not apply to your Airport operation, please answer N/A in the comment areas.

Information provided in this survey will remain confidential and only aggregated data will be presented in the final synthesis report. An important part of the synthesis will be to conduct follow-on interviews with selected Airports to collect additional information on current practices. If you agree to volunteer, you may be contacted for further information (see question #25).

- 1. Please provide us with your contact information, these data will remain confidential and will be used to contact you only with regard to this survey and a possible interview.**

Your Name: _____

Airport: _____

Address: _____

Address 2: _____

City/Town: _____

State: _____

ZIP: _____

Position Title: _____

Email Address: _____

Phone Number: _____

- 2. Which category of airport do you represent?**

- ☐ Large Hub
- ☐ Medium Hub
- ☐ Small Hub
- ☐ Non Hub
- ☐ General Aviation
- ☐ Other

Comment or Clarification (400 characters)

- 3. Does your airport manage gates through common use or exclusive use agreements?**

- ☐ All common use
- ☐ All exclusive use
- ☐ Both common and exclusive use

Comment or Clarification (400 characters)

- 4. Does your airport have any oversight or responsibility of the ramp/apron area including exclusive use space, passenger loading bridges, or ramps?**

- ☐ Yes
- ☐ No

- ☐ Only common use areas
- ☐ Only passenger loading bridges
- ☐ Only taxi lanes
- ☐ Other

Comment or Clarification (400 characters)

5. Does your airport conduct regular ramp/apron safety meetings with tenants?

- ☐ Yes
- ☐ No

Comment or Clarification (400 characters)

6. If yes, how frequently are the ramp/apron safety meetings held?

- ☐ Weekly
- ☐ Monthly
- ☐ Quarterly
- ☐ Annually
- ☐ Other

Comment or Clarification (400 characters)

7. Does your airport require airside safety training for tenants (not including AOA or AMA driving)?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

8. What types of service providers at your airport are required to have safety training? Select all that apply.

- ☐ None
- ☐ Fueling
- ☐ Baggage Handling
- ☐ A/C Handling & Loading
- ☐ A/C Ground Movement
- ☐ Passenger Handling
- ☐ A/C Maintenance
- ☐ Lav & Water
- ☐ Catering
- ☐ Cargo & Mail Handling
- ☐ A/C Load Control
- ☐ Other Services

Please list other services (500 characters)

9. If yes, what type of safety training is required? Are training requirements different by service? Select all that apply.

	All Service Providers	Fueling	Baggage Handling	A/C Handling & Loading	A/C Ground Movement	Passenger Handling	Lav & Water	Catering	Cargo & Mail Handling	A/C Load Control
General Orientation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hands-on/ Supervised	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Video Training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Classroom Training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Online Training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rules & Reg. Review	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comment or Clarification (1,000 characters)

10. Who conducts the safety training?

- ☐ Airport
☐ Tenant
☐ Both
☐ Other

Comment or Clarification (400 characters)

11. Does your airport require airside refresher safety training for tenants (not including AMA or AOA driving)?

- ☐ Yes
☐ No
☐ Other

Comment or Clarification (400 characters)

12. If yes, who conducts the safety refresher training?

- ☐ Airport
☐ Tenant
☐ Both
☐ Other

Comment or Clarification (400 characters)

13. If yes, how frequent is the safety refresher training?

- ☐ Twice a year
☐ Annually
☐ Every two years
☐ Other

Comment or Clarification (400 characters)

14. Does your airport review tenant safety training programs as part of the lease or license agreement?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

15. Do you believe that additional safety training would benefit your airport, tenants, and ground service providers?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

16. Do you have any plans to increase the amount of safety training at your airport?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

17. Would you like to see a standardized safety training program used by airports, airlines, and ground service providers, similar to the NATA fuel service training program?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

18. Does your airport issue fines for safety violations?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

19. If yes, to whom are the fines assessed?

- ☐ Company
- ☐ Individual
- ☐ Both
- ☐ Other

Comment or Clarification (400 characters)

20. If yes, what is/are the most common penalty(ies)? (500 characters)

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21. Does your airport conduct safety inspections on the ramp or in the baggage make-up areas?

- ☐ Yes
- ☐ No
- ☐ Common use gates and baggage areas only
- ☐ Other

Comments or Clarification (400 characters)

22. Does your airport manage or collaborate with airlines and ground service providers to inspect for FOD on the ramp/apron?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

23. Does your airport require an external audit of ground service providers through programs such as the IATA Safety Audit for Ground Operations (ISAGO) or insurance agencies?

- ☐ Yes
- ☐ No
- ☐ Other

If yes, please provide agency(ies) information (500 characters)

24. Please provide additional relevant comments regarding safety operations at your airport. (2,000 characters)

25. Would you be willing to participate in a 20-minute phone interview?

- ☐ Yes
- ☐ No
- ☐ I would recommend someone else in the organization

Provide Contact Information for Recommended Other Person

ACRP Airport Ground Handling Practices—Airline Survey

Thank you for participating in the following Transportation Research Board (TRB) synthesis project study. The purpose of this survey is to collect relevant information regarding Airport Ground Handling Practices from an Airline perspective. The survey contains questions about current ground handling practices and staff training within your organization. If a question does not apply to your airline operation, please answer N/A in the comment areas.

Information provided in this survey will remain confidential and only aggregated data will be presented in the final synthesis report. An important part of the synthesis will be to conduct follow-on interviews with selected Airlines to collect additional information on current practices. If you agree to volunteer, you may be contacted for further information (see question #25).

1. Please provide us with your contact information, these data will remain confidential and will be used to contact you only with regard to this survey and a possible interview.

Your Name: _____
Airline: _____
Address: _____
Address 2: _____
City/Town: _____
State: _____
ZIP: _____
Position Title: _____
Email Address: _____
Phone Number: _____

2. What types of ground support services does your Airline provide? Select all that apply.

- ☐ None
- ☐ Fueling
- ☐ Baggage Handling
- ☐ Aircraft Handling and Loading
- ☐ Aircraft Ground Movement
- ☐ Passenger Handling
- ☐ Aircraft Maintenance
- ☐ Lav and Water
- ☐ Catering
- ☐ Cargo and Mail Handling
- ☐ Load Control
- ☐ Other

If other services, please provide a list (400 characters)

3. What types of ground support services does your Airline outsource (other companies provide services to your Airline)? Select all that apply.

- ☐ None, all services are provided by our Airline staff
- ☐ Fueling
- ☐ Baggage Handling
- ☐ Aircraft Handling and Loading
- ☐ Aircraft Ground Movement
- ☐ Passenger Handling
- ☐ Aircraft Maintenance
- ☐ Lav and Water
- ☐ Catering
- ☐ Cargo and Mail Handling
- ☐ Load Control
- ☐ Other

If other services, please provide a list (400 characters)

4. Does your Airline provide ground support services to other airline customers?

- ☐ Yes
- ☐ No
- ☐ Only to alliance partners
- ☐ Other

Comments or Clarification (400 characters)

5. Does your Airline require safety training of ground support staff?

- ☐ Yes—all ground support staff (Our Airline and other companies providing ground support services)
- ☐ Yes—only our Airline ground support staff
- ☐ Does not apply, no ground services
- ☐ No
- ☐ Only some services
- ☐ Other

Comment or Clarification (400 characters)

6. Does your Airline require the same safety training for your Airline ground support staff and other company staff providing ground support services?

- ☐ Yes
- ☐ No
- ☐ Does not apply
- ☐ Only some services
- ☐ Other

Comment or Clarification (400 characters)

7. If yes, what type of safety training is required? Select all that apply.

- ☐ General Safety Orientation
- ☐ OSHA
- ☐ Ramp Operations
- ☐ Push Back
- ☐ Driving
- ☐ Marshalling
- ☐ Communication (phraseology)
- ☐ Other, please list

Please provide a list of other training (1,000 characters)

8. If yes, what type of safety training delivery is required?

- ☐ Instructional (classroom)
- ☐ On the job (OJT) or hands-on
- ☐ Both
- ☐ Other

Please provide description of other types of training formats? (400 characters)

9. If yes, what is the duration of the training?

- ☐ 1 day or less
- ☐ 1 to 2 days
- ☐ 2 to 3 days
- ☐ 3 or more days
- ☐ Other

Comments or Clarification (400 characters)

10. Does your Airline require safety refresher training for ground service staff?

- ☐ Yes
- ☐ No
- ☐ Does not apply
- ☐ Only at some locations

Comment or Clarification (400 characters)

11. If safety refresher training is required, what is the frequency?

- ☐ Twice a year
- ☐ Annually
- ☐ Every two years
- ☐ Does not apply
- ☐ Other

Comment or Clarification (400 characters)

12. Does your Airline require the same level of ground handling safety training at all locations?

- ☐ Yes
- ☐ No
- ☐ Does not apply
- ☐ Other

Comments or Clarification (400 characters)

13. If your Airline provides ground support services for other airline customers, does your Airline modify ground support staff safety training to align with the other airline's practices or standards?

- ☐ Yes
- ☐ No
- ☐ Does not apply
- ☐ At some locations only
- ☐ Other

Comment or Clarification (400 characters)

14. Does your Airline Company audit the safety training program?

- ☐ Yes
- ☐ No
- ☐ At some locations
- ☐ Does not apply
- ☐ Other

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Comment or Clarification (400 characters)

15. Do you believe that additional safety training would benefit your Airline ground handling services?

- ☐ Yes
- ☐ No
- ☐ Does not apply
- ☐ Other

Comment or Clarification (400 characters)

16. Do you have any plans to increase the amount of safety training for your staff or service providers?

- ☐ Yes, Airline ground support staff only
- ☐ Yes, both Airline staff and other ground service providers
- ☐ No
- ☐ Does not apply
- ☐ Other

Comment or Clarification (400 characters)

17. Would you like to see a standardized safety program used by airports, airlines, and ground service providers, similar to the NATA fuel service training program?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

18. What formal method does your Airline Company use to provide notice to inform staff of safety concerns? Select all that apply.

- ☐ Audit findings and reports
- ☐ Onsite visits
- ☐ LOSAs
- ☐ Fines
- ☐ Other
- ☐ Depends on the location

Comments or Clarification (400 characters)

19. Who is responsible for your Airline's safety at the national level? (400 characters)

20. Who is responsible for your Airline's safety at the local level? (400 characters)

21. How does staff report hazards or unsafe work conditions? Select all that apply.

- ☐ Report to manager or lead
- ☐ Submit a written report
- ☐ Submit a phone report
- ☐ Submit an electronic report

- ☐ Report anonymously
- ☐ Other
- ☐ None

Comment or Clarification (400 characters)

22. How are safety violations resolved? Select all that apply.

- ☐ Additional or repeat training
- ☐ Additional supervision
- ☐ Fines
- ☐ Other

Comments or Clarification (400 characters)

23. If staff self report safety violations, does management engage in a non-punitive response?

- ☐ Yes
- ☐ No
- ☐ Depends on the type of safety violation
- ☐ Other

Comments or Clarification (400 characters)

24. Please provide additional relevant comments regarding safety operations within your company. (2,000 characters)

25. Would you be willing to participate in a 20-minute phone interview?

- ☐ Yes
- ☐ No
- ☐ I would recommend someone else in the organization

Provide contact information for other recommended staff (400 characters)

ACRP Airport Ground Handling Practices—GSP Survey

Thank you for participating in the following Transportation Research Board (TRB) synthesis project study. The purpose of this survey is to collect relevant information regarding Airport Ground Handling Practices from a Ground Service Provider perspective. The survey contains questions about current ground handling practices and staff training within your organization. If a question does not apply to your operation, please answer N/A in the comment areas.

Information provided in this survey will remain confidential and only aggregated data will be presented in the final synthesis report. An important part of the synthesis will be to conduct follow-on interviews with selected Ground Service Providers to collect additional information on current practices. If you agree to volunteer, you may be contacted for further information (see question #26).

1. Please provide us with your contact information, these data will remain confidential and will be used to contact you only with regard to this survey and a possible interview.

Your Name: _____
 Company: _____
 Address: _____
 Address 2: _____
 City/Town: _____
 State: _____
 ZIP: _____
 Position Title: _____
 Email Address: _____
 Phone Number: _____

2. What types of services does your company provide? Select all that apply.

- ☐ Fueling
- ☐ Baggage Handling
- ☐ Aircraft Handling and Loading
- ☐ Aircraft Ground Movement
- ☐ Passenger Handling
- ☐ Aircraft Maintenance
- ☐ Lav and Water
- ☐ Catering
- ☐ Cargo and Mail Handling
- ☐ Load Control
- ☐ Other

If other services, please provide a list (400 characters)

3. Does your company provide services to more than one airline customer?

- ☐ Yes—Nationally (at more than one airport) we provide services for multiple airlines
- ☐ Yes—Locally (only at one airport) we provide services for multiple airlines
- ☐ No—we provide services for only one airline
- ☐ Other—Please provide comments

Comments or Clarification (400 characters)

4. Does your company require safety training of ground support staff?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

5. If yes, what types of safety training are required? Select all that apply.

- ☐ General Safety Orientation
- ☐ OSHA
- ☐ Ramp Operations
- ☐ Push Back
- ☐ Driving
- ☐ Marshalling
- ☐ Communication (phraseology)
- ☐ Other, please list

Please provide a list of other training (1,000 characters)

6. If yes, what type of safety training delivery is required?

- ☐ Instructional (classroom)
- ☐ On the job (OJT) or hands-on
- ☐ Both
- ☐ Other

Please provide description of other types of training formats (400 characters)

7. If yes, who conducts the safety training?

- ☐ Airport
- ☐ Your Company
- ☐ Other

Comment or Clarification (400 characters)

8. If yes, what is the duration of the safety training?

- ☐ 1 day or less
- ☐ 1 to 2 days
- ☐ 2 to 3 days
- ☐ 3 or more days
- ☐ Other

Comments or Clarification (400 characters)

9. Does your company require the same equivalent safety training at all airport locations?

- ☐ Yes
- ☐ No
- ☐ Other

Comments or Clarification (400 characters)

10. Does your company require safety refresher training?

- ☐ Yes
- ☐ No
- ☐ Only at some locations

Comment or Clarification (400 characters)

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11. If yes, who conducts the safety refresher training?

- ☐ Airport
- ☐ Your Company
- ☐ Both
- ☐ Other

Comment or Clarification (400 characters)

12. If yes, what is the frequency of safety refresher training?

- ☐ Twice a year
- ☐ Annually
- ☐ Every two years
- ☐ Other

Comment or Clarification (400 characters)

13. Does your company modify staff training to align with the airline customer's practices or standards?

- ☐ Yes
- ☐ No
- ☐ At some locations only
- ☐ Other

Comment or Clarification (400 characters)

14. Does your company audit the safety training program?

- ☐ Yes
- ☐ No
- ☐ At some locations
- ☐ Other

Comment or Clarification (400 characters)

15. Do you believe that additional safety training would benefit your ground handling services?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

16. Do you have any plans to increase the amount of safety training for your staff?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

17. Would you like to see a standardized safety training program used by airports, airlines, and ground service providers, similar to the NATA fuel service training program?

- ☐ Yes
- ☐ No
- ☐ Other

Comment or Clarification (400 characters)

18. What formal method does your company use to provide notice to inform staff of safety concerns?

- ☐ Audit findings and reports
- ☐ Onsite visits
- ☐ LOSAs
- ☐ Fines
- ☐ All
- ☐ Depends on the location
- ☐ Other

Comments or Clarification (400 characters)

19. Who is responsible for safety at the national level (position title)? (400 characters)

20. Who is responsible for safety at the local level (position title)?

21. Are Safety Leads (or other safety-related positions) assigned to each ground support team?

- ☐ Yes—each ground crew handling flights
- ☐ Yes—entire station
- ☐ Depends on the customer
- ☐ No
- ☐ Other

Please provide additional information if necessary (1,000 characters)

22. How does staff report hazards or unsafe work conditions?

- ☐ Report to manager or lead
- ☐ Submit a written report
- ☐ Submit a phone report
- ☐ Submit an electronic report
- ☐ Report anonymously
- ☐ All of the above
- ☐ Other
- ☐ None

Comment or Clarification (500 characters)

23. How are safety violations resolved?

- ☐ Additional or repeat training
- ☐ Additional supervision
- ☐ Fines

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- ☐ All
- ☐ Other

Comments or Clarification (500 characters)

24. When staff self report safety violations, does management engage in a non-punitive response?

- ☐ Yes
- ☐ No
- ☐ Depends on the type of safety violation
- ☐ Other

Comments or Clarification (500 characters)

25. Please provide additional relevant comments regarding safety operations within your company. (2,000 characters)

26. Would you be willing to participate in a 20-minute phone interview?

- ☐ Yes
- ☐ No
- ☐ I would recommend someone else in the organization

Provide contact information for other recommended staff (400 characters)

APPENDIX B

Respondents

A list of survey respondents is presented here by industry.

Airline	Position/Title
United Airlines	Manager, Seattle Operations
Continental Airlines	Director, Ground Safety
Alaska Air Group (Alaska/Horizon)	Manager, Occupational Safety
Continental Airlines, Inc.	International Regional Manager Safety & Regulatory Compliance
Delta Airlines	Field Director
Horizon Air	Ground Service Supervisor, Quality Assurance
Air Wisconsin	Regional Director

Ground Service Provider	Position/Title
Gate Gourmet	Manager, Safety Compliance
DAL Global Services	System Manager—Safety & Compliance
Aircraft Service International Group	HSE&T Supervisor
Menzies Aviation	VP NW Ground Handling

Airport	State	Position	Size
Baltimore Washington International Airport	MD	Risk Manager	Large Hub
Bangor International Airport	ME	Compliance Officer	Non Hub
Bismarck Airport	ND	Airport Manager	Non Hub
Boston Logan International Airport	MA	Deputy Director Aviation Operations	Large Hub
Cincinnati/Northern Kentucky International Airport	OH	VP Safety, Security, and Compliance	Medium Hub
Concord Regional Airport	NC	Assistant Aviation Director	GA
Dallas Fort Worth International Airport	TX	Assistant Terminal Manager	Large Hub
Fairbanks International Airport	AK	Operations Officer	Small Hub
Ft. Lauderdale–Hollywood International Airport	FL	Airport Manager—Operations	Large Hub
Hartsfield–Jackson Atlanta International Airport	GA	Director of Operations	Large Hub
Indianapolis International	IN	Airport Operations	Medium Hub
Jackson–Evers International Airport	MS	Director Operations, Security & Environmental Compliance	Small Hub
Jacksonville International Airport	FL	Risk Management	Medium Hub
Midland International Airport	TX	Operations Supervisor	Small Hub
Ohio State University Airport	OH	Graduate Associate SMS	GA
Paine Field Airport	WA	Director of Operations	GA
Piedmont Triad Airport	NC	Director of Operations	Small Hub
Portland International Airport	OR	Manager, Airside Operations	Medium Hub
Quad City International Airport	IL	Director of Operations	Small Hub
Sacramento International Airport	CA	Airport Safety Officer	Medium Hub
Salt Lake City International	UT	Superintendent Airport Operations	Large Hub
San Antonio International Airport	TX	SMS Manager	Medium Hub
Seattle–Tacoma International Airport	WA	Airfield Manager	Large Hub
South Bend Regional Airport	IN	Manager of Operations and Maintenance	Non Hub
Southern Illinois Airport	IL	Airport Manager	GA
Springfield–Branson National Airport	MO	Assistant Director of Aviation	Small Hub
State of Alaska, Southeast Region—GST, SIT, YAK, PSG, and WRG	AK	Regional Airport Safety and Security Officer	Non Hub
Tucson International Airport	AZ	Director of Safety Programs	Medium Hub
Wayne County Detroit Metropolitan	MI	Senior Airfield Manager	Large Hub

APPENDIX C

Interview Summaries

Interviews were conducted with one representative from each industry group either in person or by phone. A summary of answers are provided here.

David Crowner, Manager, Airfield Operations Seattle–Tacoma International Airport (Sea-Tac)

1. What impact do you see the new proposed SMS Rule (NPRM) on the management of the ramp?

With the change in Part 139 to include SMS, the airport's role will be improved in its ability to provide ramp management oversight. To date, the lack of regulatory administration regarding the non-movement area has resulted in an area that is not well controlled. SMS will create greater awareness, accountability, focus, budget, license, and importance of the ramp area. The airport's role in managing the ramp will change the dynamics of ramp safety and discussions regarding accidents, incidents, and hazard identification and mitigation.

2. Should the airport take on the role of safety oversight of the ramp? If not, who is best suited?

These are actually two questions that should be answered independently. With the introduction of SMS and inclusion of the non-movement area, airports may not be adequately prepared today to provide the necessary oversight, but with time and training airports will have the staff and capabilities to manage this area effectively. Authority over the ramp needs to be officially designated to airports to evolve and create a program that takes into consideration tenants, staff, and operations. The most effective way to reach this goal is to work with tenants in a collaborative and productive way. The collective goal needs to be safety while keeping in mind the costs of doing business.

3. How would airports and tenants work to improve safety on the ramp?

Today the ramp is not under positive control (ATO), which makes operations on the ramp advisory. With a more rigorous management program such as SMS the airport and tenants will have the opportunity to create a new team of accountabilities at all levels. Today, Sea-Tac meets with tenants on a monthly basis to discuss ramp safety issues, concerns, and hazards. The meeting is voluntary. In the future, participation in such meetings would be mandatory where the team would communicate, coordinate, cooperate, and collaborate to discuss issues, determine how to resolve problems, mitigate hazards, and develop solutions that are cost-effective and that most importantly improve safety.

4. Explain your thoughts on additional safety training? What types of training would be most effective?

One of the keys to understanding accidents and incidents is root cause analysis. I think everyone can benefit from various levels of training in this area. Also, hazard awareness training is important for all staff and tenants who work on the ramp and in the baggage area. The ability to identify a hazard or hazardous behavior to either self correct or report through management will increase the level of safety on the ramp. Sea-Tac is currently developing a safety orientation training that will be incorporated into our SITA training program. The orientation will provide basic safety tips, situational awareness, and how to report

a concern without fear of retribution. This program will be operational by the end of 2011.

5. Would standards on the ramp (markings, operations, etc.) increase situational awareness?

Yes, if markings are consistent across airports, staff, pilots, ramp workers, reduce the likelihood of errors. AC 5300-13 is a great example of standards for the movement area. An AC on non-movement area markings would benefit everyone. For example if taxi lanes and taxiing routes are consistent and take into account wingtip clearance and object free areas, the risk of ramp area accidents is reduced.

6. What top three programs or activities would you recommend to improve ramp safety?

- 1) Training at all levels.
- 2) Placing ramp safety in a realistic and relevant context through a change in culture and situational awareness as a safeguard.
- 3) Data sharing with tenants and the airport to more accurately trend issues and to resolve hazards before they lead to accidents and incidents.

Robert Royal, Director—Safety & Regulatory Compliance Delta Airlines Global Services

1. What impact do you see the new proposed SMS Rule (NPRM) on the management of the ramp?

SMS has a potential of creating problems if each airport designs and develops different programs. Unless there are consistent guidelines or standards to create consistencies, the SMS programs could lead to failures that would be unfair to airports and carriers.

2. Should the airport take on the role of safety oversight of the ramp? If not, who is best suited?

The airport can play a role in ramp safety oversight, but it can't be without involvement from airline and ground service providers. Each would have certain areas of responsibilities that would be developed collaboratively. This would lead to a safer environment.

3. How would airports and tenants work to improve safety on the ramp?

Airport and tenants would first need to define their mission or vision so collectively everyone would be able to work toward a common goal and be accountable for individual efforts. A set of standards and measurable objectives will determine that improvements are actually occurring.

4. Explain your thoughts on additional safety training? What types of training would be most effective?

At DGS we are implementing OSHA courses (10-hour and 40-hour depending on the staff). We believe that these courses increase safety awareness and understanding of hazard recognition. Typically staff doesn't know how to recognize and report hazards in the workplace; hazards like electrical problems or pot holes. Training staff how to become familiar with hazard identification leads to a safer work place so hazards can be mitigated before they lead to potential accidents or incidents.

5. Would standards on the ramp (markings, operations, etc.) increase situational awareness?

Standards would improve situational awareness if carriers would agree to a standard. Every carrier has a particular way of managing their ramp and their operations. It

is unlikely all carriers will agree to a single way of operations. Regarding markings, if each airport designs markings at their individual airport, then pilots and ramp crews will have to become familiar with each airport. Airports would benefit from a single standard for markings that would be developed and managed by the FAA.

6. What top three programs or activities would you recommend to improve ramp safety?

Only two were provided:

- 1) Improving driver training programs; at some airports non-movement area driving is really brief and could be improved to include situational awareness and hazard identification.
- 2) Hazard identification (see response to question #4)

**Roy Tschumi—Field Director, Seattle
Delta Airlines**

1. What impact do you see the new proposed SMS Rule (NPRM) on the management of the ramp?

Generally there are potential issues with airports owning safety training when each airline is responsible for their own training and especially at Delta where we go beyond the requirements. What if safety training is not what airlines want or require? Will the airport be able to capture all the various equipment types and carrier operations? Airports should be responsible for basic safety training and focus on the broad spectrum issues such as speeding, how to conform to drive lanes, and focus on airport rules and regulations instead of carrier operations.

2. Should the airport take on the role of safety oversight of the ramp? If not, who is best suited?

If airports use a program like ISAGO to establish minimum standards and then require ramp operations to comply, that will ensure a consistent oversight. Delta goes above and beyond what is required. One of the questions to ask is how does an airport that has minimum experience in ramp operations take on the role as safety oversight? The safety oversight needs to be a partnership between airports and airlines. Airlines are already being audited by the FAA through Part 121. The best approach would be something similar to the Air Transportation Oversight System (ATOS program); for an audit program to function.

3. How would airports and tenants work to improve safety on the ramp?

Airports need to support the airlines and vice versa; airports and tenants need to work together to resolve safety issues as a team. For example, the drive lanes installed at SEA took more time to get implemented than necessary. Instead of just safety meetings, there needs to be a working group with goals and objectives and identified projects to improve safety that includes tenants and airport representatives. For a successful safety program, there needs to be accountability and it will require everyone's buy-in including employees, janitors, maintenance, etc. The program can't be from the top down only, there needs to be community buy-in, where everyone has say and ownership.

4. Explain your thoughts on additional safety training? What types of training would be most effective?

Additional safety training (as mentioned in question 1) should include basic ramp operations such as driving, speed limits, reporting, and personal accountabilities and responsibilities for safety.

5. Would standards on the ramp (markings, operations, etc.) increase situational awareness?

Standards are an excellent tool for improving safety. When markings and signage are consistent it can increase awareness. But for example at Sea-Tac drive lanes are indicated on one area of the ramp but not consistently on the other side of the ramp so drivers are not sure what is the requirement and the lack of standards actually creates hazards for the staff. So the recommendation would be to make sure standards are applied throughout the ramp area consistently.

6. What top three programs or activities would you recommend to improve ramp safety?

1. Driver's safety training for all airside operations (movement and non-movement).
2. Some type of program where when offenders are being ticketed the information needs to be shared with the tenant right away to collectively work on preventative measures to stop the behavior.
3. Ramp tower involvement as a safety control to assess taxiing issues that often result (to staff and equipment) in jet blast exposure from aircraft.

Abbreviations used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI-NA	Airports Council International-North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation